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John S. Howard
Director- FERC Hydro Compliance

Via Electronic Filing

April 15, 2013

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

Re: Northfield Mountain Pumped Storage Project, FERC Project No.2485
Turners Falls Hydroelectric Project, FERC Project No. 1889
Filing of Proposed Study Plan

Dear Secretary Bose:

Pursuant to the regulations of the Federal Energy Regulatory Commission (Commission or FERC), 18 C.F.R. § 5.11, FirstLight Hydro Generating Company (FirstLight), a subsidiary of IPR-GDF SUEZ North America, Inc., Licensee of the Turners Falls Hydroelectric Project (FERC No. 1889) and the Northfield Mountain Pumped Storage Project (FERC No. 2485), encloses for filing the attached Proposed Study Plan (PSP) for the relicensing of the Turners Falls Project and Northfield Mountain Project.

FirstLight received study requests from several federal and state agencies, non-governmental organizations, and individuals (public). In addition, FERC staff issued study requests. FirstLight also included a preliminary list of studies in Section 5 of its Pre-Application Document (PAD). FERC held scoping meetings on the Turners Falls and Northfield Mountain Projects on January 30, 2013 during the day, January 31 in the evening and January 31 during the day to discuss cumulative impacts.

In addition to the study requests, FERC identified deficiencies in the PAD and additional information requests (AIRs). FirstLight has addressed the deficiencies and AIRs in Section 2.0 of the PSP and will also incorporate relevant information into its Preliminary Licensing Proposal or Draft License Application and Final License Application.

FirstLight received over 200 study requests, although many were duplicative and several had common elements. Where possible, FirstLight consolidated common themes and elements into the same study plan resulting in 36 individual PSPs. Per Commission regulation, 18 C.F.R § 5.11(e), FirstLight is required to hold a meeting(s) to discuss the PSP within 30 days of filing the PSP. FirstLight will host meetings on May 14 and 15 to begin discussion of the PSP. FirstLight recognizes; however, that 1-2 days to discuss 36 PSPs is not enough time to review them at the appropriate level of detail. Given this, FirstLight is reserving several additional meetings. The meeting schedule was filed with FERC on April 5, 2013 to provide interested stakeholders advanced notice of meeting dates and logistics. As noted in FirstLight's April 5 filing, on May 14, 2013 from 9:00 am to noon, FirstLight will provide a broad overview of all of

the studies, as required by 18 C.F.R § 5.11(e). The purpose of the "morning" meeting is to present the studies proposed, and the studies not being proposed. The intent is to provide a brief overview of the studies; it is not intended to discuss each study.

The afternoon of May 14 and the meeting schedule thereafter is designed to review and discuss, in greater detail, the individual study plans with the goal of reaching agreement on the methodology and level of effort. The schedule below may be modified, pending progress on reviewing the PSPs. For example, pending progress, some meetings may be cancelled, added to, or held via conference call in lieu of a meeting. If changes to the schedule occur, you will be notified accordingly, as explained below.

We organized "Working Group" meetings along similar resource areas such that not all parties need to attend each meeting.

Resource Area	Meeting Date & Times
Broad Overview of All Studies	May 14, 9:00 am-Noon
Working Group 1: Geology and Soils, Water Resources, Developmental Resources	May 14, 1:00-4:00 pm May 15, 9:00 am-Noon May 15, 1:00-4:00 pm
Working Group 2: Aquatic Resources, Terrestial, Wetlands, Riparian Resources	May 21, 9:00 am-4:00 pm May 22, 9:00 am-4:00 pm June 4, 9:00 am-4:00 pm June 5, 9:00 am-4:00 pm
Working Group 3: Recreation and Land Use Resources, Aesthetic Resources, Cultural Resources	June 11, 9:00 am-4:00 pm June 12, 9:00 am-4:00 pm June 13, 9:00 am-4:00 pm

As shown in the table above, Working Group 1 will discuss study plans on May 14[1] in the afternoon. FirstLight suggests that during this time, Working Groups 2 and 3 convene to develop agendas for the upcoming meetings.

FirstLight respectfully requests any person interested in attending any of these meetings to conduct the following, which will help facilitate our planning and logistics:

- Go to http://www.northfieldrelicensing.com website and click "join our mailing list", if you have not joined already. FirstLight plans on providing meeting agendas and communicating any potential changes to the schedule above via this website. If you join the mailing list (which requests your email address), you will automatically be notified via email of any changes to the meeting dates, times, location or changes to the schedule.

- **Please RSVP to firstlight@gomezandsullivan.com no later than April 19, 2013 for any of the above meetings you plan to attend**. Please identify which meetings you are interested in attending. This will allow FirstLight to determine if there is sufficient space at the Northfield Mountain Visitors Center to hold the meeting, and if not, to identify a different meeting location. Ideally, we are seeking to hold the meetings at the Visitors Center; however, if the number of people attending exceeds capacity, a different venue will be identified and you will be notified accordingly.

[1] The May 14 afternoon meeting will focus on water resources (water quality and hydraulic model) and developmental resources (operations model); the May 15 meeting will finish discussion of water resources and developmental resources issues from the May 14 meeting as well as discuss geology and soils.

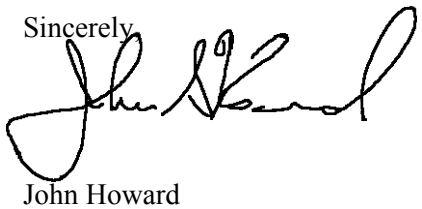
FirstLight looks forward to continuing to work with interested stakeholders in finalizing the study plan for the relicensing of the Turners Falls Project and Northfield Mountain Project. In furtherance of this effort and pursuant to Section 5.12 of the Commission's regulations (18 C.F.R. § 5.12), any comments from interested parties on the PSP must be filed with the Commission by July 14, 2013.

FirstLight is filing the PSP with the Commission electronically. To access the PSP on the Commission's website (http://www.ferc.gov), go to the "eLibrary" link, and enter docket number P-1889 (for Turners Falls) or P-2485 (for Northfield) to access the document. FirstLight is also making the PSP available for download on its website. To access the PSP here, navigate to http://www.northfieldrelicensing.com, and on click on "documents" tab on the left side of the screen.

In addition to this electronic filing with the Commission, paper copies of the PSP are also available upon request by sending a request via email to firstlight@gomezandsullivan.com. Finally, FirstLight is making available to the public the PSP at the Northfield Mountain Visitor Center at 99 Millers Falls Road, Northfield, MA 01360 during regular business hours.

If you have any questions regarding the above, please do not hesitate to contact me.

Sincerely,



John Howard
Director- FERC Hydro Compliance

PROPOSED STUDY PLAN

FOR THE
TURNERS FALLS HYDROELECTRIC PROJECT (NO. 1889)
AND
NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT (NO. 2485)

April 15, 2013

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LIST OF ABBREVIATIONS

1-D	one dimensional
2-D	two dimensional
ADCP	Acoustic-Doppler Current Profiler
AIR	Additional Information Request
AMC	Appalachian Mountain Club
ANOVA	Analysis of Variance
APE	Area of Potential Effect
ARLAC	Ashuelot River Local Advisory Committee
ASMFC	Atlantic States Marine Fisheries Commission
AWWA	American Whitewater Association
CEII	Critical Energy Infrastructure Information
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
cfs	cubic feet per second
CPUE	Catch per Unit Effort
CRASC	Connecticut River Atlantic Salmon Commission
CRJC	Connecticut River Joint Commissions
CRSEC	Connecticut River Streambank Erosion Committee
CRWC	Connecticut River Watershed Council
CRUISE	Connecticut River Unimpacted Streamflow Estimation
CT	Connecticut
CTDEEP	Connecticut Department of Energy and Environmental Protection
CY	cubic yards
°C	degrees Celsius
°F	degrees Fahrenheit
ft	foot or feet
ft^2	square feet
DO	dissolved oxygen
DEM	Digital Elevation Model
DRTU	Deerfield River Chapter of Trout Unlimited
DVR	Digital Video Recorder
EA	Environmental Assessment
ECP	Erosion Control Plan
ESA	Endangered Species Act

FERC or Commission	Federal Energy Regulatory Commission
FIS	Flood Insurance Study
FPA	Federal Power Act
FirstLight	FirstLight Hydro Generating Company
FCD	Franklin Conservation District
FRCOG	Franklin Regional Council of Governments
FCRP	Friends of the Connecticut River Paddlers
FRR	Full River Reconnaissance
FSF	Four Star Farms
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GPD	gallons per day
GPS	global positioning system
HEC-RAS	Hydraulic Engineering Center- River Analysis System
HPMP	Historic Properties Management Plan
HSI	Habitat Suitability Index
IFIM	Instream Flow Incremental Methodology
IHA	Indicators of Hydrologic Alteration
ILP	Integrated Licensing Process
ISO-NE	ISO New England
KPC	Keith Paper Company
kW	kilowatt
kWH	kilowatt-hour
LCCLC	Landowners and Concerned Citizens for License Compliance
LIS	Long Island Sound
m	meter
MA	Massachusetts
MAEOEEA	Massachusetts Executive Office of Energy and Environmental Affairs
MAFBF	Massachusetts Farm Bureau Federation Inc.
MADFW	Massachusetts Division of Fish and Wildlife
MAWMA	Massachusetts Water Management Act
MADEP	Massachusetts Department of Environmental Protection
MBI	Midwest Biodiversity Institute
MESA	Massachusetts Endangered Species Act
mi	mile
mg	milligram

MGD	million gallons per day
MHC	Massachusetts Historical Commission
MIPAG	Massachusetts Invasive Plant Advisory Group
mi^2	square miles
ml	milliliter
msl	mean sea level
MVA	megavolt ampere
MW	megawatt
MWH	megawatt-hour
NEPA	National Environmental Policy Act
NEE	New England Environmental
NEF	New England Flow
NEFU	New England Farmers Union
NEIWPCC	New England Interstate Water Pollution Control Commission
NH	New Hampshire
NHDES	New Hampshire Department of Environmental Services
NHDHR	New Hampshire Division of Historic Resources
NHESP	Natural Heritage and Endangered Species Program
NHFGD	New Hampshire Fish and Game Department
NID	National Inventory of Dams
Northfield Mountain Project	Northfield Mountain Pumped Storage Project
NMFS	National Marine Fisheries Service
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRHP	National Register of Historic Places
NHESP	Natural Heritage and Endangered Species Program
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Unit
NEBA	New England Biking Association
NU	Northeast Utilities
NWI	National Wetland Inventory
OHWM	Ordinary High Water Mark
PAD	Pre-Application Document
PCBs	polychlorinated biphenyls

PHABSIM	Physical Habitat Simulation Model
PIT	Passive Integrated Transponder
PSP	Proposed Study Plans
PVPC	Pioneer Valley Planning Commission
QAPP	Quality Assurance Project Plan
RM	River mile
RRA	River Residents Association
RSP	Revised Study Plans
RTE	Rare, Threatened, and Endangered
RTK	real time kinematic
S&A	Simons and Associates
SAV	submerged aquatic vegetation
SCORP	State Comprehensive Outdoor Recreation Plan
SD1	Scoping Document 1
SGCN	Species of Greatest Conversation Need
SHPO	State Historic Preservation Officer
TCP	traditional cultural properties
TDS	total dissolved solids
TFC	Turners Falls Company
TMDL	Total Maximum Daily Load
TN	total nitrogen
TNC	The Nature Conservancy
TP	total phosphorus
TSS	total suspended solids
Turners Falls Project	Turners Falls Hydroelectric Project
UMass	University of Massachusetts at Amherst
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VANR	Vermont Agency of Natural Resources
VT	Vermont
VTDEC	Vermont Department of Environmental Conservation
VTFWD	Vermont Fish and Wildlife Department
VRC	Vermont River Conservancy

VY	Vermont Yankee Nuclear Power Plant
WMECO	Western Massachusetts Electric Company
WMA	Wildlife Management Area
WPA	Wetlands Protection Act
WSEL	Water Surface Elevation
WUA	Weighted Usable Area
YOY	young-of-the-year

1.0 INTRODUCTION

FirstLight Hydro Generating Company (FirstLight) has initiated with the Federal Energy Regulatory Commission (FERC or Commission) the process of relicensing the 67.709-megawatt (MW) Turners Falls Hydroelectric Project (Turners Falls Project) and the 1,119.2 MW Northfield Mountain Pumped Storage Project (Northfield Mountain Project) (see Figure 1.0-1). FirstLight is applying for license renewal using the FERC's Integrated Licensing Process (ILP). The license for the Turners Falls Project was issued on May 5, 1980 and expires on April 30, 2018. The license for the Northfield Mountain Project was issued on May 14, 1968 and also expires on April 30, 2018.

As part of the ILP, FERC conducted a public scoping process during which various resource issues were identified. On October 31, 2012, FirstLight filed its Pre-Application Document (PAD) and Notice of Intent (NOI) with the FERC. The PAD included FirstLight's preliminary list of proposed studies. On December 21, 2012, FERC issued Scoping Document 1 (SD1) and preliminarily identified resource issues and concerns. On January 30 and 31, 2013, FERC held scoping meetings for the FirstLight Projects. In accordance with the FERC regulations, site visits typically occur at the same time as the scoping meetings. However, in this case, FERC accelerated the timing of the site visits to avoid a winter site visit to afford an opportunity for on-water tours. Thus, FERC held site visits of the Turners Falls Project, Northfield Mountain Project, on-water Turners Falls Impoundment and the upper reservoir on October 4, 5, and 11. Per the FERC regulations, written comments on the PAD and SD1, and formal study requests must be filed with FERC no later than March 1, 2013. Appendix A contains all of the stakeholder letters that were submitted.

Table 1.0-1, appearing at the end of this section, is a brief summary of the stakeholders that submitted comments, their affiliation, the type of filing[2], whether the filing addressed the FERC study request criteria, and the submittal date. FirstLight also received various comments/concerns that were not in the form of an official study request. These comments/concerns are summarized, along with a response, in Appendix B.

FirstLight received over 200 study requests, although many were duplicative and several had common elements. Where possible, FirstLight consolidated common themes and elements into the same study plan resulting in 36 individual proposed study plans (PSP). Table 1.0-2 shows by resource category the PSP number, PSP title, the stakeholder name along with their study request number in parenthesis, whether FirstLight proposed to conduct the study or not (yes or no), and when the study is proposed (year). This table can be used to map where a stakeholder request falls into a given PSP or if it was not proposed. FirstLight plans on reviewing this table at the May 14, 2013 morning meeting.

In response to feedback from stakeholders during the scoping process, FirstLight is proposing additional studies and information gathering efforts for the Turners Falls Project and Northfield Mountain Project.

More detailed information on each proposed study is provided in Section 3 of this document. Each PSP includes the following sections per the FERC regulations:

- General description of proposed study;
- Study goals and objectives;

[2] The FERC filings in Table 1.0-1 fell under one of three topics: 1) testimonials and information presented at the Scoping Meetings, 2) comments, issues and information submitted to FERC, or 3) study requests that met the FERC study criteria in accordance with 18 CFR § 5.9(b)(1)-(7).

- Resource management goals of agencies/tribes with jurisdiction over resource;
- Existing information and the need for additional information;
- Nexus between project operations and effects on the resource to be studied;
- Study methodology [including study area];
- Level of effort and cost; and
- Schedule.

Additionally, Section 4 of this document describes study requests that FirstLight did not adopt. FirstLight's rationale for why certain study requests were not adopted is also provided. In many instances, the proposed study did not have a nexus to project operations and effects and would not inform the development of license requirements. In other cases, less costly methodologies were available to gather the requested information.

Table 1.0-1: Stakeholder Letters filed with FERC

Name	Representing	Filing type			Date Filed
		Testimony	Comments, Concerns, or Information submitted to FERC	Did Study Request address FERC's criteria	
Leena Newcomb	The River Residents Association (RRA)	x			1/31/2013
Jennifer Tufts	Northfield Open Space Committee		x	No	1/31/2013
Thomas and Patricia Shearer	Public		x	No	1/31/2013
Warren Ondras	Public			Yes	1/31/2013
Board of Selectman	Town of Montague		x	No	2/6/2013
Mike Bathory, Alan Wallace	Landowners and Concerned Citizens for License Compliance (LCCLC)	x			2/11/2013
Mary Joe Maffei, Manager	Manager of Amherst High School Nordic Ski Team		x	No	2/16/2013
• Peter Conway • Stanley and Geri Johnson • Robert and Linda Emond • Walter and Mary Ann Patenaude • Michael and Diane Kane • Cynthia Dale • Robert Strafford and Family • Leena Newcomb • Vivien Venskowski • Betsy and Jean Egan	RRA		x	No	2/16/2013-3/1/2013
Nathan L'Etoile, Co-Owner	Four Star Farms (FSF)		x	No	2/20/2013
Jeffrey Squire, President	Western Massachusetts Climbers' Coalition		x	No	2/20/2013
Board of Selectman	Town of Montague		x	No	2/21/2013
Bill Llewelyn, Chair	Town of Northfield Conservation Commission (NCC)		x	No	2/22/2013
Barbara Skuly, Chairman	Ashuelot River Local Advisory Committee (ARLAC)		x	No	2/24/2013
Karl Meyer	Public		x	No	2/25/2013
Richard Bonanno, Director	Massachusetts Farm Bureau Federation, Inc (MFBF)		x	No	2/25/2013
River Resident (no name given)	Public		x	No	2/26/2013
Louis Chiarella, Mary Colligan	National Marine Fisheries Service (NMFS)			Yes	2/27/2013
Glen Normandeau, Executive Director	New Hampshire Fish and Game Department (NHFG)			Yes	2/27/2013
Caleb Slater, Thomas French	Massachusetts Division of Fisheries and Wildlife (MADFW), Natural Heritage and Endangered Species Program (NHESP)			Yes	2/28/2013
Chris Curtis	Public		x	No	2/28/2013
Ken Kimball, Norm Sims	Appalachian Mountain Club (AMC)		x	No	2/28/2013
Ken Kimball, Norm Sims, Bob Nasdor, Thomas Christopher	AMC, American Whitewater Association (AWWA), New England Flow (NEF)			Yes	2/28/2013
Dr. Richard Palmer	University of Massachusetts at Amherst (UMass)		x	No	2/28/2013
Carolyn Shores Ness, Vice Chair	Franklin Conservation District (FCD)			Yes	2/28/2013
Ken Kimball, Norm Sims, Noah Pollock, Stephan Syz	AMC, Vermont River Conservancy (VRC), Friends of the Connecticut River Paddlers (FCRP)			Yes	2/28/2013
Kevin Mendik	National Park Service (NPS)			Yes- not exact	2/28/2013
Joseph Graveline, President	The Nolumbeka Project, Inc		x	No	2/28/2013
Bill Perlman, Jerry Lund, Tom Miner	Franklin Regional Council of Governments (FRCOG)		x	Yes	3/1/2013
Mike Bathory	LCCLC			No	3/1/2013
Gill Selectboard	Town of Gill		x	Yes	3/1/2013

Name	Representing	Filing type			Date Filed
		Testimony	Comments, Concerns, or Information submitted to FERC	Did Study Request address FERC's criteria	
Robert Kubit	Massachusetts Department of Environmental Protection (MADEP)		x	Yes	3/1/2013
Roger Noonan, President	New England Farmers Union (NEFU)		x	No	3/1/2013
Don Pugh	Deerfield River Chapter of Trout Unlimited (DRTU)			Yes	3/1/2013
Rebecca Brown, President	Connecticut River Joint Commissions (CRJC)			Yes	3/1/2013
Elizabeth Muzzey, Director and State Historic Preservation Officer	New Hampshire Division of Historical Resources (NHDHR)		x	No	3/1/2013
Brian Fitzgerald, Streamflow Protection Coordinator	Vermont Department of Environmental Conservation (VTDEC)			Yes	3/1/2013
Gregg Comstock, PE, Supervisor, Water Quality Planning	New Hampshire Department of Environmental Services (NHDES)			Yes	3/1/2013
Kim Lutz, Director, Kathryn Mickett Kennedy, Applied River Scientist	The Nature Conservancy (TNC)			Yes	3/1/2013
Howard Fairman	Public		x	No	3/1/2013
Richard Bonanno, President	Massachusetts Farm Bureau Federation Inc. (MAFBF)		x	No	3/1/2013
Andrea Donlon, River Steward	Connecticut River Watershed Council (CRWC)			Yes	3/1/2013
Stephanie Krug, President	New England Biking Association (NEBA)			Yes	3/1/2013
Stephanie Krug, President	NEBA		x	No	3/1/2013
Tim Welsh	FERC			Yes	3/1/2013
Thomas Chapman, Supervisor	United States Fish and Wildlife Service (USFWS)			Yes	3/1/2013
Joanne McGee	Public		x	No	3/1/2013
Kurt Heidinger, Director	BioCitizens		x	No	3/1/2013
Don Stevens, Chief	Nulhegan Band of the Coosuk- Abenaki Nation		x	No	3/18/2013

Table 1.0-2: Study Request and PSP Matrix

Title	Stakeholder Requester(s)	PSP Section	Proposed	Year
Geology and Soils				
2013 Full River Reconnaissance Study	CRSEC	3.1.1	Yes	2013
Study of Turners Falls Erosion	NHFGD (9); Town of Gill (1); LCCLC (1a); FRCOG (1); FCD (1); NMFS (14); CRWC (1)	(Part of 3.1.1)	Yes	2013
Northfield Mountain/Turners Falls Operations Impact on Sediment Transport	NHFGD (6); Town of Gill (2); LCCLC (2a); FRCOG (3); FCD (2); CRWC (2); MADEP (1)	3.1.2	Yes	2014
Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations	NHDES (21c); VANR (1)	(Part of 3.1.1) (Part of 3.1.2) (Part of 4.1.1)	Partial, see section 4.1.1	2014
Water Resources				
Water Quality Monitoring Study	Proposed in PAD; Town of Gill (5); LCCLC (5a); FRCOG (4); CRWC (6); VANR (2); MADEP (2); USFWS (21); NHDES (25c)	3.2.1	Yes	2014
Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station	FERC (1)	3.2.2	Yes	2013-2014
Model River Flows and Water Levels Upstream and Downstream of the Turners Falls Project Generating Stations and Integration of Project Modeling with Upstream and Downstream Project Operations	NHFGD (16); LCCLC (8a); FRCOG (6); MADFW (13); NMFS (1); CRWC (7); NHDES (14a); USFWS (1); TU (12)	(Part of 3.2.2) (Part of 3.8.1)	Yes	2013-2015
Watershed-wide Stormwater Model	CRJC (Attachment B, pdf page 7)	4.2.1	No	NA
Aquatic Resources				
Conduct Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station	NHFGD (19); MADFW (2); NMFS (2); CRWC (11); TU (13); USFWS (2); NHFGD (20); MADFW (1); NMFS (3); CRWC (12); TU (14); USFWS (3); TNC (2)	3.3.1	Yes	Accelerated 2013
Evaluate Upstream and Downstream Passage of Adult American Shad	NHFGD (1); Town of Gill (8); NMFS (7); CRWC (14); NHDES (2); VANR (12); TU (2); USFWS (6); MADFW (3); FERC (5)	3.3.2	Yes	2014
Evaluate Downstream Passage of Juvenile American Shad	NHFGD (21); Town of Gill (13); MADFW (6); NMFS (8); CRWC (16); VANR (9); TU (15); USFWS (9)	3.3.3	Yes	2014
Evaluate Upstream Passage of American Eel at the Turners Falls Project	NHFGD (11); MADFW (7); NMFS (9); CRWC (18); VANR (22); TU (8); USFWS (14)	3.3.4	Yes	2014-2015
Evaluate Downstream Passage of American Eel	NHFGD (4); MADFW (8); NMFS (10); CRWC (20); VANR (21); TU (5); USFWS (16)	3.3.5	Yes	2015
Evaluation of Timing of Downstream Migratory Movements of American Eels on the Mainstem Connecticut River	NHFGD (2); MADFW (9); CRWC (19); NHDES (3); VANR (20); TU (4); USFWS (15)	(Part of 3.3.5)	Yes	2014
Impact of Project Operations on Shad Spawning, Spawning Habitat, and Egg Deposition in Area of the Northfield Mountain and Turners Falls Projects	NHFGD (3); Town of Gill (9); MADFW (4); NMFS (5); CRWC (15); NHDES (4); VANR (11); USFWS (5); TU (3); NMFS (5)	3.3.6	Yes	2014, possibly 2015
Fish Entrainment and Turbine Passage Mortality Study	NHFGD (8); Town of Gill (14); MADFW (12); NMFS (13); CRWC (23); TU (7); USFWS (12), FERC (4)	3.3.7	Yes	2015
Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays	NHFGD (13); MADFW (10); NMFS (12); CRWC (10); TU (10); USFWS (8)	3.3.8	Yes	2014
Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace	NHFGD (7); Town of Gill (7); LCCLC (7a); MADFW (11); CRWC (4); TU (6); USFWS (13)	3.3.9	Yes	2014
Assess Operational Impacts on Emergence of State-Listed Odonates in the Connecticut River	MADFW (22)	3.3.10	Yes	2014
Fish Assemblage Assessment	NHFGD (15); Town of Gill (11); CRWC (8); FERC (3); TNC (4); VANR (13); TU (11); USFWS (17); MADFW (21)	3.3.11	Yes	2014
Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Spill Events on Shortnose Sturgeon Spawning and Rearing Habitat	NHFGD (14); NMFS (4); CRWC (25); USFWS (4)	3.3.12	Yes	2014, possibly 2015
Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Spawning and Spawning Habitat	MADFW (15); USFWS (18);NHFGD (18); Town of Gill (12); CRWC (9); VANR (18)	3.3.13	Yes	2014
Aquatic Habitat Mapping of Turners Falls Impoundment	FERC (2)	3.3.14	Yes	2014
Assessment of Adult Sea Lamprey Spawning within the Turners Falls Impoundment and Northfield Mountain Project Area	NMFS (11)	3.3.15	Yes	2014
Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the CT River below Cabot station	MADFW (20)	3.3.16	Yes	Portions in 2013, if possible; 2014
Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitats	NHFGD (5); Town of Gill (10); MADFW (14); CRWC (21); VANR (19); USFWS (19)	3.3.17	Yes	2014
Impacts of Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms	NHFGD (12); MADFW (17); NMFS (6); CRWC (24); TU (9); USFWS (11)	3.3.18	Yes	2014-2015
Evaluate the Use of an Ultrasound Array to Facilitate Upstream Shad Movement to Turners Falls Dam by Avoiding Cabot Station Tailrace.	NHFGD (22); CRWC (17); USFWS (7)	3.3.19	Yes	2015
Shad Population Model for the CT River	NHFGD (10); MADFW (5); CRWC (13); NHDES (6); TU (1); USFWS (10)	4.3.1	No	NA

Table 1.0-2 (Continued)

Title	Stakeholder Requester(s)	PSP Section	Proposed	Year
Terrestrial Resources				
Baseline Study of Terrestrial Wildlife and Botanical Resources at the Turners Falls Impoundment, the Bypass Reach and below Cabot Station	Proposed in PAD	3.4.1	Yes	2014
Wildlife Habitat Assessment of Bypass	Montague Board of Selectmen	(Part of 3.4.1)	Yes	2014
Effects of Northfield Mountain Project-related Land Management Practices and Recreation Use on Terrestrial Habitats	FERC (8)	3.4.2	Yes	2014
Wetlands Riparian and Littoral Habitat				
Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species	Incorporates 10 requests below	3.5.1	Yes	2014
Integrate Modeled River Flows and Water Levels with Habitat Assessment for State-Listed Riparian Invertebrate Spp.	MADFW (19)	(Part of 3.5.1)	Yes	2014
Assessing Operational Impacts on State-listed Rare Plants in the CT River	MADFW (23)	(Part of 3.5.1)	Yes	2014
Impacts of Water Level Fluctuations on Riparian and Aquatic Veg. Including Invasive Spp. And their Associated Habitats in the TF Impoundment	NHFGD (17); Town of Gill (6); LCCLC (6a); FRCOG (5); CRWC (22); NHDES (15b); VANR (26); USFWS (20)	(Part of 3.5.1 and 3.3.14)	Yes	2014
Recreation and Land Use				
Recreation Use/User Contact Survey	Proposed in PAD; FERC (6)	3.6.1	Yes	2014
Recreation Facilities Inventory and Assessment	Proposed in PAD; FERC (6)	3.6.2	Yes	Accelerated 2012-13
Whitewater Boating Evaluation	NPS (2); AMC, VRC, FCRPT (2); NEF, AMC, American Whitewater (1); FERC (7)	3.6.3	Yes	2014
Assessment of Day Use and Overnight Facilities Associated with Non-motorized Boats	NPS (1); AMC, VRC, FCRPT (1); NEF, AMC, American Whitewater (2) and (3); Montague Board of Selectmen; AMC; CRWC (26)	3.6.4	Yes	2014
Land Use Inventory	FL proposed in PAD	3.6.5	Yes	2014
Assessment of Effects of Project Operation on Recreation and Land Use	FL proposed in PAD	3.6.6	Yes	2014
Recreation Study at Northfield Mountain, Including Assessment of Sufficiency of Trails for Shared Use	NPS (4); AMC, VRC, FCRPT (4); Citizen(Krug)	3.6.7	Yes	2014
Contingent Valuation Study	NEF, AMC, American Whitewater (4)	4.5.1	No	NA
Mitigation Impacts of the Connecticut River and loss of Whitewater Recreation at and above Turners Falls Dam	NEF, AMC, American Whitewater (5)	4.5.2	No	NA
Aesthetics				
Noise Level Determination for Northfield Mountain Project Operations	Citizen (Ondras)	4.4.1	No	NA
Cultural Resources				
Phase 1A Archeological Survey	Proposed in PAD; Montague Board of Selectmen (2-21-2013); Montague Selectmen (2-25-13); FERC (AIR 2)	3.7.1	Yes	2014
Reconnaissance-Level Historic Structures Survey	Proposed in PAD	3.7.2	Yes	2014
Assess Preservation of Cultural, Historical, and Educational Resources	NPS (3); AMC, VRC, FCRPT (3)	4.6.1	No	NA
Socioeconomics				
Feasibility of Converting the Northfield Mountain Pumped Storage Facility to a Closed-Loop or Partially Closed-Loop System	Town of Gill (3); LCCLC (3a); FRCOG (2); FCD (3); CRWC (3)	4.7.1	No	NA
Creation of a Decommissioning Fund	NPS (5); AMC, VRC, FCRPT (5)	4.7.2	No	NA
Other				
Climate Change and Continued Project Operations	Town of Gill (4); LCCLC (4a); MADFW (18); CRWC (5); NHDES (27); USFWS (22)	4.2.2	No	NA
Development Resources				
Evaluate the Impact of Current and Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation	Proposed in PAD; TNC (1)	3.8.1	Yes	2013-2015, updated with data from other studies
Develop and Comprehensive and Predictive Model of Electrical Generation System Consisting of 5 Generation Projects along the CT River; Study the Impact and Feasibility of Various Changes in operations on Environmental Resources	FRCOG (7)	(Part of 3.8.1)	Yes	2013-2015, updated with data from other studies

FIRSTLIGHT POWER RESOURCES

PROPOSED STUDY PLAN

N

0 0.5 1 2 Miles

Figure 1.0-1
Turners Falls Project and Northfield Mountain Project Boundary Map

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2.0 FERC ISSUED PAD DEFICIENCIES AND ADDITIONAL INFORMATION REQUESTS

In addition to making their study requests, FERC issued PAD deficiencies as well as additional information requests (AIRs) to supplement the content of the PAD. These deficiencies and AIRs are addressed below.

2.1 FERC PAD Deficiencies

2.1.1 Project Facilities and Operation (FERC Deficiency #1a and #1b)

FERC Def #1a: Please provide the dependable capacity of the Turners Falls Project and the Northfield Mountain Pumped Storage Project and the basis for the determination of the dependable capacity as required per § 5.6(d)(2)(iii)(E) of the regulations.

FirstLight Response: According to *Civil Engineering Guidelines for Planning and Designing Hydroelectric Developments* published by the American Society of Civil Engineers in 1989, dependable capacity is defined as "*the load-carrying ability of a power plant under adverse load and flow conditions.*" For a standard hydroelectric facility, these conditions would be present during a period of high electrical demand and low flow.

The contracted capacity for the Turners Falls Project with ISO-New England is 68.2 MW (61.8 MW at Cabot and 6.4 MW at Station No. 1). If there were no storage capacity in the Turners Falls Impoundment, the dependable capacity would be lower and would be based on the lowest flow period, which occurs in September (see Figure page 4-30 of the PAD). The highest electrical demand months were estimated from Northfield generation data (see Page 3-33 of PAD) as a true indicator of demand or "adverse load". For the period 2000-2009, September was the third highest generation (demand) month, behind July and August. For purposes of this analysis, it was assumed that September reasonably represents a low flow/high demand period. The September median flow at the Turners Falls Dam for the period 1941 to 2010 is approximately 4,008 cfs (see page 4-30 of PAD). Assuming all 4,008 cfs is passed through Cabot Station under a net head of approximately 60 feet; the estimated dependable capacity of the Turners Falls Project (without storage capacity) would be approximately 17.7 MW.

The contracted capacity for the Northfield Mountain Project with ISO-New England is 1,124.0 MW, which assumes a full upper reservoir.

FERC Def #1b: Please provide land use maps which include key features as required per § 5.6(d)(2)(ii) of the regulations.

FirstLight Response: Land cover maps were included in the PAD on a larger scale in Figure 4.1.1-1. Land use data is readily available in Massachusetts through the Mass-GIS; land use data is not available for New Hampshire or Vermont. Figure 2.1.1 (a-g) provides a series of land use maps on a smaller scale than that provided in the PAD.

2.1.2 Geology and Soils (FERC Deficiency #2a, #2b, and #2c)

FERC Def #2a: The PAD describes the soils and occurrences; however, it does not provide descriptions of chemical characteristics, erodibility and potential mass movement as required by § 5.6(d)(3)(ii)(B) of the Commission's regulations. Therefore, to the extent known, please provide a description of chemical characteristics, erodibility and potential mass movement of soils in each project's area.

FirstLight Response: Section 4.2.3 of the PAD contains a discussion of soil types and mapping from Vernon Dam to the Cabot tailrace including the identification of the ten most common soil series found in the Project boundary (PAD Table 4.2.3-1). Although general characteristics of each soil series were included in the PAD, quantitative data pertaining to the chemical and physical properties and erodibility were not discussed. As such, please find the following enclosed in Appendix C:

- Chemical properties including cation-exchange capacity, effective cation-exchange capacity, and pH;
- Physical properties including percent sand, silt, and clay, saturated hydraulic conductivity, organic matter, and erosion factors (Kw, Kf, and T factors); and
- Potential erosion hazard

Soil erodibility factors contained in Appendix C include both the K and T factors. K factor values typically range from 0.02 (least erodible) to 0.64 (most erodible) and can be divided into two sub-categories, Kw and Kf factors. The Kw factor is calculated by taking into consideration the whole soil, while the Kf factor only considers the fine-earth fraction (<2.0 mm diameter). Soil properties affecting the K factor, and therefore the erodibility, can include texture, organic matter content, structure, infiltration, and permeability. The T factor is the maximum amount of annual sheet and rill erosion that permits the fertility and productive capacity of the soil to be maintained indefinitely. T factor values range from 1 ton per acre per year for the most fragile soils, to 5 tons per acre per year for soils that can sustain more erosion without significant productive rainfall. Soil properties affecting T factor values include texture, permeability, available water capacity, and depth to restrictive layer such as rock, clay, or gravel (NRCS, 2013, http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm). Data included in Appendix C is parsed based on soil profile depth.

In addition to the NRCS data referenced above, FirstLight has conducted years of river bank erosion studies along the Turners Falls Impoundment resulting in numerous filings with the FERC. As part of the Erosion Control Plan, FirstLight has conducted Full River Reconnaissance (FRR) surveys every 3-5 years since 1998. During these surveys, information such as bank height, bank slope, bank erosion, bank material, and degree of vegetation is collected. In addition to the FRRs, FirstLight recently filed long term monitoring transects within the Turners Falls Impoundment showing geomorphic changes over the last 10+ years. Thus, very specific information on erodibility is contained in these reports.

FERC Def #2a: Additionally, section 5.6(d)(3)(ii)(C) specifies that the PAD provide information on the erosion within the project area. However, while the PAD provides information on erosion around the Turners Falls reservoir, it did not provide any information on the presence of erosion, mass soil movement, slumping or other forms of instability along the bypass reach or the project's power canal. Therefore, pursuant to section 5.6(d)(3)(ii)(C)(2) of the Commission's regulations please provide a description of all known erosion sites within the Turners Falls project's bypass reach and/or along its power canal, and to the extent known, a determination as to the cause of the erosion. The description of each site should include the length of shoreline affected by erosion, the height of the eroded area, and the soil type.

FirstLight Response: FirstLight performed an aquatic mesohabitat study that encompassed the Turners Falls Bypass Reach during 2012. This work entailed walking the bypass reach from the Turners Falls Dam to the Cabot tailrace. The substrate within the bypass reach is primarily bedrock controlled with few areas containing fine substrate; the river-right embankments are naturally armored, high and steep-sided. The river-left embankments are primarily lined with buildings. No areas along the bypass reach river banks were found to be eroding.

FirstLight conducts annual inspections of the power canal in a partially dewatered state every September. During 2007-2009, Kleinschmidt Associates investigated an area within the Turners Falls power canal where a slough had formed along the eastern dike (about 400 feet downstream of where the power canal begins to widen) and actions to fix the issue were taking place. The erosion responsible for creating the slough was attributed to considerable sediment buildup toward the western side of the canal, which caused the water velocity along the east bank to be higher than originally intended. The original depth of the west side of the canal was 14 feet, but the sediment accumulation since the canal was built had created a large area where the depth was shallow enough for geese to stand. Additionally, the scouring in the vicinity of the slough was 17 feet below the water level of the canal during dewatering inn 2007; by 2008, the scoured hole was 20 feet deep. Removal of sediment from the west bank to the scoured area, along with the addition of stone to stabilize the sediments, resulted in the hole being filled with 42,700 cubic yards (CY) of fill. It was concluded that the work completed in 2009 was a success, with improved flow distribution and lower velocities along the eastern dike. Also, armoring likely increased the stability of the dike with reduced potential for future sloughing. A 300 foot long section of scour at the downstream end of the filled in area was not considered a priority due to being shallow and was not filled in; it is a potential location for future redistribution of silt. A report was filed by Kleinschmidt Associates ("Canal Maintenance Completion Report", July 2009) under Critical Energy Infrastructure Information (CEII).

FERC Def #2b: As specified in § 5.6(d)(3)(ii)(C), please provide a description of reservoir shorelines within the Northfield Mountain upper reservoir. The description should include a description of soils, geometry, and existing armoring and stabilization measures.

FirstLight Response: The shoreline of the Northfield Mountain Reservoir is approximately 3.5 miles long. The majority of the shoreline is the rockfill embankment, but there are also four natural ridges. The 3.5 mile shoreline is comprised of approximately 2.2 miles of rockfill embankment, 0.8 miles of more natural (primarily udorthents, or human disturbed) soils and 0.5 miles of excavated bedrock (near the intake). The United States Department of Agriculture's online Web Soil Survey application was queried for soil identification and description, for the approximately 0.8 miles of udorthent soil. An area at the northern end of the reservoir is identified as Woodstock-Millsite-Rock outcrop complex. This soil, which comprises about 1,000 feet of the shoreline, consists of very rocky and rocky soils and rock outcrop. The Soil Survey Report also identified an area about 1800 feet long on the west shore and an area about 1400 feet long on the northeast shore, along natural ridge areas, which consist of generally very fine sand to fine sandy loam. There is some grass and other low growing vegetation on the north shore and west shore areas identified above. The northeast shore area is generally free of vegetation. The upstream face of the embankment consists of large stone fill, with an overall slope of approximately 1:1.8 (V:H), though the upper portion of the slope is somewhat steeper at about 1:1.5 (V:H). There is little to no vegetation growing along this portion of the shoreline, except at very low elevations in some areas, where sediment has deposited.

The upper reservoir, intake channel and intake structure are in the Dry Hill gneiss, which is quite durable and hard rock material. The rocks comprising the west flank of the Northfield Mountain are part of the hard crystalline metasedimentary complex. Near the crest of the mountain, the Dry Hill granite gneiss crops out with the average layering dips from 10° to 12° to the N68°W. Stratification around the project suggests that the ancient sedimentary sequence was metamorphosed by intrusive sills, perhaps from the east. Past studies have indicated that the Dry Hill is considered as an igneous unit, which intrudes the Poplar Mountain formation. The upper portion of the Dry Hill appears to be much less highly metamorphosed, with massive strata separated by thin interbeds of dark biotite and hornblende. Additional information on the geology of the Northfield Mountain Project is included in Section 4.2.2 of the PAD.

FERC Def #2c: As specified in § 5.6(d)(3)(ii)(B), please provide a description of the sediment management in the Northfield Mountain upper reservoir, including monitoring, removal and disposal.

FirstLight Response: On February 15, 2012 FirstLight submitted for FERC approval a *Sediment Management Plan* for the Northfield Mountain Project. As part of this plan, FirstLight has committed to monitoring suspended sediment concentration in the Northfield Mountain Project intake and discharge under a range of operating and ambient river conditions; monitor suspended sediment concentration in the Turner Falls Impoundment at the Route 10 Bridge under a range of flow and water level elevation conditions; conduct bathymetric mapping of the upper reservoir to estimate annual sediment accumulation rates and locations; and, at the end of the monitoring period (2015) propose measures to address the entrainment of sediment into the Project works during upper reservoir drawdown or dewatering activities. For a detailed description of sediment monitoring activities please refer to the *Sediment Management Plan*[3].

2.1.3 Water Resources (FERC Deficiency #3)

FERC Def #3: Please provide the Northfield Mountain upper reservoir maximum, minimum and mean depth as well as the shoreline length as required per § 5.6(d)(3)(iii)(H) of the regulations.

FirstLight Response: As described in Section 3.2.2 of the PAD, the upper reservoir has a gross storage capacity of 17,050 acre-feet and a surface area of approximately 286 acres at a water surface elevation of 1000.5 feet. The mean depth is calculated to be 59.6 feet. Based on the most recent bathymetric survey of the upper reservoir conducted in 2012, the maximum depth in the upper reservoir is approximately 120 feet when the reservoir is full.

The shoreline of the upper reservoir is approximately 3.5 miles long.

2.1.4 Recreation and Land Use (FERC Deficiency #4)

FERC Def #4: For Turners Falls Fishway Viewing Area and Bennett Meadow Wildlife Management Area (WMA) please address the ownership information as specified in § 5.6 (d)(3)(viii)(A).

FirstLight Response: FirstLight owns in fee the Turners Falls Project fish viewing area and the Bennett Meadows Wildlife Management Area.

2.1.5 Aesthetic Resources (FERC Deficiency #5)

FERC Def #5: The PAD did not provide information on the description of aesthetic and visual characteristics of the Turners Falls Project dam and adjacent facilities as required by § 5.6(d)(3)(ix). Please provide this information with accompanying photos (if available).

FirstLight Response: As described in Section 3.2.1 of the PAD, the Turners Falls Dam consists of two individual concrete dams—Gill Dam and Montague Dam—that are connected by a natural rock island known as Great Island. The 630-foot-long, approximately 35-foot-high Montague Dam connects Great Island to the west bank of the Connecticut River and includes four gates and a fixed crest section, which is normally not overflowed. The Gill Dam is approximately 55 feet high and 493 feet long, extending from the Gill shoreline (east bank) to Great Island, and includes three tainter spillway gates.

[3] FirstLight filed its *Sediment Management Plan* with FERC on July 15, 2011.

The power canal gatehouse is located on the Montague side of the Connecticut River, forming the abutment for connecting the Montague Dam spillway. The structure is approximately 214 feet long and has masonry and reinforced concrete foundations with a brick walled superstructure.

The power canal is approximately 2.1 miles long and ranges in width from approximately 920 feet in the Cabot forebay (downstream terminus of canal) to 120 feet in the canal proper.

An aerial image of the dam, gatehouse, and upstream ends of the power canal and bypass reach is shown in Figure 2.1.5a. The Gill-Montague Bridge just below Turners Falls Dam provides limited views of the dam and bypass reach.

Station No. 1 is located approximately 0.8 miles downstream from the dam along the bypass reach, where it is connected to the power canal via an approximately 700-foot-long by 100-foot-wide branch canal. The powerhouse consists of brick masonry on concrete foundations and has eight intake bays—each 15 feet wide for a total intake width of 120 feet—narrowing to four penstock outlets. Figure 2.1.5b shows a view of Station No. 1 from the bypass reach. The powerhouse can generally only be viewed by the public from the bypass reach (access to the powerhouse is gated).

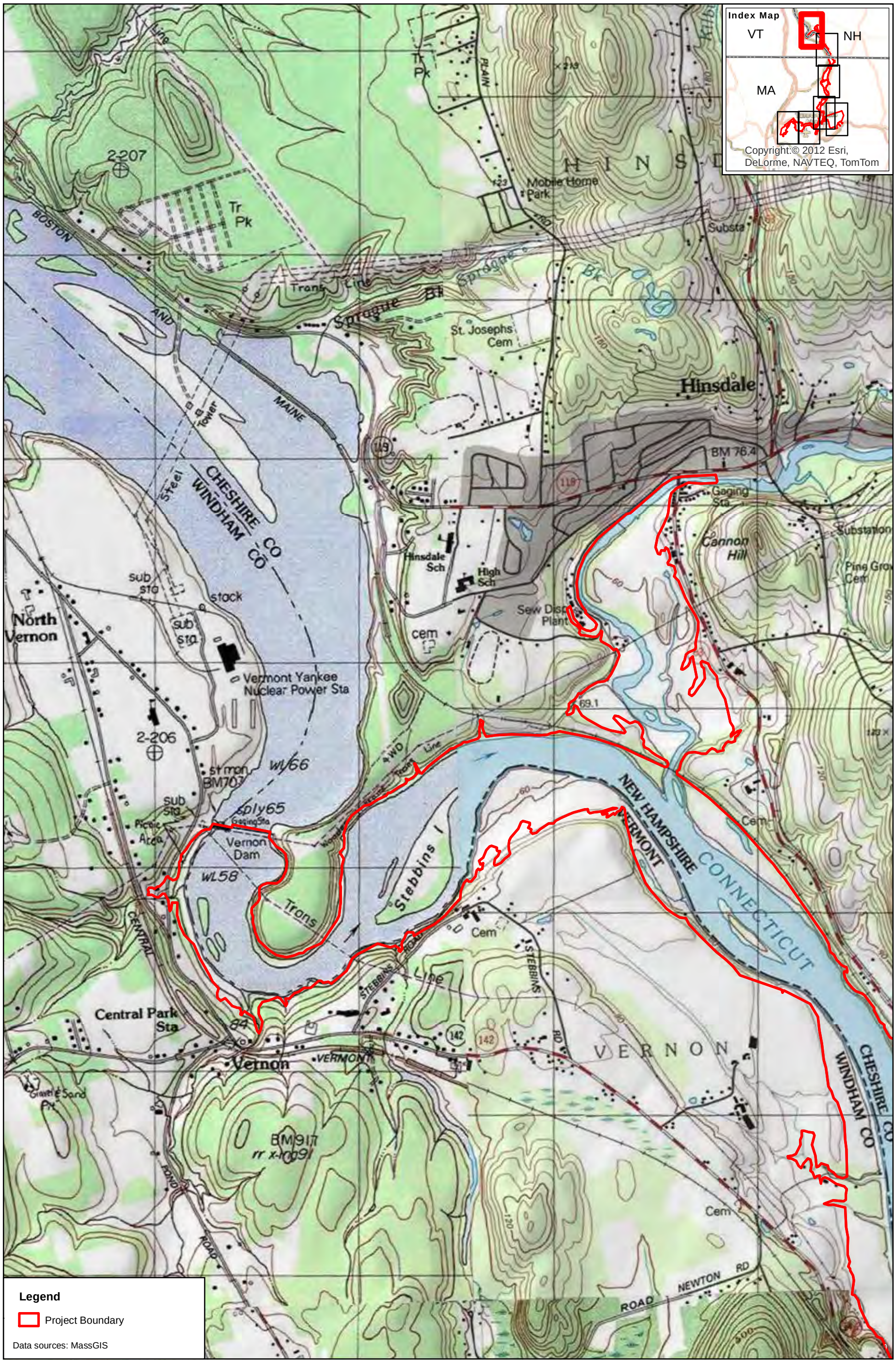
Cabot Station is located at the downstream terminus of the power canal. The powerhouse is a brick and steel structure set on a concrete substructure on a rock foundation, with an intake opening 217 feet wide by 31 feet high. Adjacent to the powerhouse are eight wooden spillway gates. An upstream view of Cabot Station from the Tailwater area is shown in Figure 2.1.5c. As with Station No. 1, the powerhouse can generally only be viewed by the public from the bypass reach (powerhouse access is gated).

2.1.6 Cultural Resources (FERC Deficiency #6)

FERC Def #6: Please provide a description of existing discovery measures for locating, identifying, and assessing the significance of resources as specified in § 5.6(d)(3)(x)(B). Please provide available information on Indian traditional cultural and religious properties as specified in § 5.6(d)(3)(x)(C).

FirstLight Response: FirstLight consults with the applicable State Historic Preservation Office (SHPO), whenever FirstLight proposes to undertake ground-disturbing activity within the Turners Falls Project and Northfield Mountain Project boundaries that require a state or federal permit, in order to locate, identify, and assess the significance of either known or currently unknown cultural resources. In addition, prior to granting permission to others for non-Project uses of Project lands and waters, FirstLight consults with the applicable SHPO in accordance with the procedures of Article 43 of the Turners Falls Project license and Article 52 of the Northfield Mountain Project license. The purpose of such consultation is to determine whether such grants of permission or ground disturbing activity have the potential to adversely affect historic properties.

There are no known Indian traditional cultural properties (TCPs) or religious properties within the Turners Falls Project and Northfield Mountain Project boundaries. One property – The Turners Falls Sacred Ceremonial Hill Site – was determined eligible for inclusion in the National Register of Historic Places as a TCP in 2008. No portion of this ceremonial site is located in either of the Projects' boundaries.



FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

FIGURE 2.1.1 a
Turners Falls Project and Northfield Mountain Project Land Use Maps

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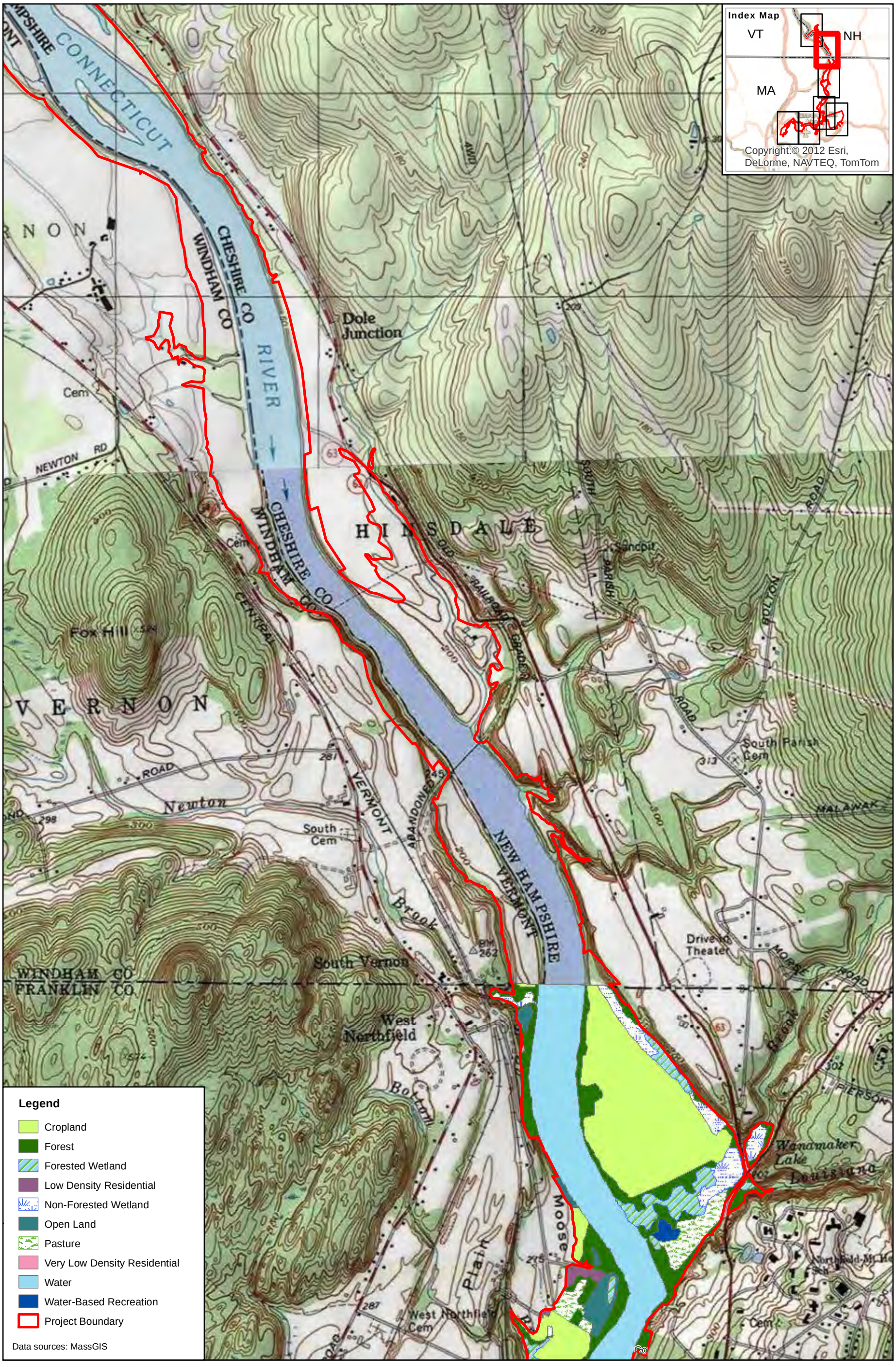

FirstLight Power Resources
GDF SUEZ

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

0 750 1,500 3,000 Feet

FIGURE 2.1.1 b
Turners Falls Project and Northfield Mountain Project Land Use Maps

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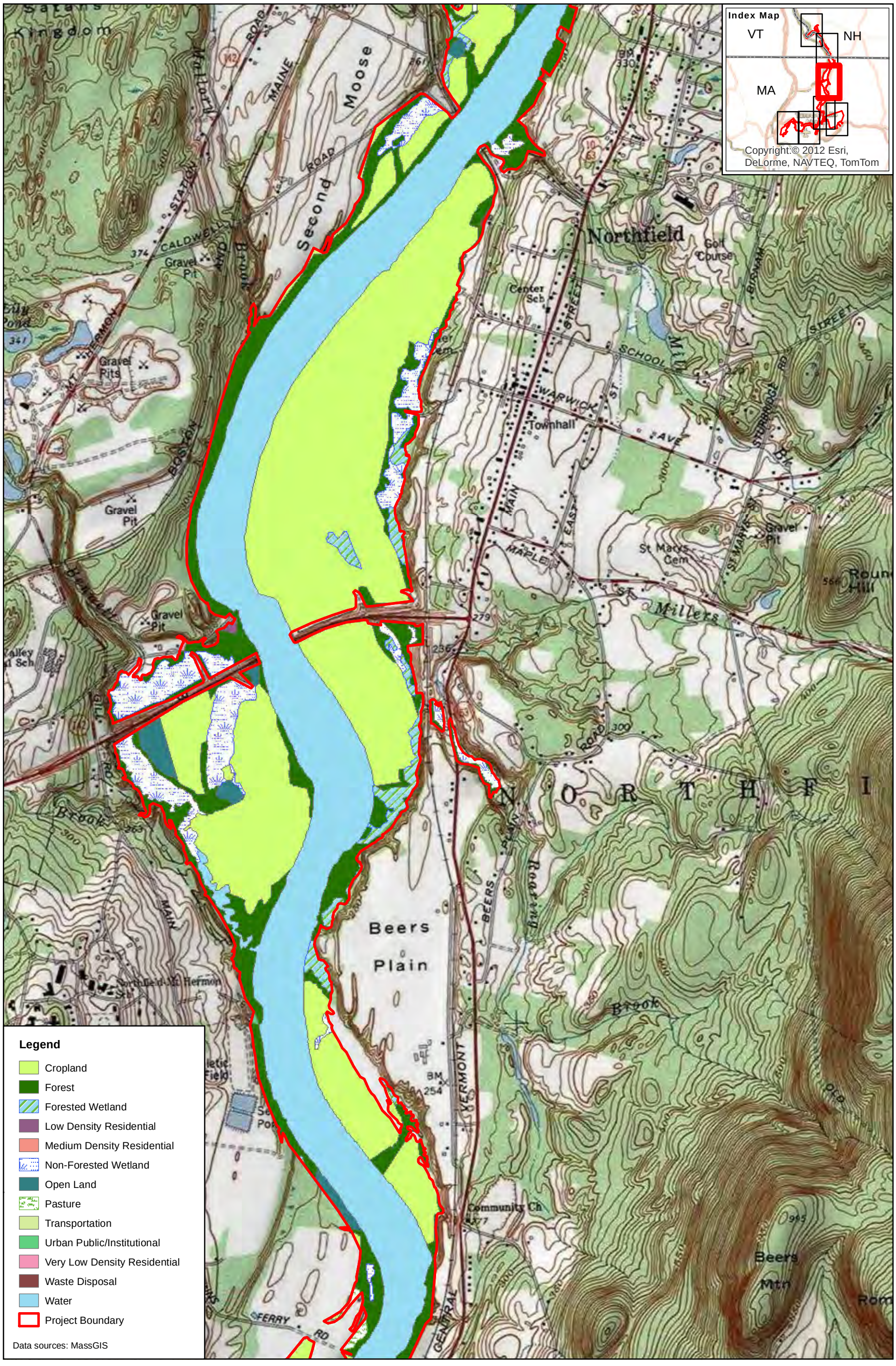

FirstLight Power Resources
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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

0 750 1,500 3,000 Feet

FIGURE 2.1.1 c
Turners Falls Project and Northfield Mountain Project Land Use Maps

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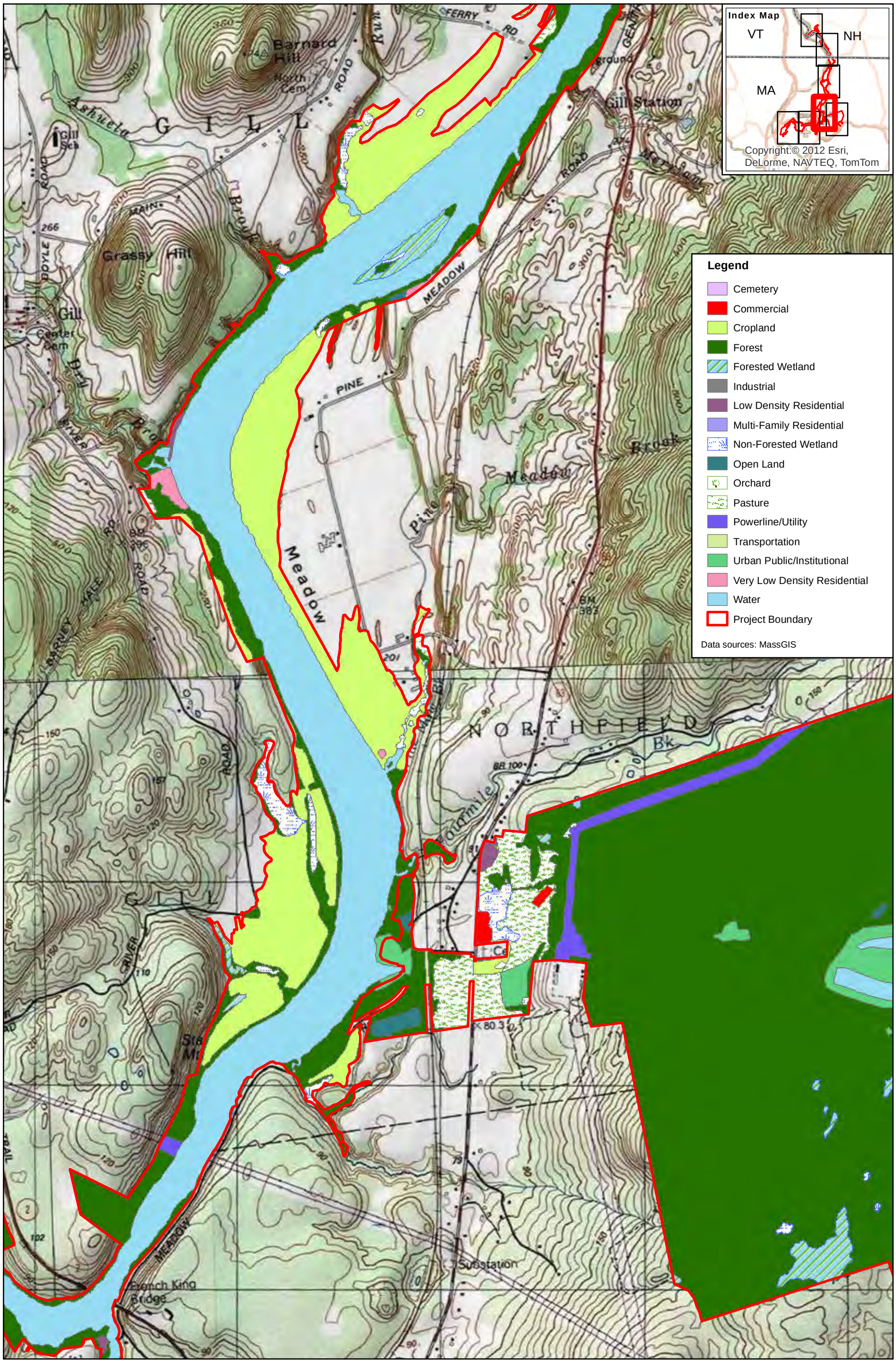

FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

0 750 1,500 3,000 Feet

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FIGURE 2.1.1 d
Turners Falls Project and Northfield Mountain Project Land Use Maps

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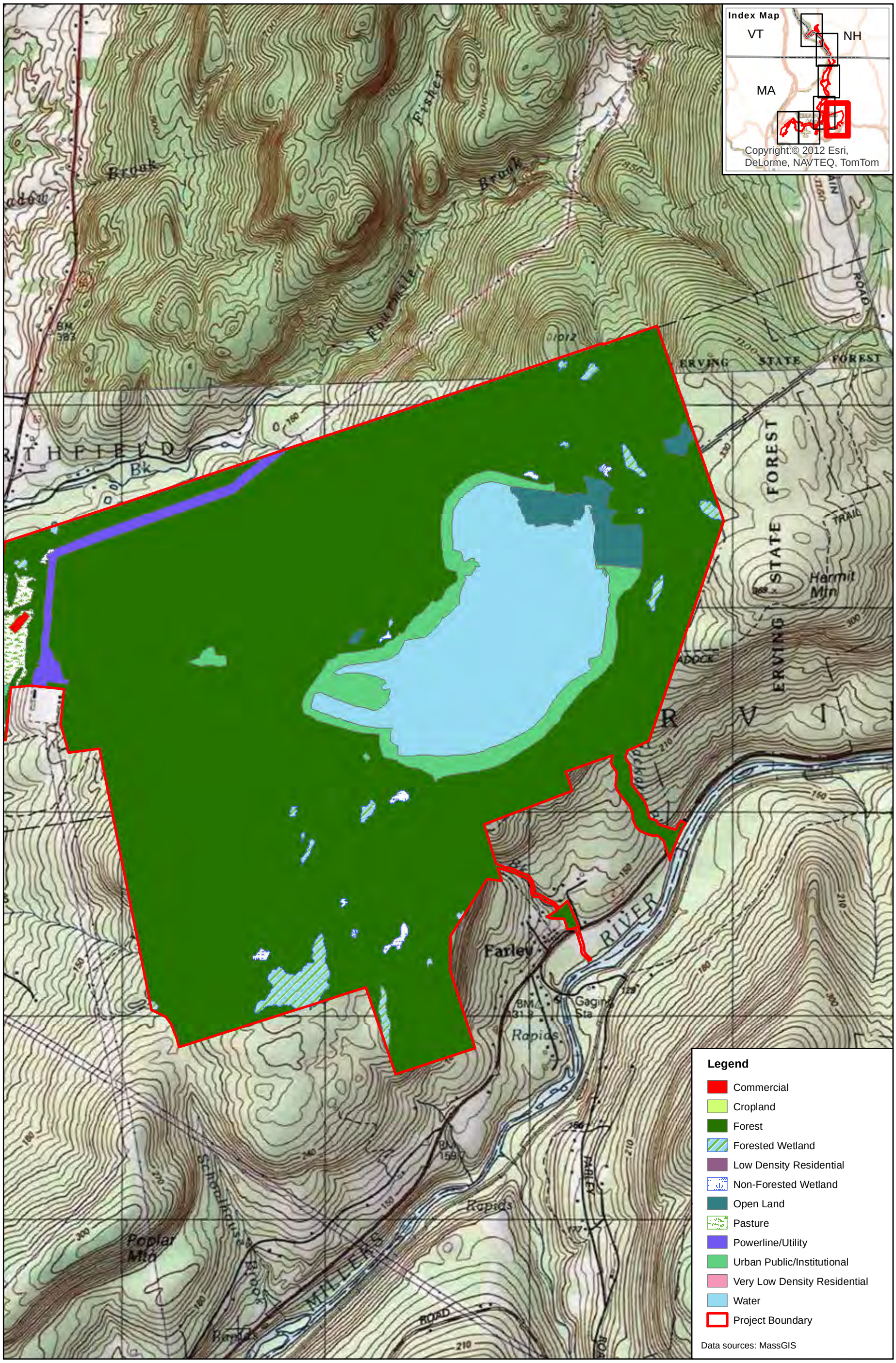

FirstLight Power Resources
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PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

FIGURE 2.1.1 e
Turners Falls Project and Northfield Mountain Project Land Use Maps

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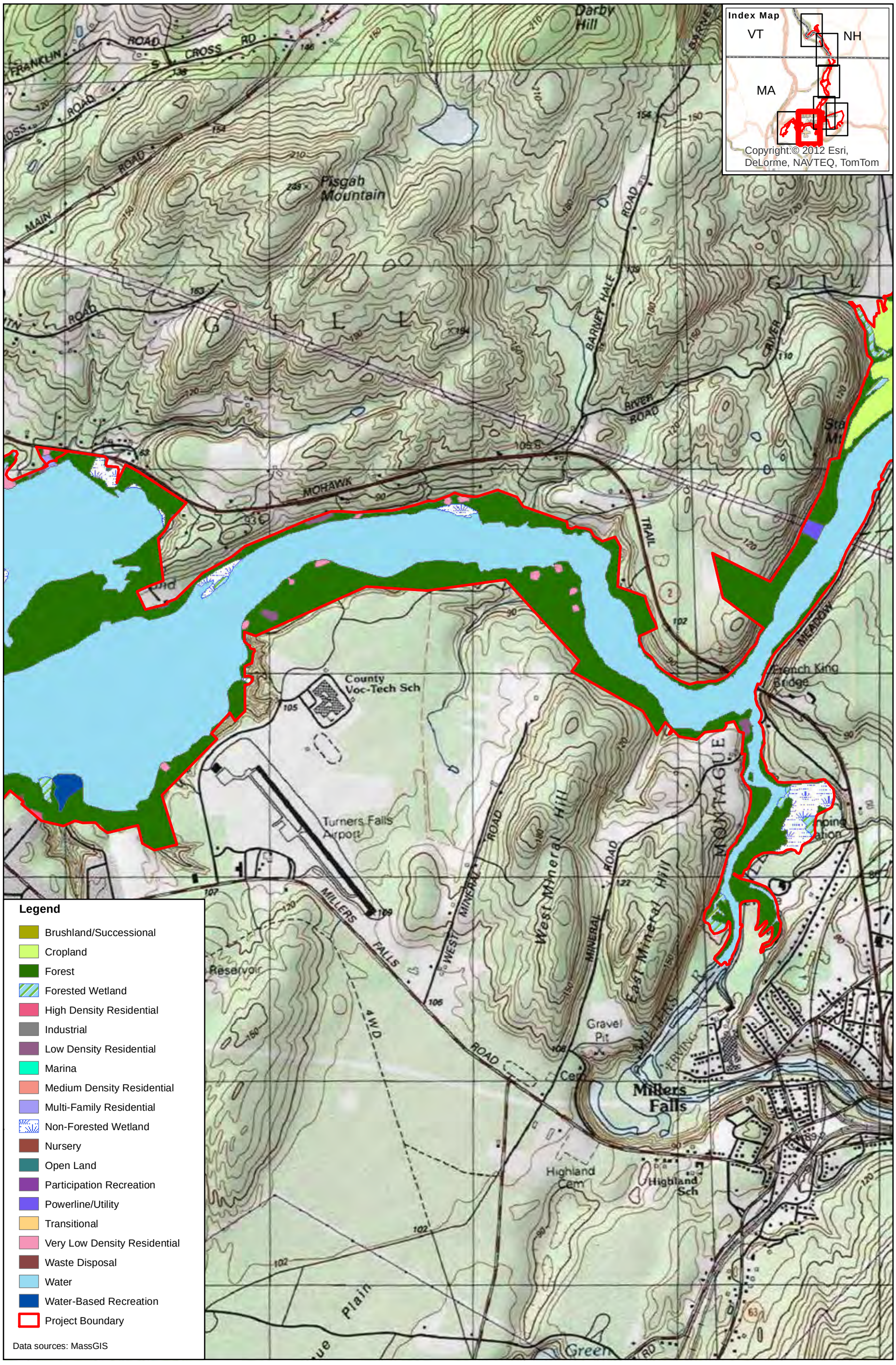

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

FIGURE 2.1.1 f
Turners Falls Project and Northfield Mountain Project Land Use Maps

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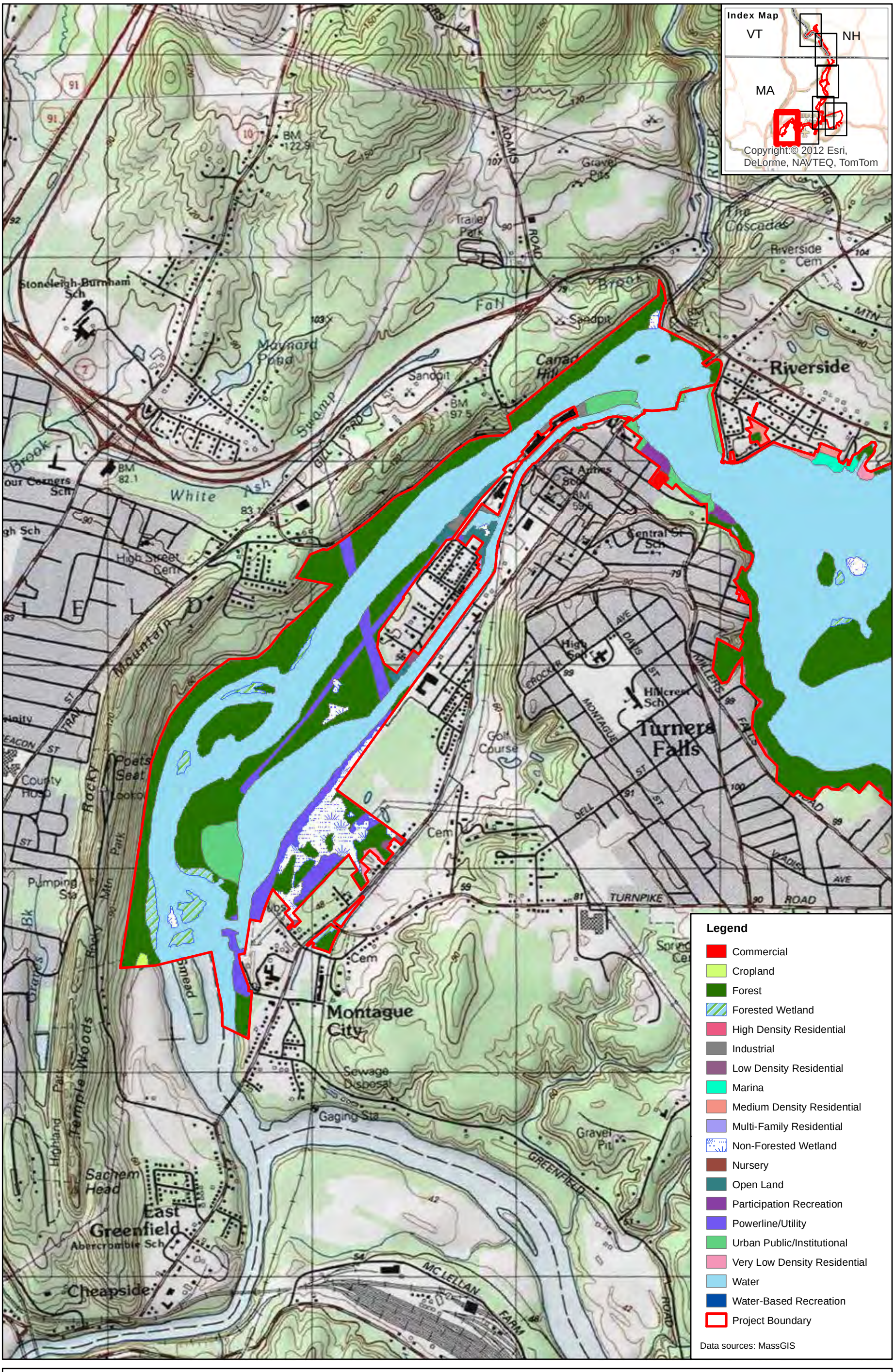

FirstLight Power Resources
GDF SUEZ

FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT
ADDITIONAL INFORMATION REQUEST

FIGURE 2.1.1 g
Turners Falls Project and Northfield Mountain Project Land Use Maps

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Figure 2.1.5 (a-c): Photographs of Turners Falls Dam and Adjacent Facilities

Figure 2.1.5a – Turners Falls Dam, Bypass Channel, and Power Canal (looking downstream)

Figure 2.1.5b – View of Station No. 1 from Bypass Channel

Figure 2.1.5c – Upstream View of Cabot Station from Tailwater Area

2.2 Turners Falls FERC Additional Information Requests

2.2.1 Proposed Changes to Project Operation (FERC AIR #1)

FERC AIR #1: In the PAD you identify alternatives you will consider through the licensing process for potential changes to facilities and operation of the Turners Falls Project including the following: (1) upgrade Station No. 1 with new or rehabilitated turbines, (2) close Station No. 1 and add a turbine generator at Cabot of similar hydraulic capacity to Station No. 1's, and (3) use the full hydraulic capacity of Cabot Station turbines. However, you do not describe the extent or range of the possible modifications to the hydraulic capacity of Cabot Station and Station No. 1. Therefore, so that we may fully understand and evaluate your proposal and determine the appropriate studies needed, please provide detail on the physical and operational changes contemplated at the Turners Falls Project.

FirstLight Response: The combined hydraulic capacity of Cabot Station (13,728 cfs) and Station No. 1 (2,210 cfs) is approximately 15,938 cfs. The maximum hydraulic capacity of the power canal is approximately 18,000 cfs. In addition to Cabot Station and Station No. 1 there are other water entities having water rights to withdraw water from the canal including: Southworth Paper (115 cfs), Turners Falls Hydro, LLC (288 cfs), and a minimal amount of water used by the United States Geological Service (USGS) Conte Anadromous Fish Laboratory. Thus, any increase in hydraulic capacity would be no more than 18,000 cfs less 15,938 cfs, plus water needed for other canal users, or less than approximately 2,000 cfs. Not until studies[4] are conducted will FirstLight have a better sense of whether to propose additional hydraulic capacity, and if so, whether the additional hydraulic capacity would be located at Cabot or Station No. 1.

2.2.2 Cultural Resources (FERC AIR #2)

FERC AIR #2: In section 5.2.10 of the PAD you propose to conduct a Phase IA Archaeological Survey and Historic Structures Survey of the APE. You also indicate that FirstLight may propose to conduct a Phase IB archaeological and an intensive-level architectural level survey, depending on the results of the Phase IA investigation and after consultation with the Massachusetts, New Hampshire, and Vermont SHPOs. However, you have not provided a map specifically defining the APE, and we are unclear on how you would specifically carry out the various tasks involving your proposed study.

Include in your study proposal that you would also consult with the Vermont, Massachusetts, and New Hampshire SHPOs, and any involved Indian tribe or other interested parties in formulating each of the tasks listed below. As a result, we ask you to include the following in your study proposal for cultural resources:

a) Define an APE for the project that would include all lands enclosed by the project boundary including both in-water and on-shore project lands and facilities, and lands or properties outside the project boundary where project operations or other project-related activities may directly or indirectly cause changes in the character or use of historic properties, if any historic properties exist. Your study proposal should also include a record of consultation with the Vermont, Massachusetts, and New Hampshire SHPOs, involved Indian tribes, and other interested parties regarding the APE (Once you have defined your APE, send your APE definition and APE map to the Vermont, Massachusetts, and New Hampshire SHPOs and seek their concurrence. The APE

[4] The study that will best inform potential changes to the hydraulic capacity of the Turners Falls Project is Study No. 3.3.1 *Conduct Instream Flow Habitat Assessment in the Bypass Reach and below Cabot Station*, as described later in this document.

definition and map should be included in your study proposal, along with a record of consultation.). Include a detailed map showing all aspects of the APE, including designations of land ownership**.**

b) Include the specific techniques on how you would carry out the Phase IA investigation, in addition to any other methods (if needed) by which other cultural resources that may be directly or indirectly affected by the project will be inventoried. Your proposal should include methods for inventorying all archaeological and historic resources that may lie within the APE, including project facilities, non-project architectural resources, and properties of traditional religious or cultural significance. Attention should be given on the assessment of the Turner Falls Ceremonial Site and proposed Great Falls Native Cultural Park, and potential project-related effects to these places (see Town of Montague filing, dated February 6, 2013 and filed on February 20, 2013).

c) Develop and include in your study proposal a process for evaluating the National Register of Historic Places (National Register) eligibility of all cultural resources during the field inventory stage, and afterwards, through additional second season field investigations (If necessary: If all National Register eligibility determinations cannot be done in either the first or second season of field investigations, a program to follow-up on completing all National Register eligibility determinations of properties located within the APE could be developed and included in the Historic Properties Management Plan (HPMP).), including a strategy for examining, testing, or excavating cultural resources. This process should take into account applicable guidelines and standards promulgated by the Vermont, Massachusetts, and New Hampshire SHPOs.

d) Elaborate on what methods you would use to identify any existing project-related effects (both direct and indirect) on historic properties recorded during the field inventory, and determine how project operations may affect or potentially affect them.

e) Include in any study report: (1) a background section on previous work in and around the APE; (2) a culture history of the research area; (3) definition and map of the APE; (4) methods used for the archival research and field pedestrian survey and how the APE was systematically inventoried; (5) the results of the survey and detailed descriptions of the cultural resources found (including a table depicting type of cultural resources, age, property location, and land ownership associated artifacts, existing and potential effects, and National Register eligibility status); (6) results of National Register evaluations for all cultural resources located within the APE(In consultation with the involved parties, once you have determined which cultural resources may, or may not be eligible for the National Register, submit your evaluations to the Vermont, Massachusetts, and New Hampshire SHPOs (as applicable) for concurrence.); and (7) site or resource specific descriptions of existing and potential project-related effects on cultural resources considered to be eligible for inclusion in the National Register. Put a statement in your study proposal you will also prepare a HPMP in consultation with the involved parties and will file a draft HPMP along with your preliminary licensing proposal, and a final HPMP with your final license application (Note that once the Commission finds the HPMP to be final, we would attach it to a programmatic agreement and after noticing the Advisory Council on Historic Preservation, we would execute the programmatic agreement with the Vermont, Massachusetts, and New Hampshire SHPOs, if the Advisory Council on Historic Preservation declines to participate. Execution of the programmatic agreement would evidence that the Commission has resolved any potential adverse effects to historic properties involved with the proposed project.). Among other things, the HPMP should provide site-specific measures to resolve any potential project-related adverse effect to historic properties located within the project's APE. You should use the Guidelines for the Development of Historic Properties Management Plans for FERC

Hydroelectric Projects, developed by the Advisory Council on Historic Preservation and Commission in May 2002.

f) Provide a schedule for carrying out all of the various tasks involving your study, including the filing of draft and final reports and HPMPs.

g) Provide estimated costs associated with the various tasks in your study, along with the costs of report production and crafting the HPMP.

FirstLight Response: Sections 3.7.1 and 3.7.2 of the PSP contain FirstLight's study plans for the proposed Phase IA Archaeological Survey and Historic Structures Surveys. FERC's AIR requests that the study plans include a definition of the Area of Potential Effect (APE) and a record of consultation with the Vermont, New Hampshire, and Massachusetts SHPOs on the proposed definition of the APE. Typically, however, consultation with and concurrence of the SHPOs regarding an APE, occurs in conjunction with a SHPO's review of the cultural resources study plans so that the SHPOs will have a context in which to determine an APE. The study plans proposed herein include a proposed definition of the APE. The study plans also include a proposal to consult with the Vermont, New Hampshire, and Massachusetts SHPOs to seek their concurrence on an appropriate APE for the Projects. FirstLight will not undertake any cultural resources surveys prior to obtaining SHPO concurrence of the definition of the APE.

FERC's AIR requests that the study plans should give attention to the assessment of the Turner Falls Ceremonial Site, the Town of Montague's proposed Great Falls Native Cultural Park and potential project-related effects to these places. The Turners Falls Ceremonial Site is located well away from the Projects. To the extent that any historic properties within the APE are identified during the course of archaeological studies undertaken in connection with the relicensing that may have a connection to the Great Falls Native Cultural Park, FirstLight will discuss these properties in its archaeological survey reports.

FERC's AIR also requests that the cultural resources study plan provide estimated costs associated with the various tasks in the study plan, along with the costs of report production and crafting the HPMP. The study plans include costs for conducting the Phase IA Archaeological Survey and Historic Structures Survey. These costs include the costs of report production. To the extent that an HPMP is necessary, FirstLight has also provided an estimate for the crafting of an HPMP. This cost will need to be refined after cultural resources surveys are complete and results are available to inform the need for and, if needed, the development of an HPMP.

2.2.3 Socioeconomic (FERC AIR #3)

FERC AIR #3: In PAD section 4.11.1., you cite a document referred to as "PVPC". However, you do not provide the complete citation. Therefore, so that we may fully understand the supporting documentation for the PAD, please provide the complete citation for the PVPC reference in PAD section 4.11.1. If this document is not readily available to the public please provide a copy of the document.

FirstLight Response: The information was obtained from the Pioneer Valley Planning Commission, and is currently available to the general public. The citation is:

Pioneer Valley Planning Commission (PVPC). (n.d). Profile of the Region – The Pioneer Valley. Retrieved from http://www.pvpc.org/about/profileofregion.shtml on 3/13/2013.

2.2.4 Recreation and Land Use (FERC AIR #4)

FERC AIR #4: In the PAD, the current project boundary maps are presented. However, it is difficult to discern ownership and extent of shoreline buffer from the maps and associated narrative in the PAD. Therefore, so that we may fully understand and evaluate your proposal and determine the appropriate studies needed, please describe the project boundary (i.e., is it a metes and bounds survey, and elevation contour, or some combination), and shoreline buffer (e.g., typical distance from normal reservoir elevation to the project boundary, vegetative cover types).

In the PAD, there is no information on the recreation facilities and public access and use on the unnamed island located to the west of the power canal and east of the bypassed reach of the Connecticut River. The PAD also lacks information regarding how access to the island may be restricted by project uses. During the scoping meetings, we learned that the island is accessible by two walkway bridges which are currently closed. Therefore, please provide information on the ownership and management of the walkway, bridges, and an explanation of why the bridges are closed.

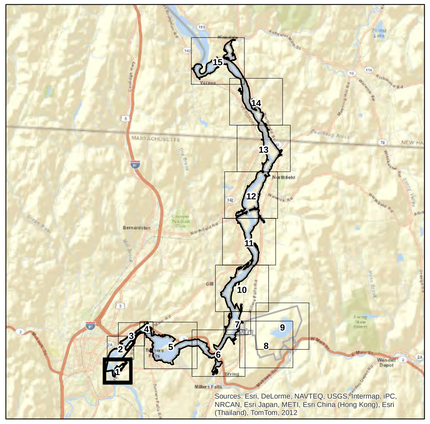
FirstLight Response: Detailed aerial maps of the Turners Falls and Northfield Projects showing the Projects' boundaries by metes and bounds survey and/or contour elevations, shoreline buffers, and location of recreational facilities associated with the Projects are contained in Figures 2.2.4-1 to 2.2.4-15.

The first walkway bridge is the Strathmore Footbridge. In an 1873 indenture between Turners Falls Company (TFC), predecessor to the Licensee, and Keith Paper Company (KPC), predecessor to the Town of Montague in which TFC conveyed land to KPC, TFC agreed to "*forever maintain a suitable bridge over said canal*." After the canal was lengthened and widened in the early 1900's, TFC and KPC reached a new agreement, which was recorded in a 1912 indenture. In this indenture was a lease that allowed TFC and its successors, for a period of 99 years, to maintain and operate a drain or tunnel (Keith drainage pipe) across KPC's land from the canal to the westerly edge of the Connecticut River. In consideration of this, TFC agreed to construct and maintain a steel footbridge from Canal Street to the mill for the purpose of traveling to the mill and carrying "*property, goods and merchandise*." The mill side of the bridge ends in the mill's second floor. The obligation to maintain the footbridge lasted the duration of the lease. Paper production at the mill stopped in 1994 when the then current mill owner (International Paper) shut down operations. The lease expired March 31, 2011 and the Strathmore footbridge was closed. FirstLight retains title to the footbridge. The Strathmore Bridge has never been used or needed for project purposes.

The second bridge is known as the IP Bridge. The IP Bridge resides just downstream of FirstLight's canal headgate house for the power canal. This bridge was present before the canal enlargement and was also modified. Another International Paper Company mill was located on the island near the headgate house, and this bridge was used for mill access. Unlike the Strathmore footbridge, the IP Bridge was built for vehicular use. The bridge is currently posted for a weight limit of 20 ton (2 axle truck) and 30 ton (3 axle truck) with a posted speed limit of 10 miles per hour. The bridge is gated to restrict vehicular access although it is available for emergency use up to the ratings posted. In addition, FirstLight allows pedestrian access across the bridge for recreation purposes, such as fishing access. FirstLight retains title to the IP Bridge.

The State of Massachusetts owns and maintains three other bridges that provide access to the island. The Fifth Street Bridge provides for vehicular access to the industrial end of the island from the Town of Montague for mill access and deliveries. The Sixth Street bridge, located just downstream of the Fifth Street bridge and the Eleventh Street bridge located just downstream of the Sixth Street bridge, are used to access a residential area on the island, the USGS Conte Research Laboratory, the Turners Falls Project No. 1 Station, Branch Canal, Cabot Woods recreation areas, and the back gate of Cabot Station.

The locations of the five bridges are depicted on Figure 2.2.4 -3 and Figure 2.2.4-4.



Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N20-01-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-1

SHEET 1 OF 15

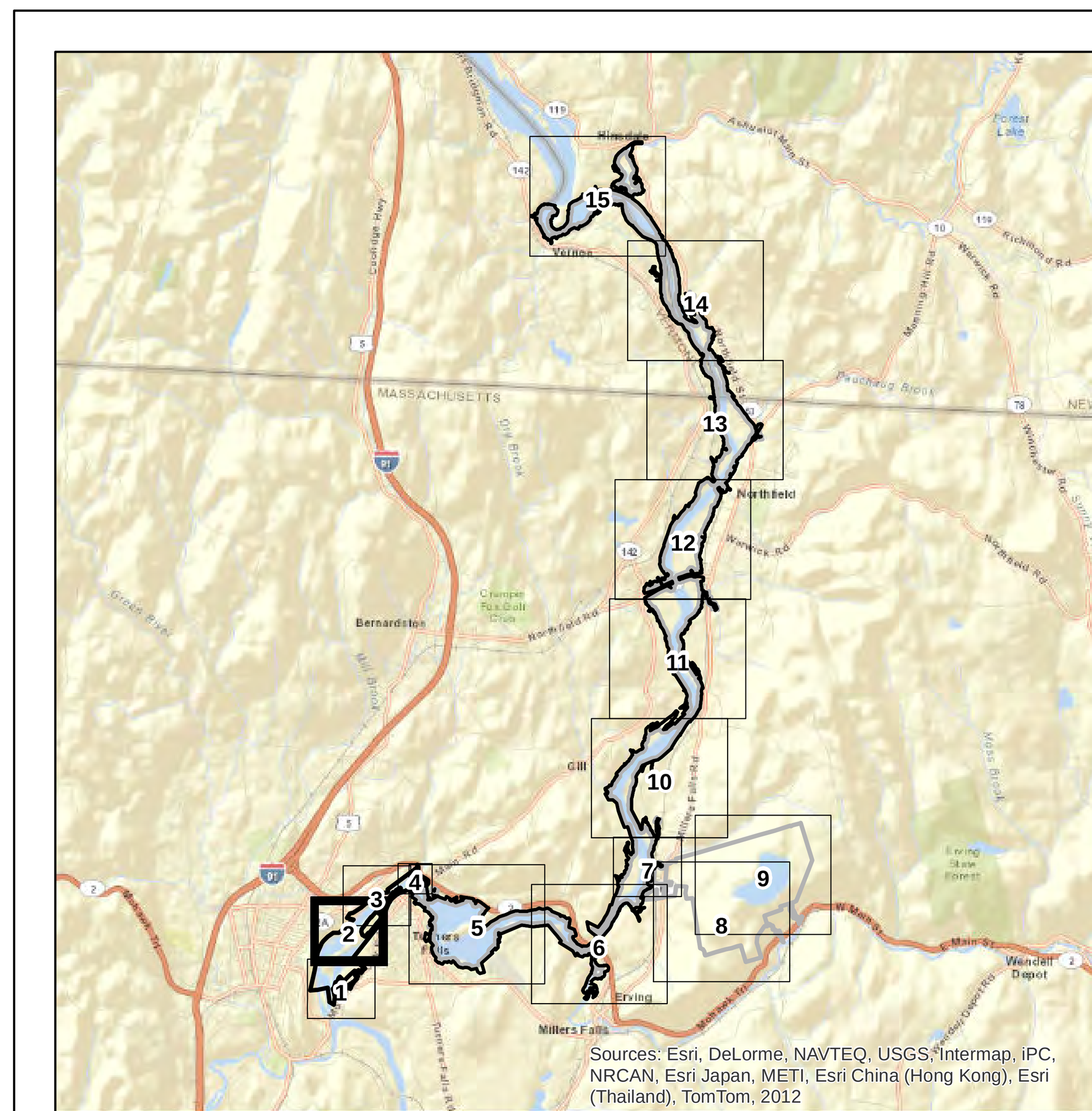
200 100 0 200 400 600 800 Feet

1 inch = 200 feet

When printed full size (28"X40")

1:2,400

Path: W:\gis\mxpro\pad\figure_2_2_4.mxd



Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary

N 24-31-15 E 134.5 FT — Project Boundary Survey Metes and Bounds

ELEV. 207.6 FT — Project Boundary Elevation Contour

N

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PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-2

SHEET 2 OF 15

200 100 0 200 400 600 800 Feet

1 inch = 200 feet

When printed full size (28"X40")

1:2,400

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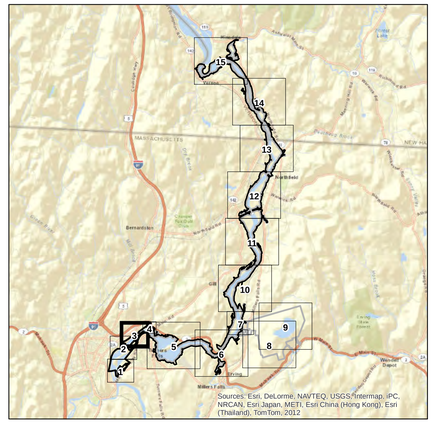

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N20-01-15 E 124.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-3

SHEET 3 OF 15

200 100 0 200 400 600 800 Feet

1 inch = 200 feet

When printed full size (28"X40")

1:2,400

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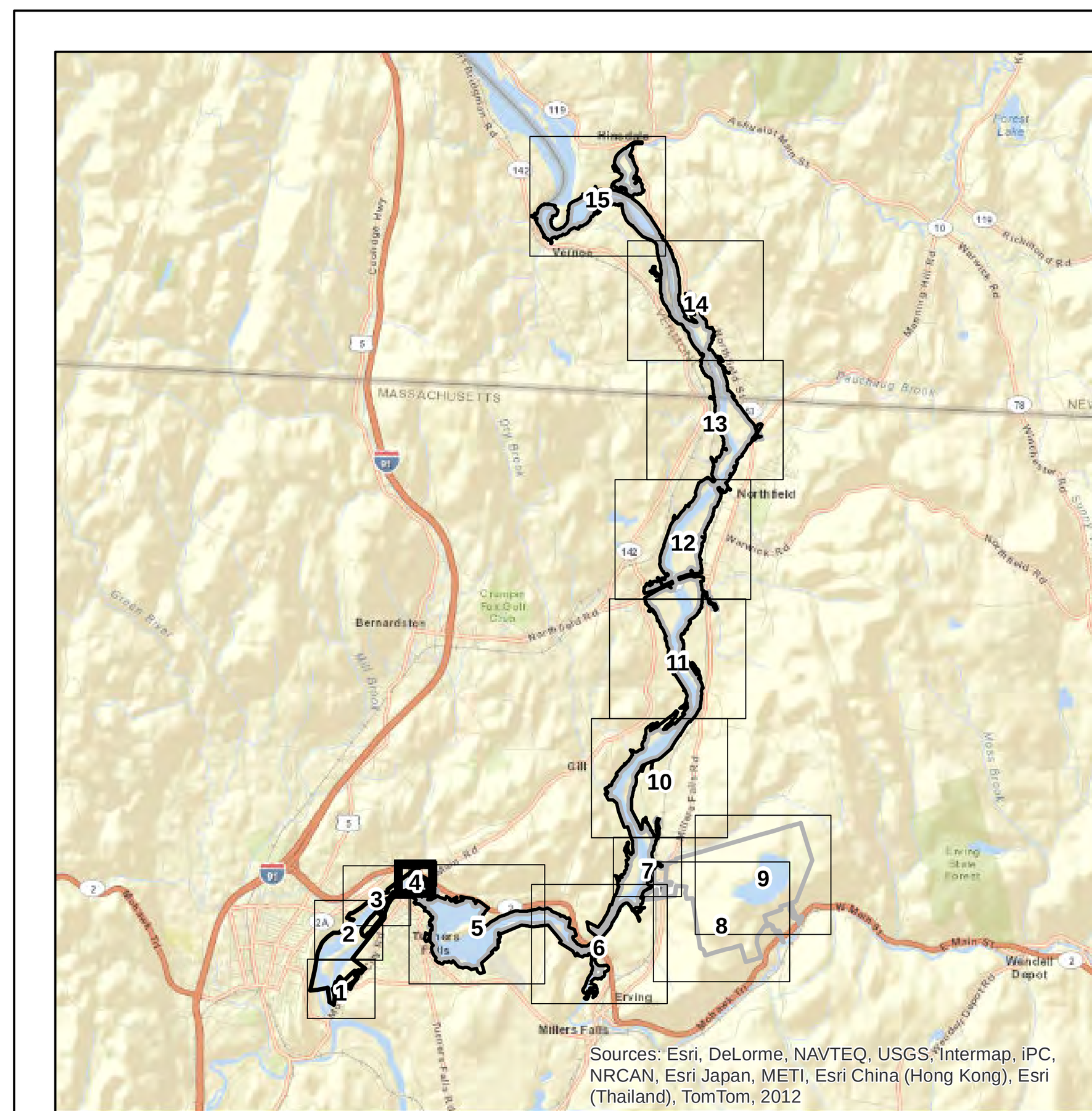

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary

N 24-31-15 E 134.5 FT — Project Boundary Survey Metes and Bounds

ELEV. 207.6 FT — Project Boundary Elevation Contour

N

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PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-4

SHEET 4 OF 15

100 50 0 100 200 300 400 Feet

1 inch = 100 feet

When printed full size (28"X40")

1:1,200

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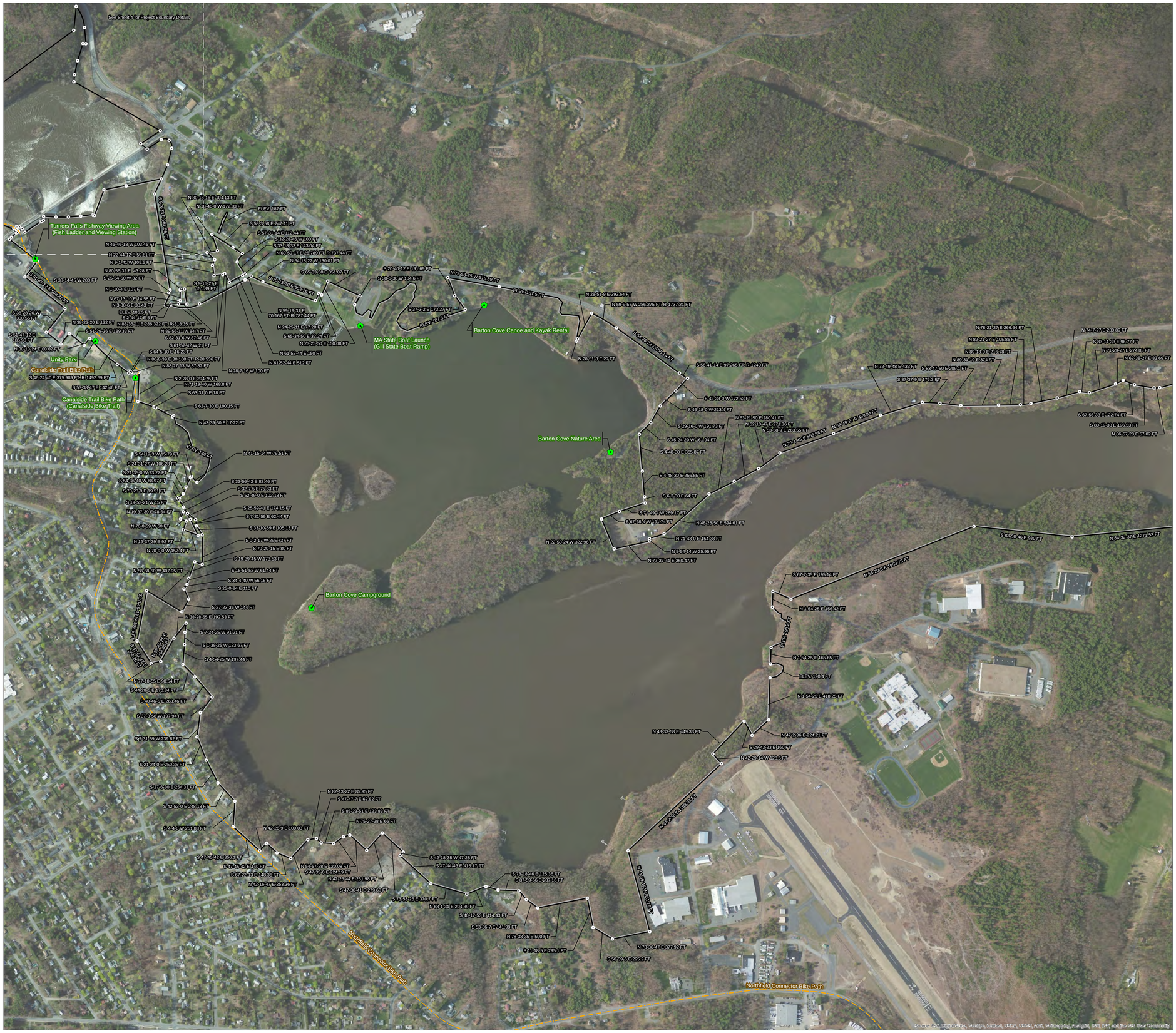

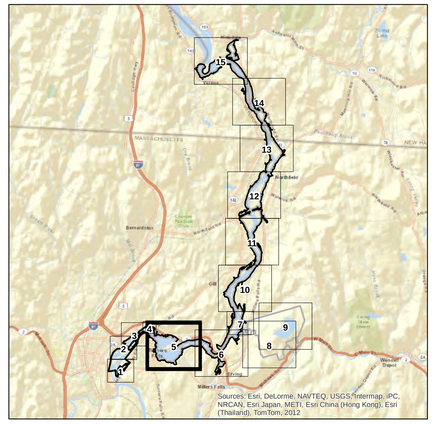

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N20-01-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

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PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-5

SHEET 5 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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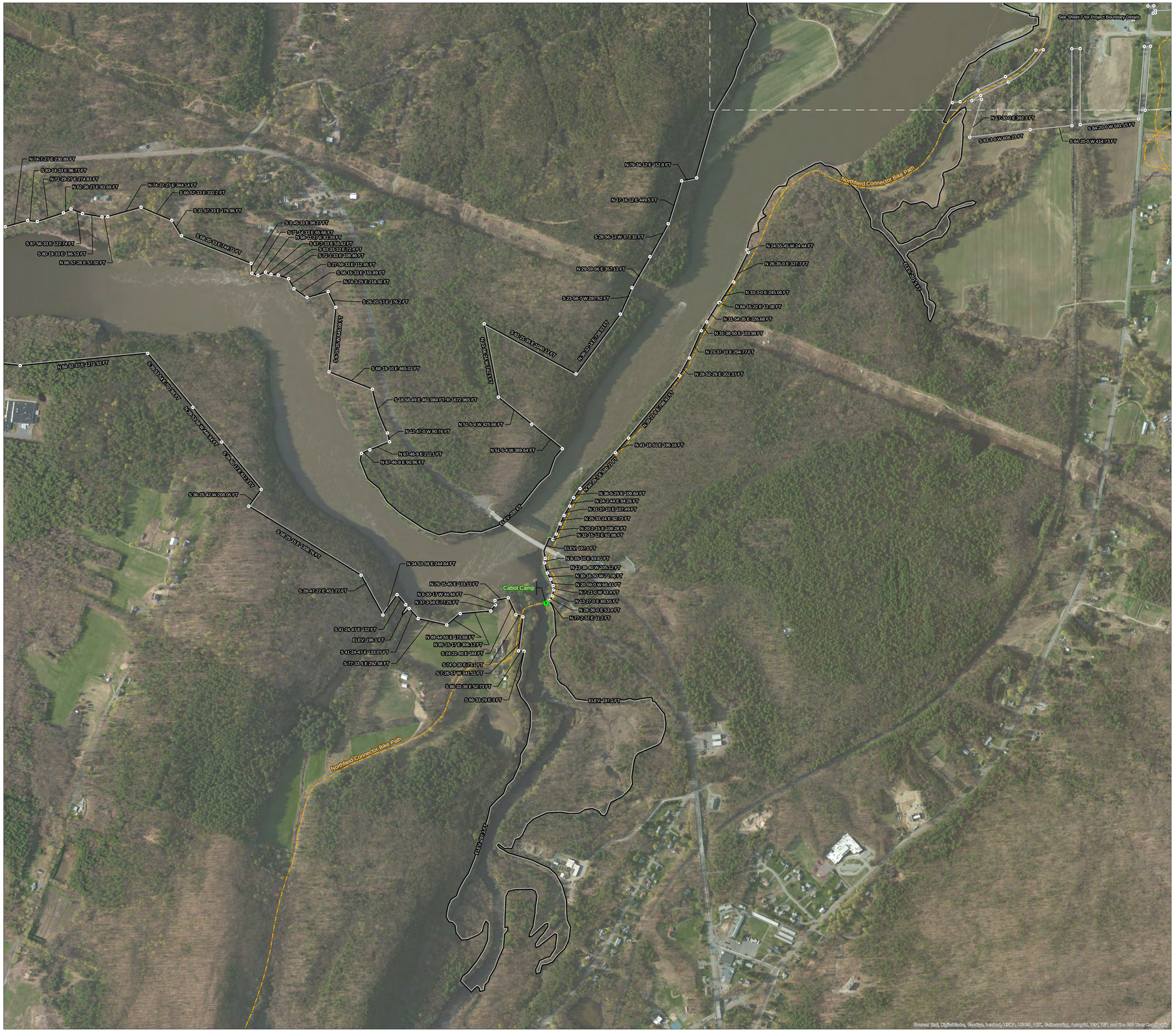

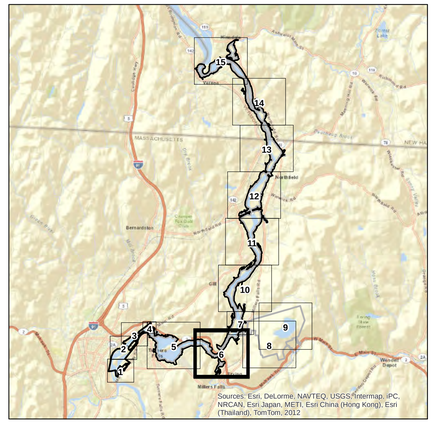

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-01-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.8 FT — Project Boundary Elevation Contour

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PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-6

SHEET 6 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-31-15 E 124.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-7

SHEET 7 OF 15

200 100 0 200 400 600 800 Feet

1 inch = 200 feet

When printed full size (28"X40")

1:2,400

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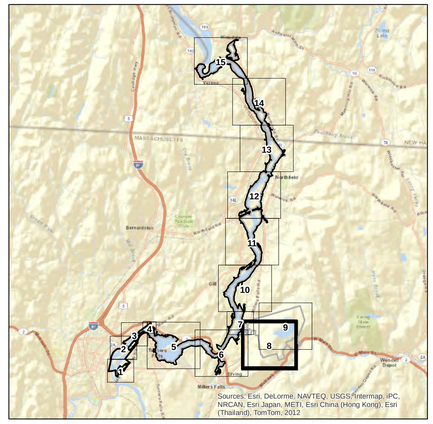

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-31-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-8

SHEET 8 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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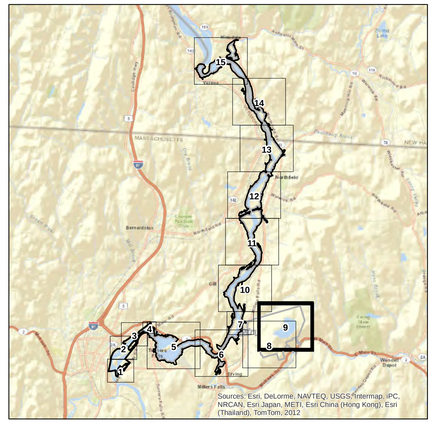

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-01-15 E 124.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-9

SHEET 9 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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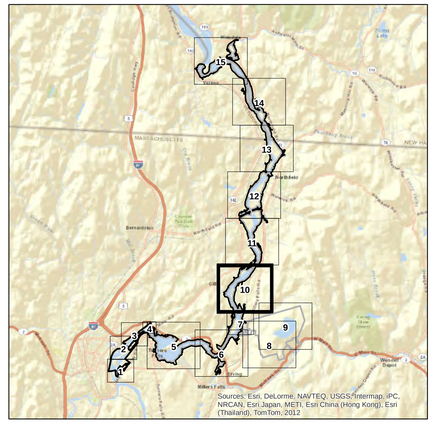

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary

N24-91-15 E 194.5 FT — Project Boundary Survey Metes and Bounds

ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-10

SHEET 10 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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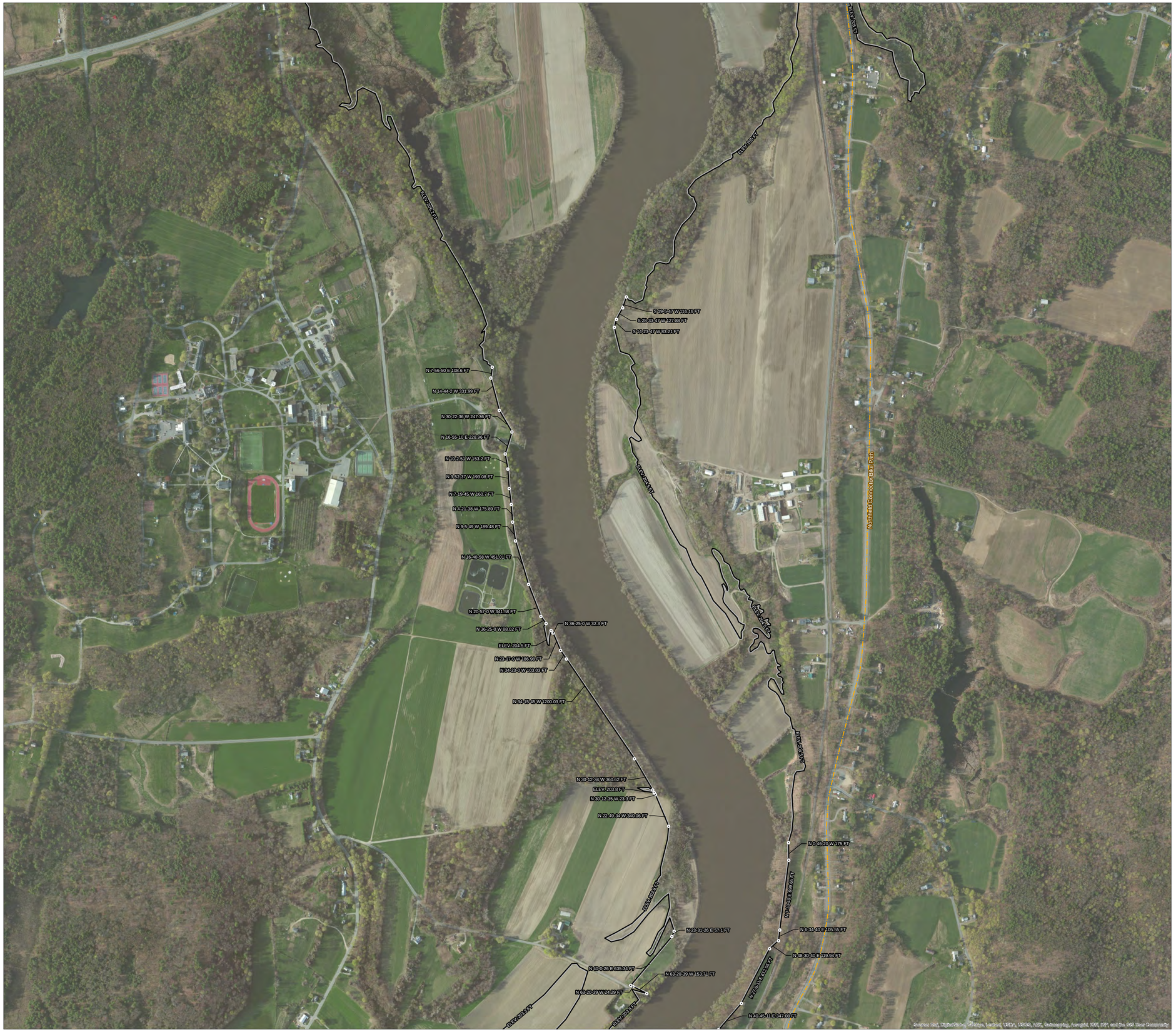

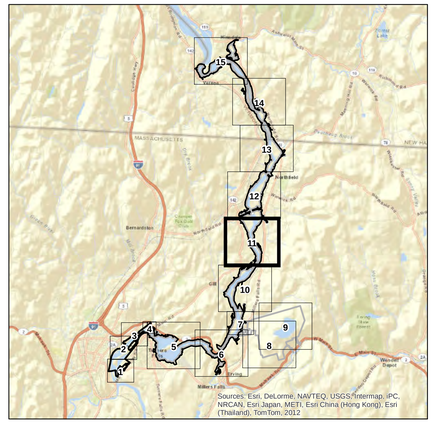

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-31-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-11

SHEET 11 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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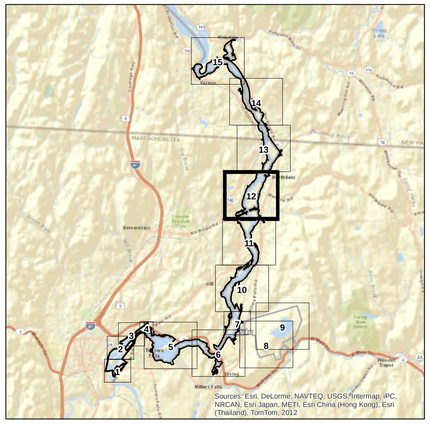

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-01-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-12

SHEET 12 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

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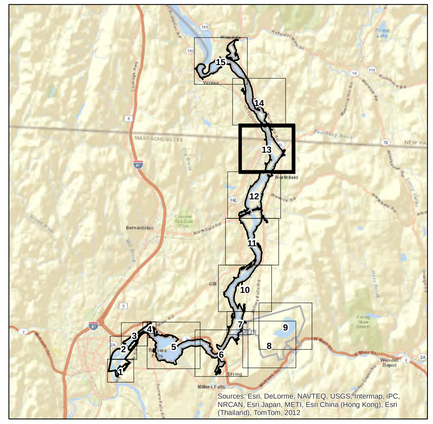

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 20-31-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.8 FT — Project Boundary Elevation Contour

N

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-13

SHEET 13 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

Path: W:\gis\mxp\cpad\figure_2_2_4.mxd

Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 24-31-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

N

FirstLight Power Resources
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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-14

SHEET 14 OF 15

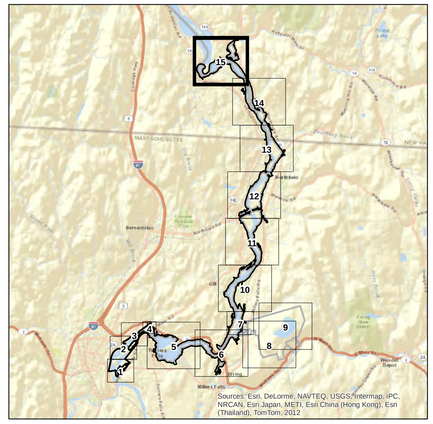
400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

Path: W:\gis\mxp\pad\figure_2_2_4.mxd



Legend

- Recreation Facility
- Project Trail
- Northfield Mountain Pumped Storage Project Boundary
- Turners Falls Hydroelectric Project Boundary
- N 24-31-15 E 194.5 FT — Project Boundary Survey Metes and Bounds
- ELEV. 207.9 FT — Project Boundary Elevation Contour

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FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

NORTHFIELD MOUNTAIN PUMPED STORAGE PROJECT
TURNERS FALLS HYDROELECTRIC PROJECT
DETAILED PROJECT BOUNDARY MAP

FIGURE 2.2.4-15

SHEET 15 OF 15

400 200 0 400 800 1,200 1,600 Feet

1 inch = 400 feet

When printed full size (28"X40")

1:4,800

Path: W:\gis\maps\pad\figure_2_2_4.mxd

2.3 Northfield Mountain Pumped Storage Project FERC Additional Information Requests

2.3.1 Proposed Changes to Project Operation (FERC AIR #5)

FERC AIR #5: In the PAD you propose potential changes to facilities and operation of the project including the following: (1) utilize more storage in the Northfield Mountain Project's upper reservoir and, (2) increase the unit and station capacity. However, you do not describe the extent of possible modifications to the hydraulic capacity and to the storage operations within the upper reservoir. Therefore, so that we may fully understand and evaluate your proposal and determine the appropriate studies needed, please provide detail on the physical and operational changes contemplated at the Northfield Mountain Pumped Storage Project.

FirstLight Response: Relative to the Northfield Mountain Project, the maximum additional increase in hydraulic capacity when operating in a generation mode would be approximately 2,000 cfs, or 500 cfs/turbine for potential total station hydraulic capacity of approximately 22,000 cfs (compared to 20,000 cfs currently). Based on preliminary analysis, under a maximum hydraulic capacity of approximately 22,000 cfs, the station capacity would increase from the 1,168 MW to approximately 1,174 MW.

Relative to storage operations, the upper reservoir is licensed to fluctuate between 1000.5 feet msl and 938 feet msl, a total fluctuation of 62.5 feet. As noted in the PAD, the upper reservoir was originally designed to safely retain water up to elevation 1004.5 feet, msl and can be drawn down to elevation 920 feet, msl. The increase in fluctuation provides for an additional 3,009 acre-feet of storage and 1,990 MWHs of energy. FirstLight will be conducting further analysis to determine the feasibility of utilizing more upper reservoir storage capacity.

2.3.2 Recreation and Land Use (FERC AIR #6)

FERC AIR #6: In the PAD, the project boundary maps are presented. However, it is difficult to discern ownership and extent of shoreline buffer from the maps and associated narrative in the PAD. Therefore, so that we may fully understand and evaluate your proposal and determine the appropriate studies needed, please describe the project boundary (i.e., is it a metes and bounds survey, and elevation contour, or some combination), and shoreline buffer (e.g., typical distance from normal reservoir elevation to the project boundary, vegetative cover types).

FirstLight Response: Detailed aerial maps of the Turners Falls and Northfield Projects showing the Projects' boundaries by metes and bounds survey and/or contour elevations, shoreline buffers, and location of recreational facilities associated with the Projects are contained in Figures 2.2.4-1 to 2.2.4-15.

2.3.3 Cultural Resources (FERC AIR #7)

FERC AIR #7: In section 4.10.4 of the PAD, you state that, by letter dated September 30, 2011, the Massachusetts SHPO has recommended that a qualified cultural resources consultant research and compile the information necessary to identify historic and archaeological resources and archaeologically sensitive areas within the project's APE. In section 5.2.10 of the PAD you propose to conduct a Phase IA Archaeological Survey and Historic Structures Survey of the APE. You also indicate that FirstLight may propose to conduct a Phase IB archaeological and an intensive-level architectural level survey, depending on the results of the Phase IA investigation and after consultation with the Massachusetts, New Hampshire, and Vermont SHPOs. However, you have not provided a map specifically defining the APE, and we are unclear on how you would specifically carry out the various tasks involving your proposed study. As a result, in your study proposal for cultural resources we ask you to include the same

information, specific to the Northfield Mountain Project, as outlined above for the Turners Falls Project. Include in your study proposal that you would also consult with the Vermont, Massachusetts, and New Hampshire SHPOs, and any involved Indian tribe or other interested parties in formulating each of the tasks.

FirstLight Response: Sections 3.7.1 and 3.7.2 of the Proposed Study Plan contain FirstLight's study plans for the proposed Phase IA Archaeological Survey and Historic Structures Surveys. FERC's AIR requests that the study plans include a definition of the APE and a record of consultation with the Vermont, New Hampshire, and Massachusetts SHPOs on the proposed definition of the APE. Typically, however, consultation with and concurrence of the SHPOs regarding an APE, occurs in conjunction with a SHPO's review of the proposed study plans so that the SHPOs will have a context in which to determine an APE. The study plans proposed herein include a proposed definition of the APE. The study plans also include a proposal to consult with the Vermont, New Hampshire, and Massachusetts SHPOs to seek their concurrence on an appropriate APE for the Projects. FirstLight will not undertake any cultural resources surveys prior to obtaining SHPO concurrence of the definition of the APE.

FERC's AIR requests that the study plans should give attention to the assessment of the Turner Falls Ceremonial Site and the Town of Montague's proposed Great Falls Native Cultural Park and potential project-related effects to these places. The Turners Falls Ceremonial Site is located well away from the Projects. To the extent that any historic properties within the APE are identified during the course of archaeological studies undertaken in connection with the relicensing that may have a connection to the Great Falls Native Cultural Park, FirstLight will discuss these properties in its archaeological survey reports.

FERC's AIR also requests study plans provide estimated costs associated with the various tasks in the study plan, along with the costs of report production and crafting the HPMP. The study plans include costs for conducting the Phase IA Archaeological Survey and Historic Structures Survey. These costs include the costs of report production. To the extent that an HPMP is necessary, FirstLight has also provided an estimate for the crafting of an HPMP. This cost will need to be refined after cultural resources surveys are complete and results are available to inform the need for and, if needed, the development of an HPMP.

3.0 PROPOSED STUDIES

3.1 Geology and Soils

3.1.1 2013 Full River Reconnaissance Study

General Description of Proposed Study

FirstLight is required by FERC to conduct a Full River Reconnaissance (FRR) Study every 3-5 years in accordance with the Northfield Mountain Project's Erosion Control Plan (ECP) and to satisfy compliance requirements associated with the Turners Falls Project and Northfield Mountain Project licenses. The next FRR is slated for November 2013 during leaf off. With the impending relicensing effort and timing of the next FRR, FERC contacted FirstLight and indicated that the 2013 FRR should be folded into the relicensing.

Prior to FERC contacting FirstLight, FirstLight had been working with the Franklin Regional Council of Government (FRCOG), Connecticut River Watershed Council (CRWC), and Landowners and Concerned Citizens for License Compliance (LCCLC) on crafting a Quality Assurance Project Plan (QAPP). The goal of the QAPP is to ensure consistency with data collection methods such that any future FRRs would allow for direct comparison. A draft version of the QAPP and FRR was circulated to the FRCOG, CRWC and LCCLC for review and comment, and a meeting was held. Since the QAPP/FRR is now incorporated into the FERC relicensing process, FirstLight developed this study plan based on the study plan criteria. However, as part of this study, stakeholders should also review Appendix D, which includes the QAPP/FRR. The QAPP/FRR contains significantly more detail than this study plan.

Several stakeholder groups submitted study requests pertaining to: 1) Study of shoreline erosion caused by Northfield Mountain Pumped Storage operations and 2) Impact of Turners Falls and Northfield Mountain Project operations on sedimentation and sediment transport. Study requests related to these subjects were received from: Massachusetts Department of Environmental Protection (MADEP), New Hampshire Fish and Game Department (NHFGD), New Hampshire Department of Environmental Service (NHDES), FRCOG, Franklin Conservation District (FCD), CRWC, LCCLC and the Town of Gill. Portions of these study requests were incorporated into this study, while other portions are discussed in Study No. 3.1.2 *Northfield Mountain/Turners Falls Operations Impact on Sediment Transport.*

The proposed FRR study calls for conducting a boat survey along the riverbanks of the Turners Falls Impoundment to document erosion using consistent methods and procedures to allow for comparisons of any future FRRs. It is not designed to determine the cause of erosion; that issue is addressed in Study No. 3.1.2 *Northfield Mountain/Turners Falls Operations Impact on Sediment Transport*

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The purpose of the FRR study is to conduct a reconnaissance level evaluation of erosion in the Turners Falls Impoundment without reference to the cause of the erosion. The goals and objectives of this study are to:

- Develop a QAPP for the FRR;
- Document existing riverbank features and characteristics;
- Accurately map and scientifically describe all portions of the Turners Falls Impoundment where active or recent bank erosion is occurring;

- Spatially define, using a global positioning system (GPS), the transition points or end points where riverbank characteristics or features change from one classification to another;
- Map land use practices adjacent to the river (note that land use maps along the riverbanks are being developed as part of the FERC relicensing process). Describe areas that are directly observed and linked to bank erosion.
- Develop classification techniques of observations into a definable and repeatable methodology;
- Develop distribution and summary statistics of conditions in 2013, assess change in riverbank conditions in context of the ECP since implementation, analyze change in condition of the riverbank since the 2008 FRR; and
- Develop a final report, including maps delineating features identified in the field that will document and summarize the findings of the 2013 FRR.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

As part of the current license requirements of the Northfield Mountain and Turners Falls Projects FirstLight is required to conduct a FRR every 3-5 years. Given the impending relicensing effort and timing of the next FRR (November 2013), FERC contacted FirstLight and indicated that the 2013 FRR should be folded into the relicensing.

In addition, MADEP, NHFGD, NHDES, NMFS, NHDES, and VANR, as well as stakeholder groups FRCOG, FCD, CRWC, LCCLC, and the Town of Gill, all submitted study requests pertaining to soils and geology. Study request tasks that were related directly to the goals and objectives outlined in the Study Goals and Objectives section above were incorporated in this reconnaissance level study. All other tasks were included in Study No. 3.1.2 *Northfield Mountain/Turners Falls Operations Impact on Sediment Transport* or not included in the PSP.

Resource management goals of the Agencies related specifically to this effort include documenting and describing the changes to banks upstream and downstream of riverbank restoration projects, including bank recession.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

In 1998, Simons & Associates (S&A) developed the "*Erosion Control Plan for the Turners Falls Pool of the Connecticut River (ECP)*" (1999). As part of the ECP, FRR studies were conducted in 1998, 2001, 2004, and 2008 to document existing riverbank features and characteristics. The ECP and FRR studies are readily available for use as support documentation or as tools to compare past and present riverbank conditions.

Extensive research has been conducted evaluating erosion along the Connecticut River in the Turners Falls Impoundment; such research includes:

Connecticut River Joint Commissions and Trails Conservation Assistance Program of the National Park Service through the Connecticut Valley Partnership. (1996). *River Dynamics and Erosion.* Charlestown, NH: Author.

Field Geology Services. (2004). *Fluvial Geomorphology Assessment of the Northern Connecticut River, Vermont and New Hampshire.* Farmington, ME: Author.

Field Geology Services (FGS). (2007). *Fluvial Geomorphology Study of the Turners Falls Pool on the Connecticut River between Turners Falls, MA and Vernon, VT.* Farmington, ME: Author.

New England Environmental (NEE). (2001). *Erosion Control Plan for the Turners Falls Pool of the Connecticut River*. Amherst, MA: Northeast Utilities Service Company.

New England Environmental (NEE). (2005). *Erosion Control Plan for the Turners Falls Pool of the Connecticut River, 2004 Full River Reconnaissance.* Amherst, MA: Northeast Utilities Service Company.

Simons & Associates (S&A). (1999). *Erosion control plan for the Turners Falls Pool of the Connecticut River. Prepared for Northeast Utilities*. Midway, UT: Author.

Simons & Associates (S&A). (2009). *Full river reconnaissance – 2008: Turners Falls Pool, Connecticut River*. Prepared for FirstLight Power Resources. Midway, UT: Author.

Simons & Associates (S&A). (2012a). *Analysis of Erosion in Vicinity of Route 10 Bridge Spanning the Connecticut River*. Prepared for FirstLight Power Resources, Midway, UT: Author.

Simons & Associates (S&A). (2012b). *Riverbank Erosion Comparison along the Connecticut River*. Prepared for FirstLight Power Resources, Midway, UT: Author.

Simons, D.B., Andrew, J.W., Li, R.M., & Alawady, M.A. (1979). *Connecticut River Streambank Erosion Study: Massachusetts, New Hampshire, and Vermont*. Waltham, MA: US Army Corps of Engineers (USACE).

Western Massachusetts Electric Company, (1995), *Long Term Riverbank Plan for Connecticut River between Vernon, VT and Turners Falls, MA*. Author.

US Army Corps of Engineers (USACE). (1991). *General investigation study - Connecticut River streambank erosion*. Waltham, MA: USACE, New England Division.

Project Nexus (18 CFR § 5.11(d)(4))

The Connecticut River is an alluvial river, subject to natural processes that result in dynamics such as lateral shifting, erosion, and deposition. These natural processes and dynamic response of the river is further affected by land-use practices, modified flow/water level regime, motorized boating, and other factors. Due to a variety of factors, the riverbanks along the Connecticut River, not just in the Turners Falls Impoundment, have a history of being susceptible to erosion. In accordance with the existing license requirements of the Turners Falls and Northfield Mountain Projects, a reconnaissance survey of the Turners Falls Impoundment was conducted in 1998 to map riverbank characteristics and prioritize erosion sites to be considered for stabilization. As a result of this work, the "*Erosion Control Plan for the Turners Falls Pool of the Connecticut River (ECP)*" was developed by Simons and Associates (1999). The ECP requires FirstLight to conduct FRR studies every 3-5 years to continually monitor and evaluate erosion conditions throughout the Impoundment. As part of the FERC relicensing of the Turners Falls and Northfield Mountain Projects, the Commission has requested that the 2013 FRR be folded into a relicensing study.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The following methods, as outlined in the QAPP (Appendix D), will be used to document existing riverbank features and characteristics and to analyze any change in riverbank conditions since the 2008 FRR. Note that the task descriptions provided below summarize the more detailed tasks outlined in the QAPP (Appendix D). It is recommended that stakeholders fully review Appendix D.

This study will include the entire length of the Turners Falls Impoundment from Vernon Dam to Turners Falls Dam to show the full range of conditions that are observed within this reach and to be consistent with previous FRRs.

The following methods will be used to document riverbank features and characteristics and to analyze change in riverbank conditions since the 2008 FRR. Study methods will consist of the following tasks: 1) document existing riverbank features and characteristics; 2) spatially define riverbank feature transition points; 3) map and develop distribution of riverbank features and characteristics including summary statistics, evaluation of conditions in 2013 in context with historical changes since implementation of the ECP, and analyze changes in conditions from previous FRR studies; and 4) develop a final report and mapping.

Task 1: Document Existing Riverbank Features and Characteristics

Current riverbank features and characteristics will be identified and defined through the use of a pre-determined matrix of nine riverbank criteria. This matrix (see Table 3.1-1) includes characteristics such as slope, vegetation, height, and riverbank sediment to name a few (consistent with previous FRRs as well as other riverbank assessment approaches). Using the 2008 FRR matrix as a guide, FirstLight will identify areas of improvement within the existing matrix; however, for the sake of consistency with the previous FRRs all features and characteristics in the 2008 matrix will be retained and utilized in future FRRs, while perhaps considering additional features and characteristics as is being done with the land-based component of the reconnaissance. The classification of features and characteristics found within the matrix will be based on field observations and not quantitative measurements (consistent with other FRRs). FirstLight will use the comprehensive matrix and document by example photographs representing all the features and characteristics as shown in the QAPP for use in 2013 as well as for any future FRR studies. In doing so, FirstLight will ensure that all future FRR studies are conducted in a consistent manner to make the task of comparing past and present conditions more consistent and direct. Table 3.1-1 provides the 2008 matrix of riverbank features and characteristics proposed for the boat-based component of the FRR.

Table 3.1-1: Connecticut River– Turners Falls Impoundment Riverbank Characteristics Matrix, Boat-based field data logging worksheet

Upper Riverbank Slope	Overhanging	Vertical	Steep (>2:1)	Moderate (4-2:1)	Flat (<4:1)	
Lower Riverbank Slope	Vertical	Steep (>2:1)	Moderate (4-2:1)	Flat (<4:1)		
Upper Riverbank Sediment	Silt/Sand	Gravel	Cobbles	Boulders	Rock	Clay
Lower Riverbank Sediment	Silt/Sand	Gravel	Cobbles	Boulders	Rock	Clay
Upper Riverbank Height	Low (<8 ft.)	Medium (8-12 ft.)	High (>12 ft.)			
Degree Upper Riverbank Vegetation	Heavily Vegetated	Moderately Vegetated	Sparsely Vegetated	None to Very Sparse		
Mass Wasting	Little/None	Some	Extensive			
Erosion Type	None	Overhanging Bank	Undercut Toe	Notching	Slide	
Lower Riverbank Vegetation	None	Heavy	Moderate	Sparse		

In addition to the classification efforts outlined above geo-referenced video photography will be conducted to capture riverbank conditions and characteristics. Red Hen Systems (also used in 1998, 2001, 2004, and 2008) provides hardware and software that collects geo-referenced video in the field and brings that data into desktops or web-based maps. The geo-referenced videos will serve as a means for data control and reference checking back to the photos guiding the classification process that are included in the QAPP, during post-processing efforts.

While the majority of riverbank evaluation and classification will be boat based, a ground-based component will be implemented during this task. Ground-based field work will consist of walking along the top of the riverbank at specific areas of interest. The selection of these areas will be based on land-use types, boat-based riverbank observations such as tension cracks, evidence of mass-movements/wasting and any other types of erosion. Table 3.1-2, provides an overview of attributes to be captured during ground-based observations. The location of the beginning and end points of these features will be collected via sub-meter GPS. Observations will be entered into the data-logger and backed up by geo-referenced digital photograph and/or video documentation.

Table 3.1-2: Ground-Based Erosion Evaluation Form

Town /East or West Bank	Coordinates Start-End	Distance from River	Height above River	Type of Erosion*	Description/ Comments

* Type of Erosion: Erosion types identified will include, but not be limited to, the following: tension cracks, gullies, slides, slips, slumps, falls

Task 2: Spatially Define Riverbank Feature Transitions

The location of transition points, or end points, from one riverbank feature or classification to another will be captured via GPS in a standard coordinate system (i.e. NAD 83 State Plane or UTM coordinates). In order to capture these locations, FirstLight will utilize a sub-meter GPS unit, a data-logger, and a laser range-finder for all data collection. The individual conducting the classification will select a point of

transition from one category of riverbank to another and "shoot" the point with the laser-range finder. Once the point has been "shot" the location of that point is stored on the data logger. The features and characteristics of the next segment of riverbank will be classified and verbally transmitted to the individual operating the data logger. This individual will then enter the classification on the data logger for storage.

Task 3: Develop Maps, Summary Statistics, Evaluation of Conditions, and Analyze Changes in Condition since Implementation of ECP and from 2008 FRR

Segmentation of all riverbank features and characteristics will be developed showing the longitudinal extent and distribution along the Turners Falls Impoundment. Summary statistics quantifying the lengths of features and characteristics will be calculated. Conditions in 2013 will be evaluated based on comparisons over time of the river going back as far as the implementation of the ECP.

Once all field efforts, post-processing, and development of the spatial segmentation of riverbanks based on field classification of features and characteristics is completed, analysis of the 2013 field data will be conducted to develop summary statistics of the riverbank classification. Maps showing all riverbank features and characteristics within each feature will be developed in ArcGIS showing results of the 2013 FRR. Geo-referenced video from the boat-based field work and geo-referenced photographs from the land-based field work will be available in documenting and analyzing the condition of riverbanks. Comparisons of riverbank conditions will be made back to the time of the initial FRR (in 1998 as part of the ECP) and other FRRs using overall summary statistics of riverbank features and characteristics and photography. A comparison of the 2013 FRR will be made to the previous FRR's using summary statistics and analysis in ArcGIS, accounting for any differences in methods and considering the accuracy of the technology utilized in collecting the spatial component of the data. Comparison efforts may include analyzing changes in the length of riverbank shoreline experiencing erosion, severity of erosion, length of riverbank stabilization, success of erosion remediation efforts, identification of new erosion areas, etc.

The FRR will include mapping and description of riverbank features and characteristics where active or recent bank erosion is occurring at the time of the field work. Areas of erosion adjacent to previous bank stabilization will be identified and discussed in context of the type of stabilization utilized. Additionally, land-use practices that are related to riverbank erosion processes will be mapped as part of the land-based component of the FRR.

Sediment classification of the upper and lower riverbanks is included in the matrix of features and characteristics, with maps showing location and extent of the range of sediment types included in the FRR. Sediment classification is sub-divided into 6 key categories ranging from clay, silt/sand, up through boulders and bedrock; allowing easy understanding of which areas consist of erodible soils and which are not – including the location and extent of bedrock.

Task 4: Develop Final Report and Mapping

Following post processing and analysis of field data, a final report documenting the methodology and results of the 2013 FRR study will be generated, including discussion of summary statistics and comparisons over time with previous FRRs. In addition, maps will be generated in ArcGIS delineating all features and characteristics captured during field efforts and summary maps. Maps will be made available digitally as well as in the final report.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort defined above is adequate to conduct a comprehensive full river reconnaissance study. The estimated cost for this study is between $200,000- $250,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

FirstLight is proposing to conduct the field component of this study in the fall (ideally November 2013) during leaf-off conditions. Based on the ILP schedule, and assuming there is no dispute with this particular study, FERC would issue its study plan determination letter by September 12, 2013. This would allow sufficient time to conduct the November 2013 FRR. However, if an agency with mandatory conditioning authority disputes this particular study, FERC would not issue its study plan determination letter until December 11, 2013. Thus, FirstLight would have to delay conducting the 2013 FRR until November 2014.

3.1.2 Northfield Mountain/Turners Falls Operations Impact on Sediment Transport

General Description of Proposed Study

This study was requested by the MADEP; however, several other stakeholders (FRCOG-2[5], CRWC-2, FCD-2, Town of Gill-2, and LCCLC-2a) had a similar study request containing many of the same study objectives and elements as the MADEP. The latter group requested the same study entitled: "*Study the Impact of Operations of the Northfield Mountain Project and Turners Falls Dam on Sedimentation and Sediment Transport in the Connecticut River*". FirstLight is addressing many of their study objectives/elements in this study; however, those study objectives/elements not proposed are summarized in Section 4.0 Studies Not Included in the PSP- see Study No. 4.1.2.

The study calls for evaluating the causes of erosion in the Turners Falls Impoundment, determining if they are related to project operations, and identifying measures to stabilize the sites. In addition, the study calls for evaluating options to minimize sediment transport through the upper reservoir and power canal.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The study goals include:

- Assess management measures available to minimize sediment transport through the Turners Falls Canal and from the Upper Reservoir at Northfield Mountain during and after maintenance drawdowns; and

- Conduct a focused investigation of bank instability in the Turners Falls Impoundment where there is a causative relationship between the presence of fine-grained soils susceptible to instability due to water level fluctuations associated with hydropower operations.

The study results should provide information sufficient to understand current and proposed effects of water level fluctuations, both natural and anthropogenic, and to identify sites where biostabilization techniques or other measures may be beneficial to water quality. The purpose of the study is to focus attention and resources on that fraction remaining as per the PAD of the river banks within the Turners

[5] The "-2" refers to the stakeholders' study request number.

Falls Impoundment which are scientifically established to be susceptible to erosion due to repeated soil wetting and drying.

The specific objectives include:

a. Accurately map and scientifically describe that portion of the Turners Falls Impoundment where active or recent "bank" "erosion" is occurring (maybe as much as 18% of the banks in the Turners Falls Impoundment)—all terms should be precisely defined, and linked to jurisdictional definitions, whenever possible;

b. Note any of the areas of active or recent bank erosion that have been the locus of prior bank stabilization and identify the method of stabilization implemented at that locus;

c. Within the mapped areas of active or recent bank erosion, establish and designate fixed, recoverable transects; Transects should be representative of various reaches and utilize, to the extent practicable, existing data.

d. Analyze soils (classification, structure, parent materials, texture, hydric regime, position on landscape, chemistry, and most importantly engineering dynamics such as susceptibility to slope failure) at each transect;

e. Along these same transects collect cross-section data related to bathymetric and riverine hydrology, most especially as they relate to jurisdiction and water level fluctuation. Determine the precise elevation of the Ordinary High Water Mark (OHWM), normal impoundment elevation, maximum and minimum daily range elevations. Evaluated the subsurface hydrology at each transect, but above OHWM, to account for groundwater influences on soil slumping.

f. Once the initial data is collected and organized, a geotechnical engineer will evaluate field data plotted at each cross section on various transects to analyze conditions of slope instability and erosion. This analysis will focus on slope conditions, relative susceptibility of bank failure due to repeated wetting and drying. Soil engineering analysis e.g. slope stress, failure planes, shear stress, "Plasticity Index" and "Erosion Factors", would help guide direction of the stabilization efforts. Of special concern is to analyze all causes for slope instability, and to separate out those locations where repeated wetting and drying is a primary factor. This analysis should investigate site soils within the range of daily fluctuation of water levels extending up to and including the capillary zone. All water level data and soil hydrology should be plotted on cross sections to allow for proper analysis.

g. Map land use practices that are directly observationally linked to bank erosion directly beneath and/or proximate to them, and target these areas for employment of best management practices;

h. Superimpose on the 18% of the impoundment which comprises the "study area" a "sensitive receptors" overlay, which will map in detail the position of bank-nesting bird species, rare species occurrences, "vegetated shallows", and other sensitive and agreed to factors which might make such sites less preferable as locations for biostabilization, in favor of less sensitive sites;

i. Transects will then need to be periodically revisited and data collected, for use in determining progression of relative erosion at each, the effectiveness of biostabilization at transects where this technique has been employed, and potential differences in soil profiles at different transects to withstand repeated, daily wetting and drying.

j. Determine through accurate, repeatable, scientifically based mapping what fraction of the banks of the impoundment are susceptible to or experiencing erosion due to repeated wetting and drying of the soil column; eliminate all other "banks" within the impoundment from further erosion study, including areas in which bedrock predominates; soils/substrates are presently stable; or where hardscape stabilization has already been installed.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The 2012 Integrated List of Waters shows the segment from VT/NH state line to the Turners Falls Dam (MA34-01 and MA34-02) as impaired and considered "*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 also shown as impaired by these causes as well as total suspended solids. MADEP notes that the requested studies will assist it in issuing a Water Quality Certification that complies with the State and Federal Clean Water Acts.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Extensive research has been conducted evaluating the causes and effects of erosion along the Connecticut River in the Turners Falls Impoundment; such research includes:

Connecticut River Joint Commissions and Trails Conservation Assistance Program of the National Park Service through the Connecticut Valley Partnership. (1996) *River Dynamics and Erosion.* Authors.

Field Geology Services. (2004). *Fluvial Geomorphology Assessment of the Northern Connecticut River, Vermont and New Hampshire.* Farmington, ME: Author.

Field Geology Services. (2007). *Fluvial Geomorphology Study of the Turners Falls Pool on the Connecticut River between Turners Falls, MA and Vernon, VT*. Farmington, ME: Author.

Simons & Associates. (1998). *Erosion Control Plan for Turners Falls Pool of the Connecticut River (Draft).* Western Massachusetts Electric.

Simons & Associates. (1998). *Long Term Riverbank Plan for the Turners Falls Pool of the Connecticut River.* Author.

United States Army Corps of Engineers. (1979). *Connecticut River Streambank Erosion Study Massachusetts, New Hampshire, Vermont.* Author.

Woodlot Alternatives. (2007). *Connecticut River Hydraulic Analysis Vernon Dam to Turners Falls Dam.* Author.

In addition, the following information is available to help inform this study:

- Bathymetric mapping of the Turners Falls Impoundment was completed in 2006 and bathymetric mapping of the upper reservoir was completed in 2010, 2011 and 2012.

- On January 22, 2013, FirstLight filed with FERC plan maps showing the location of 22 transects located in the Turners Falls Impoundment. Also provided were cross-section plots of these transects that have been surveyed twice annually since 1998. It is unclear at this juncture whether any of the 22 transects could be used as part of this study as further assessment is needed to determine if any of the 22 transects are in locations where erosion is caused by water level fluctuations due to hydropower operations.

- Section 4.2.3 of the PAD contains a discussion of soil types and mapping from Vernon Dam to the Cabot tailrace including the identification of the ten most common soil series found in the Project boundary (PAD Table 4.2.3-1). Soils maps along the riverbanks were included in the PAD. Included as part of FERC's AIR (see Section 2.0) for the top ten most common soils, FirstLight has included in Appendix C[6] the following other data that will help support MADEP study objective (d):

    - Relative to soil chemical properties: depth, cation-exchange capacity, effective cation-exchange capacity, and pH.

    - Relative to soil physical properties: percent sand, silt, and clay, moist bulk density, saturated hydraulic conductivity, available water capacity, linear extensibility, organic matter and erosion factors (Kw, Kf, and T).

- FirstLight maintains paper copies of their log sheets that include hourly data on flows, water elevations and generation. For the period 2000-2009, FirstLight has converted the paper copies to electronic data. The following data is available that will be of assistance in this study.

    - Relative to flows, FirstLight has Vernon discharges, and adds to this USGS flows as recorded at the Ashuelot and Millers River to estimate total inflow. FirstLight also has estimated flows passed through the gatehouse and estimated flows passed over the Turners Falls Dam.

    - Relative to water levels, FirstLight maintains water level recorders on the same vertical datum in the Turners Falls Impoundment at the following locations a) immediately below Vernon Dam, b) directly below the Northfield Mountain tailrace, c) at the boat barrier buoy line approximately 1,500 feet upstream of the Turners Falls Dam and d) at the Turners Falls Dam (see Figure 4.3.1.3-1 in PAD for locations).

- FirstLight also maintained water level recorders on the same vertical datum for approximately the period May 1 through mid-August at two additional locations in the Turners Falls Impoundment --at West Northfield Road (near the VT/NH/MA border) and at the Route 10 Bridge (see Figure 4.3.1.6-1 in PAD for locations).

- Two hydraulic models of the Turners Falls Impoundment are available using the 2006 bathymetry including a steady-state one-dimensional HEC-RAS model and a two-dimensional RIVER2D model. FirstLight recently used the HEC-RAS model to evaluate at what flow hydraulic control of the river shifts from the Turners Falls Dam to the French King Gorge. The analysis also demonstrated that the upstream influence of the Turners Falls Project extends to approximately 9,000 feet below the Vernon Dam. This analysis was filed with FERC on February 22, 2013.

- Past reports contain significant background information on the geomorphic history of the Connecticut River, which provides some context.

- Pressure transducers were used to measure water level fluctuations in the river and groundwater near Bennett Meadow on the west bank just below the Route 10 Bridge. One transducer was placed in the river, and three (52 ft, 65 ft and 210 ft from the river) were placed in monitoring wells along a line perpendicular to the riverbank. The field work was conducted from mid-July

[6] The soil information was obtained from the United States Natural Resources Conservation Service.

1997 through February 1998. These data provide information on the groundwater elevation and hydraulic gradient.

- Hydraulic (near shore velocity), bank material sampling, and suspended sediment sampling was conducted over a range of flow conditions from 1997 through 2011. These data provide information on velocity, hydraulic shear stresses, particle size distributions, and sediment transport.

- Data on boat waves was collected on July 12-13, 1997 and July 26-27, 2008. At several locations, temporary staff gages were installed to document wave amplitude and frequency using videotape. Suspended sediment samples were also collected in the area where the waves impacted the shoreline.

- Two reports addressing riverbank erosion were filed with FERC on January 8, 2013 as follows:

    - Simons & Associates. (2012). *Riverbank Erosion Comparison along the Connecticut River*. Prepared for FirstLight. Midway, UT: Author.
    - Simons & Associates. (2013). *Analysis of Erosion in Vicinity of Route 10 Bridge Spanning the Connecticut River*. Prepared for FirstLight. Midway, UT: Author.

- One goal is an assessment of management measures to minimize sediment releases from the upper reservoir during maintenance drawdowns. On July 15, 2011, FirstLight filed a *Sediment Management Plan* for the Northfield Mountain Project. The plan was filed in response to FERC's directive requiring measures to avoid or minimize entrainment of silt into the project's works during drawdown of the upper reservoir. The original plan has since been modified, in consultation with the MADEP and FERC, and calls for FirstLight to continuously record suspended sediment concentrations at the Route 10 Bridge and at the Northfield Mountain Project (both water used in pumping and generating). In addition, the plan called for annual bathymetric mapping of the upper reservoir to document changes in sediment accumulation or transport. At the end of each year FirstLight files with the FERC the study findings. The most recent report was filed with FERC on November 30, 2012. FirstLight is implementing the plan over a 4-year period, concluding with a final report to FERC by December 1, 2015. Based on the study findings, FirstLight will evaluate alternatives for sediment management in the upper reservoir during maintenance drawdowns. The suspended sediment concentration data and bathymetric surveys of the upper reservoir are available for this study.

Project Nexus (18 CFR § 5.11(d)(4))

The Connecticut River in the Turners Falls Impoundment is impacted by three hydroelectric projects which discharge or draw water from the river for hydropower generation. These Projects are (from downstream to upstream): the Turners Falls Project, Northfield Mountain Project, and Vernon Hydroelectric Project. All three Projects can operate as peaking facilities when flows are within the hydraulic capacity of the facilities, which can directly impact water level fluctuations in the Turners Falls Impoundment. When flows exceed the hydraulic capacity of the Vernon and Turners Falls Projects, the projects are operated as a run-of-river project.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Data Gathering and Background Mapping

Data Gathering

Extensive research and data gathering efforts have been conducted within the Turners Falls Impoundment over the past several decades which will assist in this study. Existing data includes: hydrology, water elevation data, suspended sediment measurements, hydraulic modeling, and previous FRRs.

Background Mapping

Prior to conducting any field work, geo-referenced aerial imagery of the Turners Falls Impoundment will be developed in GIS and uploaded to pentop computer so that the geographic extents of active or recent bank erosion can be noted directly in the field. Also, separate GIS layers showing soil mapping and land use classification will be loaded along with the aerial imagery to allow personnel conducting the field assessment with quick reference data.

Task 2: Geomorphic Understanding of Connecticut River

It is important that the study include background of the geomorphic setting of the Connecticut River. This task would entail summarizing, as part of a larger report, the historic and modern geomorphology of the Connecticut River to provide readers with context. In addition, it would include background on the dynamic nature of alluvial rivers. More specifically, FirstLight will document causes of riverbank erosion that occur within a river corridor even if the river is not subject to rising and falling water levels due to hydropower operations. Causes or erosion include natural processes such as naturally high flow events as well as anthropogenic influences unrelated to hydropower operations.

Task 3: Evaluation of Water Elevation and Flow Data

The purpose of this task is to document the normal, maximum and minimum Turners Falls Impoundment elevation at four locations in the impoundment. This task is not intended to fully replace Objective (e) of the study that requests minimum, maximum and critical elevation data along the transects where active or recent erosion is field-documented. Rather it will provide a sense of the timing, magnitude, and duration of water level fluctuations that is occurring at four locations in the impoundment due to hydropower operations and naturally high flows.

As noted in the existing information section, FirstLight has hourly water elevation and flow data within the Turners Falls Impoundment for a 10-year period of record (2000-2009). Using the hourly data for this period of record, the following graphs and statistics will be developed for the four long-term water level recorders in the Turners Falls Impoundment:

- A table will be developed showing the monthly (and annual) minimum, maximum, median and average impoundment elevation at the four locations.

- Elevation duration curves have already been developed using the 2000-2009 data for the four long-term monitoring locations (see Section 4.3.1.6 and Appendix E of the PAD). The elevation duration curves provide background on the range of fluctuation.

- Ten graphs will be developed for each year between 2000 and 2009. Each graph will include the hourly water elevation for the four locations along with the flow estimated at the dam (which will

be a sum of the flow passed to the gatehouse and that passed below the Turners Falls Dam, as recorded on the log sheets). Also shown on these same graphs will the flow as recorded at the USGS gage in Montague City, MA. This will provide background information on the relationship between the magnitude of streamflow and impoundment elevations.

In addition to water elevation data, the following flow information will be evaluated.

- Flow data from the Montague City USGS gage will be used to provide context on the magnitude, timing, frequency and duration of flows. Mean daily flows from this gage will be prorated, based on a ratio of drainage areas, to represent flow at Turners Falls Dam. As shown in the PAD, annual and monthly flow duration curves have been developed. FirstLight will develop a mean daily average annual hydrograph for the period after several USACE flood control facilities were constructed, to understand the magnitude of flow throughout the year, relative to the hydraulic capacity to the Project. In addition, using the post-USACE instantaneous peak flow data, a flood frequency analysis (Log Pearson Type III) will be conducted to predict the 2-, 10-, 50- and 100-year flood flows at the Turners Falls Dam. This information will be used for the hydraulic modeling assessment as described below.

- FirstLight records on an hourly basis the Vernon Dam discharge and the magnitude of generation or pumping (MW) at the Northfield Mountain Project. The Northfield pumping and generating data will be converted to flow based on MW versus cfs curve. For select periods of record representing high and low flows, weekly graphs (on an hourly basis) will display the flow at these two locations, along with the water elevation data recorded at the four long-term water monitoring gages for the same period of record. The purpose of this evaluation is to gain a better understanding of the contributions of water level fluctuations in the impoundment due to Vernon discharges, Northfield Mountain Project operations and both facilities.

Task 4: Hydraulic Model of Turners Falls Impoundment

A hydraulic model (HEC-RAS) of the Turners Falls Impoundment is available to assist with this study and can provide valuable information. In Objective (e), the precise elevation of the minimum, maximum and normal impoundment elevations, OHWM, and min/max daily ranges at those locations where erosion is occurring is sought. FirstLight believes that the hydraulic model, once calibrated to observed elevations as recorded at water level monitoring locations, could be used to predict the min/max, and normal pond elevations, recognizing that it will not fully replace field-based physical measurements.

As described in Study No. 3.2.2 *Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station*, FirstLight is proposing to calibrate the existing hydraulic model to observed Turners Falls Impoundment elevation data. Specifically, the goal is to simulate a few steady flow conditions (high flow and low flow) where flow throughout the length of the impoundment remains relatively stable and compare the model predicted elevation at the four long-term monitoring locations (and two gages installed in 2012) with observed elevation data. If the model reasonably reflects the observed water surface profile along the impoundment, it could be used to simulate a range of flows and range of downstream boundary conditions- in this case the water elevations at Turners Falls Dam.

In addition to the HEC-RAS model, the RIVER2D model yields information on the relationship between flow and near-bank velocity. RIVER2D modeling will be used to analyze near-bank velocity to determine shear stress along the bed and banks of the river. Analyzing near-bank velocity will be particularly useful in any future stabilization designs in areas identified in the field as active or recent bank erosion.

Task 5: Map and Describe Active or Recent Bank Erosion

FirstLight proposes to engage the following personal to conduct the study: a) a fluvial geomorphologist and professional engineer having specific expertise in hydrology, hydraulics, fluvial geomorphology, and sediment transport, b) a geotechnical professional engineer having specific experience with riverbank stabilization projects, c) an environmental scientist having experience with habitat needs for bank swallows and identifying "sensitive receptors, and d) other support staff. This field team will boat the Turners Falls Impoundment shoreline to conduct the following:

- Accurately map the start and end of any active or recent bank erosion sites (MADEP Objective (a)).

- Document any areas of bank erosion that have been the locus of prior bank stabilization and identify the method of stabilization implemented. The intent here is to learn from potential past stabilization projects that were unsuccessful such that future stabilization on river banks with similar features considers alternative methods (Objective (b)). A detailed review of all previously stabilized sites will be conducted. Specifically, several feet of shoreline has been stabilized over the decade using various techniques, some considered experimental. FirstLight wants to know what stabilization measures have or have not been successful. Based on this, it will help inform any potential future stabilization projects identified as part of this field study.

- Within the mapped areas of active or recent bank erosion, establish fixed, recoverable transects (Objective (c)). This will require establishing vertical and horizontal control at two benchmarks set back from the top of bank. By establishing monumented controls on the left and right banks, the endpoints will be fixed and, future cross-section surveys can be readily compared.

- Within the mapped areas of active or recent bank erosion, map land use practices that are directly observationally linked to erosion directly beneath and/or proximate to them (Objective (g)). Determine if the active or recent bank erosion is partially or fully attributable to land management practices adjacent to the river banks.

- Within the mapped areas of active or recent bank erosion, document any "sensitive receptors" such as specific locations of bank-nesting bird occurrences, "vegetated shallows" and other sensitive factors (Objective (h)). There may be instances where erosion is occurring, but stabilization may not the best option if the eroded area provides particular types of high value habitat.

- At each of the transects within the active or recent bank erosion site, analyze the soils including: classification, structure, parent materials, texture, hydric regime, position on landscape, chemistry and most importantly engineering dynamics such as susceptibility to slope failure. Much of the information listed above can be obtained from previous sources; however, the fluvial geomorphologist and geotechnical engineer must collectively document observed soils in area of erosion (Objective (d)).

Task 6: Causes of Erosion

At each transect and erosion site documented above, the fluvial geomorphologist and geotechnical engineer will collectively evaluate the cause or causes of riverbank erosion. The erosion could be due to a single source or combination of sources. Potential causes of erosion could include:

- Hydraulic shear stress due to flowing water

- Water level fluctuations due to hydropower operations
- Boat and wind waves
- Land management practices
- Seepage and piping
- Freeze-thaw
- Ice or debris
- Animals such as nesting burrows
- Anthropogenic influences to the riparian zone (e.g., removal of riparian vegetation, cattle grazing to the river's edge, heavily traveled recreation trails

In the report, the potential causes of erosion will be summarized. The fluvial geomorphologist and geotechnical engineer will determine if the susceptibility to bank failure is due to a) water level fluctuations due to hydropower operations, b) a combination of water level fluctuations due to hydropower operations in combination with other causes or c) other causes (Objective (f)).

The fluvial geomorphologist and geotechnical engineer will collectively look at all of the available data gathered above (plasticity index, soils maps, water level data, etc.) to make the determination as to whether the slope instability and/or erosion is caused (in whole or in combination with other factors) by hydropower operations.

Task 7. Identify Bank Stabilization Projects

Based on the information obtained for the field study and in-house work, FirstLight will identify bank stabilization projects within the Turners Falls Impoundment where a causal relationship to water level fluctuations due to hydropower operations can be determined.

Task 8: Upper Reservoir Drawdown Sediment Transport

As noted above under the Existing Information section, FirstLight is currently in the process of conducting a 4-year study as part of its *Sediment Management Plan*. The study includes a) continuously measuring suspended sediment concentrations at the Route 10 Bridge and at the Northfield Mountain Project (both water used in pumping and generating), and b) annual bathymetric mapping of the upper reservoir to document changes in sediment accumulation or transport. Suspended sediment monitoring is being performed year-round within the Northfield Mountain intake tunnel, and seasonally (spring-fall) in the Connecticut River. The most recent report was filed with FERC on November 30, 2012. Additional reports are anticipated to be filed on December 1 2013 and 2014. Per the *Sediment Management Plan* the final report will be filed with FERC by December 1, 2015. In the final report, FirstLight will evaluate practical strategies to minimize the release of accumulated sediment through the Northfield Mountain Project works during upper reservoir dewatering activities.

Task 9: Turners Falls Power Canal Sediment Transport

To drawdown the power canal, FirstLight uses the Cabot turbines; the Cabot spillway gates or log sluice are not used. FirstLight has not observed sediment releases due to using the Cabot turbines to lower the canal elevation. However, other stakeholders have requested a study to evaluate the impact of using the Cabot spillway on re-suspending sediment located in the Connecticut River – likely at the base of the Cabot spillway-- on sturgeon spawning habitat. Two separate studies addressing these issues are included as Study No. 3.3.12 *Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station* and Study No. 3.3.18 *Impacts of the Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms*.

Task 10: Report

A comprehensive report will be developed and it is anticipated it will include the following sections:

- Executive Summary
- Introduction
- Geomorphology of the Connecticut River
- Evaluation of Water Level and Flow Data
- Evaluation of Boat Wakes
- Hydraulic Modeling
- Soil Mapping
- Field Study and Mapping
- Erosion Processes
- Causes of Erosion Attributable to FirstLight's Hydropower Operations
- Identify Bank Stabilization Project Attributable to FirstLight's Hydropower Operations
- Upper Reservoir *Sediment Management Plan* (note this study will not be completed until December 2015

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is between approximately $180,000 and $220,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The cover letter outlines the PSP meeting schedule. The purpose of the Study Plan Meeting will be to resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. A portion of the field work may be conducted in 2013 along with the FRR. However, it is likely that the bulk of this study will be conducted during leaf-off in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.2 Water Resources

3.2.1 Water Quality Monitoring Study

General Description of Proposed Study

Several stakeholder groups submitted a water quality study request to FirstLight. Water quality monitoring requests were received by MADEP, USFWS, CRWC, FRCOG, Town of Gill, LCCLC, VANR and NHDES.

The MADEP, USFWS, and CRWC study requests were similar and requested that the applicant conduct a water quality survey of the Turner Falls Impoundment, bypass reach, power canal, 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). MADEP, USFWS, and CRWC request that FirstLight collect continuous water temperature and dissolved oxygen (DO) data including biweekly DO and temperature profiles in the Connecticut River from April 1 through November 15, and monthly DO and temperature profiles within the upper reservoir from June through September. FirstLight is proposing continuous temperature and DO sampling, along with biweekly vertical profiles within the Connecticut River. As an alternative to periodic profile sampling in the upper reservoir, water quality from the Northfield Mountain Project discharge is proposed to be continuously monitored at the tailrace. These methods will be consistent with and therefore comparable to continuous data collected upstream and downstream of the tailrace, and can directly assess the impact of the discharge on water quality in the Connecticut River.

MADEP, USFWS, and CRWC also request that impoundment sediment adjacent to the Turners Falls Dam should be analyzed for metals and polychlorinated biphenyls (PCBs). As described in the existing information, benthic sediment was sampled in the Turners Falls Impoundment and upper reservoir in August 2010 as part of the USEPA consent order to inform FirstLight's dredging operations. The samples were analyzed for metals, organics, pesticides, and PCBs compared to MADEP regulatory standards. FirstLight is not proposing to conduct sediment sampling as part of this study.

Town of Gill, FRCOG, and LCCLC submitted similar requests for a water quality study, and included a request for monthly samples of total suspended solids and turbidity within the upper reservoir. FirstLight is not proposing to add turbidity or TSS to the water quality study plan because suspended sediment data are already being collected under FirstLight's *Sediment Management Plan* as described under Study No. 3.1.2 (see existing information section).

VANR and NHDES requested a more focused water quality study to determine if project operations are causing or contributing to violations of New Hampshire and/or Vermont state water quality standards. Their request for continuous data was linked to low flow periods and included additional parameters such as nutrients and chlorophyll a. FirstLight has proposed a sampling location in the Connecticut River upstream of the Massachusetts border which would be representative of inflow conditions to the Project. Sample parameters at this location will include temperature and DO, consistent with the sampling locations throughout the remainder of the Project study area. FirstLight is not proposing to collect data on nutrient parameters in the Connecticut River upstream of the Massachusetts border because these parameters are not consistent with MADEP's request and would not provide useful information if collected from a limited area.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The objectives of this study are to:

- Characterize water temperature and DO within the Turners Falls Impoundment, bypass channel, power canal, and below Cabot Station.
- Determine potential impacts of the Turners Falls Project and Northfield Mountain Project on water temperature and DO.
- Compare collected data with applicable state water quality standards.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The MADEP is responsible for issuing a water quality certification to FirstLight for the continued operation of the projects under Section 401 of the Clean Water Act. The MADEP has designated the Connecticut River as a Class B river for its entire length in Massachusetts, and is assigned the designated uses of habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation, 314 CMR 4.05(3)(b). The anti-degradation provisions of 314 CMR 4.04 require protection of all existing and designated uses of water bodies, and maintenance of the level of water quality needed to protect those uses.

The USFWS water quality goals are to: 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; and 2) Minimize current and potential negative project operation effects on water quality and aquatic habitat.

Part of the project area is within New Hampshire, and the NHDES establishes and administers surface water quality standards for New Hampshire; the Connecticut River within the New Hampshire portion of the project area is Class B water. The NHDES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained. The Connecticut River is also classified by the state of Vermont as Class B cold water fish habitat, which should be managed to achieve and maintain a level of quality that fully supports aquatic biota and habitat, although criteria for Vermont are, in some cases, different than New Hampshire.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Water Quality Data and Reports

A multitude of federal, state and local organizations have studied the water quality of the Connecticut River in the vicinity of the Projects, including the following:

Carr, J. W. & Kennedy, L. E. (2008). *Connecticut River watershed 2003 water quality assessment report* (Rep. No. 34-AC-2). Worcester, MA: Massachusetts Department of Environmental Protection, Division of Watershed Management.

Connecticut River Joint Commissions (CRJC). (2009). *Connecticut River management plan – Wantastiquet region.* Charlestown, NH: Author.

Deacon, J., Smith, T., Johnston, C., Moore, R., Weidman, R., & Blake, L. (2006). *Assessment of total nitrogen in the Upper Connecticut River basin in New Hampshire, Vermont, and Massachusetts, December 2002-September 2005* (Scientific Investigations Report 2006-5144). Reston, VA: US Geological Survey.

Donlon, Andrea. (2008). *Volunteer water quality monitoring program annual report 2007*. Greenfield, MA: Connecticut River Watershed Council.

Donlon, Andrea. (2009). *Volunteer water quality monitoring program annual report 2008*. Greenfield, MA: Connecticut River Watershed Council.

Hellyer, Greg. (2006). Connecticut River fish tissue contaminant study 2000 – Ecological and human health risk screening. North Chelmsford, MA: US Environmental Protection Agency, New England Regional Laboratory. Retrieved from: http://www.epa.gov/region1/lab/reportsdocuments/ctriverftr2000/

Hickey, K. & Shanahan, P. (2012). *Review of Vermont Yankee Thermal Discharge Permit Requirements and Analysis of Connecticut River Water Temperature and Flow*. Acton, MA: HydroAnalysis.

Matusky & Skelly Engineers. (1993). *Hydrodynamic and thermal modeling studies*. Berlin, CT: Northeast Utilities Services Company.

US Fish and Wildlife Service, Personal Communication, Ken Sprankle. Raw data of temperature monitoring in the Turners Falls Impoundment in 2010.

Need for Additional Water Quality Data

The state and federal resource agencies have requested a study of current water quality of the Connecticut River within the Project area. The results of the study should provide information sufficient to enable agencies to understand water quality conditions at the Project.

Sediment Contaminant Data

The resource agencies have requested that impoundment sediment adjacent to the Turners Falls Dam should be analyzed for metals and PCBs. FirstLight believes that recently collected data from the Turners Falls Impoundment contains sufficient data to address this issue.

Sediment was sampled in the Turners Falls Impoundment and upper reservoir in August 2010 as part of the USEPA consent order to inform FirstLight's dredging operations. The samples were analyzed for metals, organics, pesticides, and PCBs compared to MADEP regulatory standards. No detections were noted in any of the samples collected for PCBs and pesticides. Naturally occurring metals were detected in all of the samples at low levels below the residential soil standards, with the exception of nickel. Some nickel samples modestly exceeded the residential soil standards, but on average the nickel concentrations were below the residential soil standards. MADEP is currently seeking input on raising the regulatory standard for nickel. If the new standard is passed, the tested sediments will be well below the new nickel standard. In any event, it appears the nickel is naturally occurring and unrelated to project operations. If requested, the sediment sampling data will be made available.

Project Nexus (18 CFR § 5.11(d)(4))

Operation of the Turners Falls Project and Northfield Mountain Pumped Storage Project may directly impact water quality through the use of water for hydropower generation.

The investigation area includes the following:

- The 20-mile Turners Falls Impoundment extending from the base of Vernon Dam to the Turners Falls Dam.
- The Northfield Mountain Project Tailrace.
- The 2.7 mile long bypass from the Turners Falls Dam to the confluence with Cabot Station.
- The Turners Falls Power Canal.
- The Connecticut River downstream of Cabot Station.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

As recommended by the MADEP, water quality will be assessed in relation to project operations from spring through fall. 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. Two types of water quality sampling will be performed, including: 1) continuous temperature and DO monitoring, and 2) periodic vertical profiles of temperature and DO.

Task 1: Develop Sampling Plan

MADEP states that a proposed water quality sampling plan is to be submitted to MADEP for approval prior to sampling and should be developed in consultation with MADEP and USFWS. Once the FERC Study Plan Determination is issued, which would detail the elements of the water quality study, FirstLight will prepare a detailed sampling plan consistent with FERC's determination for review and approval by MADEP. The sampling plan will include quality assurances procedures to be followed during the study execution.

Task 2: Continuous Dissolved Oxygen and Temperature Monitoring

Temperature and DO will be continuously monitored every 15 minutes using *in situ* water quality meters at eight proposed locations within the project area (Table 3.2.1-1). The sampling locations are shown in Figure 3.2.1-1, Figure 3.2.1-2, and Figure 3.2.1-3. Continuous water temperature will be collected from April 1 through November 15. Continuous DO measurements will be collected from the same locations during the summer low flow, high temperature period from June 1 through September 30. Continuous meters installed in impounded waters will be suspended from a surface buoy and deployed to 25% of the depth of the sampling location. In the bypass reach, canal, and downstream sampling locations, the meters will be installed mid-channel, mid-depth, as practical.

Spot measurements of DO and temperature will be taken during deployment, bi-weekly site visits, and upon retrieval to verify meter accuracy. Field notes will be collected and weather and flow[7] conditions will be noted.

The water quality meters will be visited approximately bi-weekly, at which time data will be downloaded, the meter checked for calibration, and then re-deployed. The meter locations will be geo-referenced using GPS.

Task 3: DO and Temperature Profiles

To examine the vertical trends in temperature and DO within the Turners Falls Impoundment, a bi-weekly vertical profile of temperature and DO concentration will be recorded at the deepest location within the impoundment located downstream of the French King Gorge (Figure 3.2.1-4). Starting at the surface, measurements of temperature and DO will be collected at 1.0 meter depth increments; the depth of a thermocline or chemocline will be recorded. Bathymetric data indicate that this location is approximately 106 – 115 feet deep, depending on the water level within the impoundment. Vertical profiles will be collected bi-weekly starting in early April 2014 through mid November 2014, for a total of approximately 16 profiles, concurrent with Task 2.

Task 4: Report

A report will be prepared describing the monitoring methods and the results. An assessment of the potential effects of Turners Falls Project and Northfield Mountain Project operations on water quality will be discussed. For this assessment, FirstLight will provide hourly operations data during the duration of the continuous DO and temperature monitoring, including:

- Turners Falls Impoundment elevations as measured at the Vernon Tailrace, Northfield Mountain Tailrace, and Turners Falls Dam;
- Periods when Northfield Mountain is pumping, generating, or idle;
- Periods when Cabot Station and Station No. 1 are generating or idle;
- Discharges from Turners Falls Dam (spill), and;
- "Natural Routed Flow" through the Turners Falls Impoundment (estimate of flow at Turners Falls Dam).

The report will be submitted as part of the Initial Study Report as per the ILP process schedule. A tentative table of contents for the water quality report follows:

- Introduction
- Project Operations
- Hydrology and Weather Conditions
- Water Quality Monitoring Methods
- Water Quality Monitoring Results
- Discussion/Conclusions

[7] Flow conditions in the Turners Falls Impoundment will be based on the estimated discharge from the Vernon Hydroelectric Project, intervening inflow from the Ashuelot and Millers River USGS gages, estimated discharge over the Turners Falls Dam, and the Connecticut River at Montague USGS gage.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Projects on water quality in the investigation area. The estimated cost for this one-year study is between approximately $65,000 and $85,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

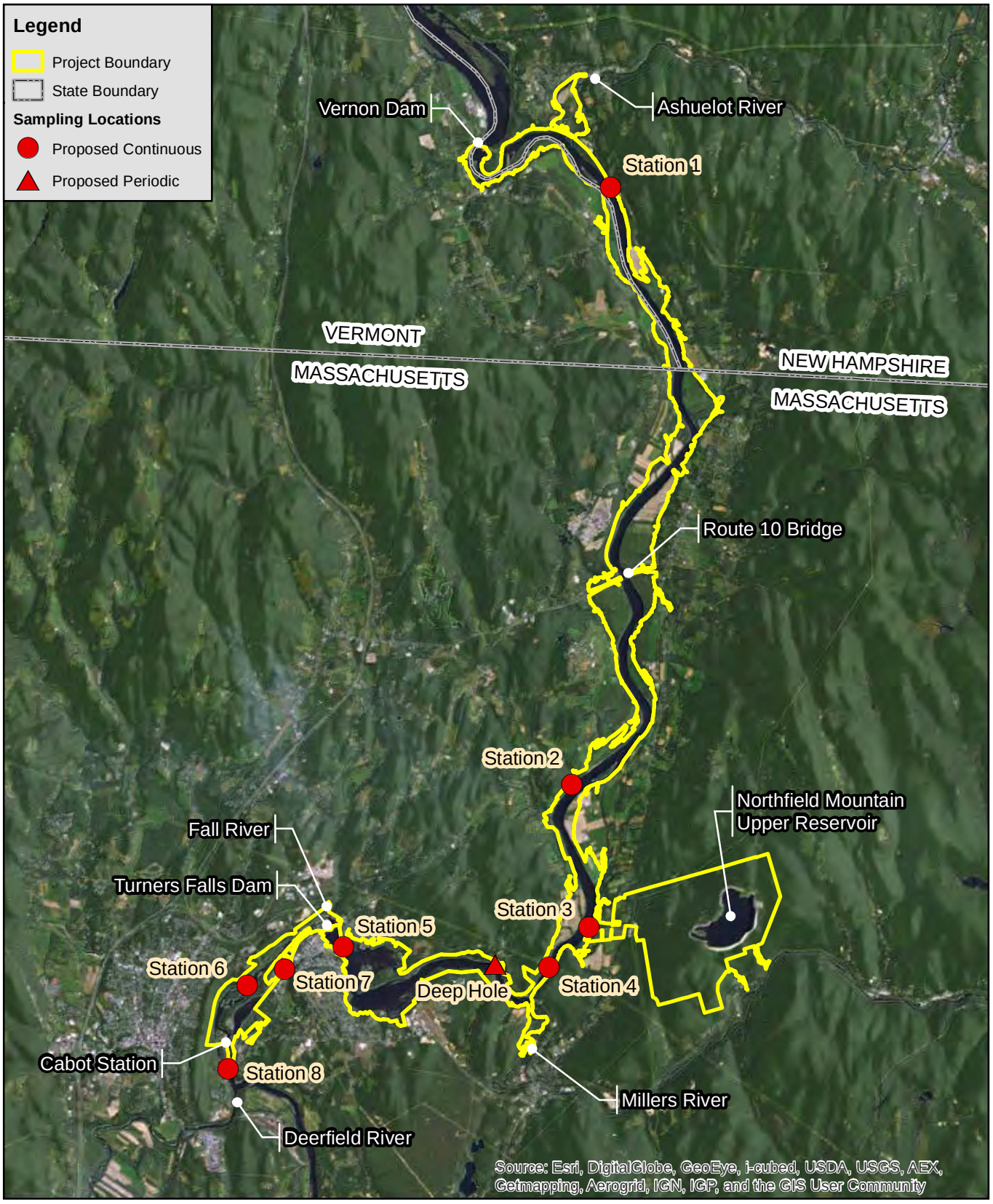
In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

A draft sampling plan developed under Task 1 will be provided to MADEP and USFWS in late 2013 once the FERC Study Plan Determination is issued. The sampling plan will provide more detail on the scope of work approved in the Study Plan Determination. Field work for this study is planned to occur from April through November 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Table 3.2.1-1: Proposed Water Quality Sampling Locations

Station No.	Location	Comments
	Connecticut River- Turners Falls Impoundment	
1	Below the Vernon Dam and Ashuelot River Confluence	Near thalweg at 25% depth
2	Above the Northfield Mountain Discharge; Downstream of Kidds Island	Near thalweg at 25% depth
3	Northfield Mountain Tailrace	Within the Northfield Mountain Tailrace at 25% depth
4	Below the Northfield Mountain Tailrace; Upstream of Millers River Confluence	Near thalweg at 25% depth
5	Upstream of the Turners Falls Dam at Boat Barrier	Near thalweg at 25% depth
	Connecticut River- Bypass Reach	
6	Within pool upstream of Rock Dam; downstream of Station No. 1	Mid-channel, mid-depth
	Turners Falls Power Canal	
7	At the 11th Street Bridge	Mid-channel, mid-depth
	Connecticut River- Below Cabot Station	
8	Below the Cabot Station tailrace, upstream of Deerfield River confluence	Thalweg, mid-depth.



FIRSTLIGHT POWER RESOURCES

Proposed Study Plan

N

0 1 2 4 Miles

Figure 3.2.1-1
Overview of Proposed Water Quality Sampling Locations

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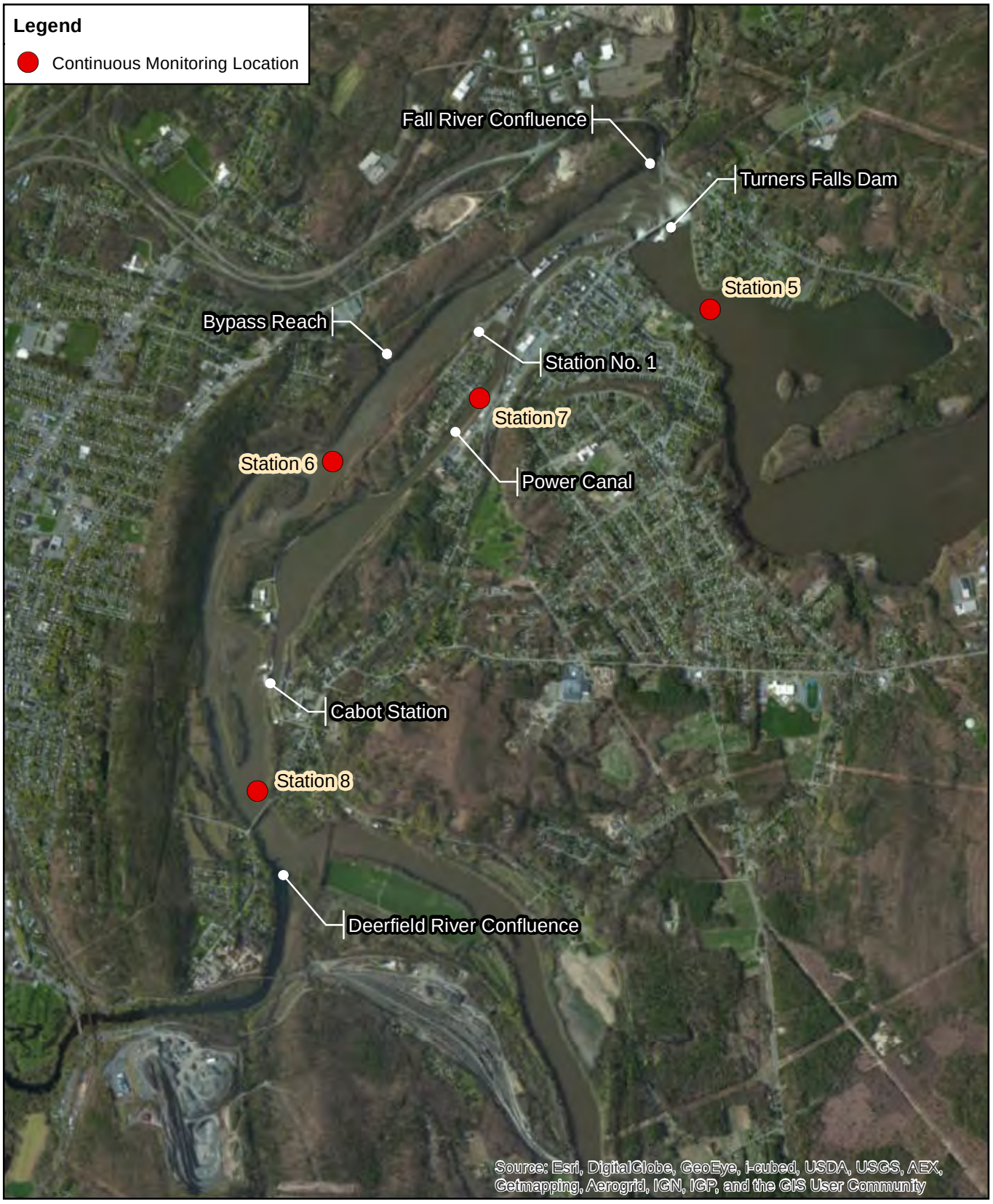


FIRSTLIGHT POWER RESOURCES

Proposed Study Plan

N

0 0.25 0.5 1 Miles

Figure 3.2.1-2
Proposed Water Quality Sampling Locations Near Turners Falls Dam

Path: W:\gis\maps\Study_Plans\Water Quality Study\Figure 3.2.1-2.mxd

FIRSTLIGHT POWER RESOURCES

Proposed Study Plan

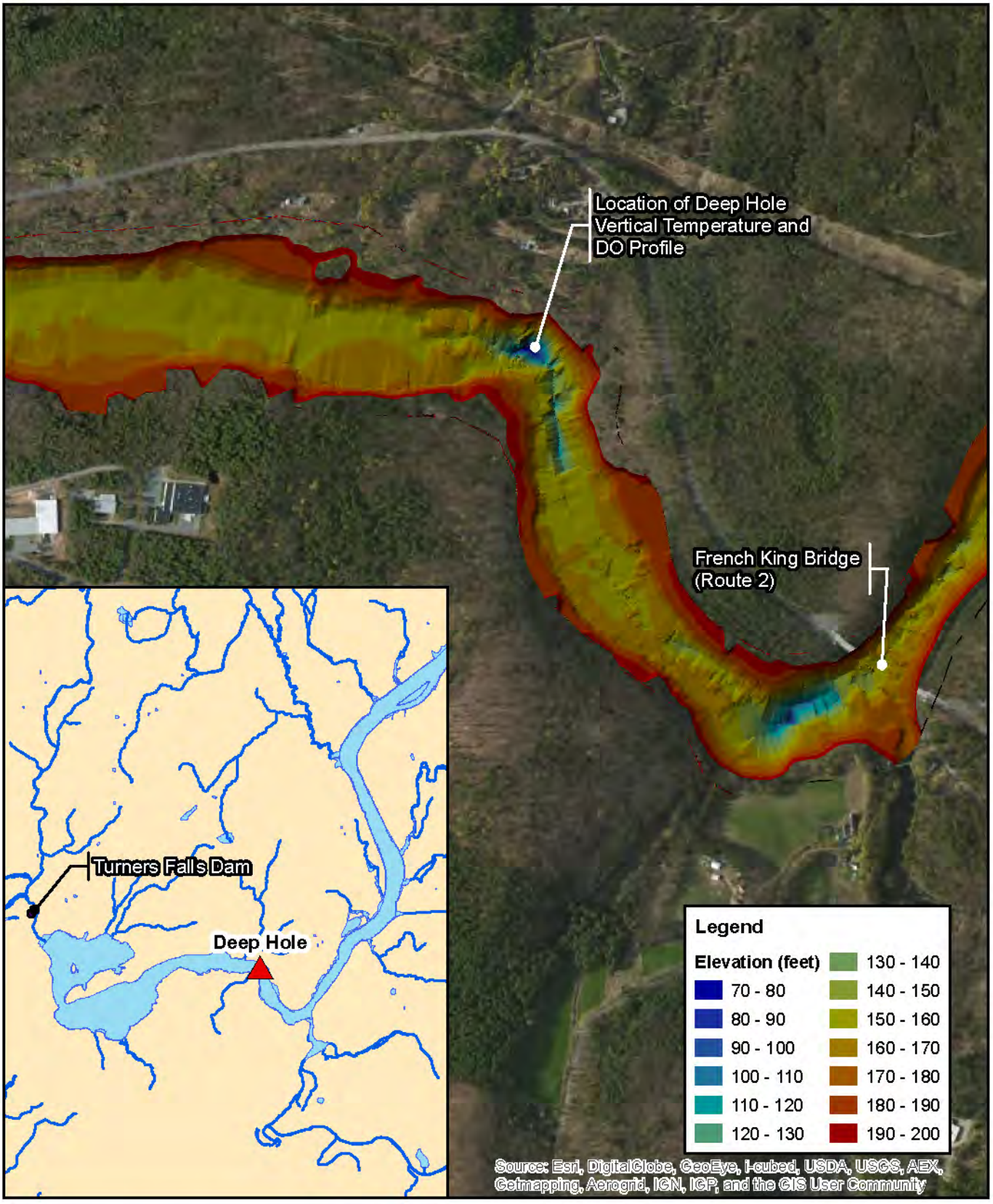
FirstLight Power Resources
GDF SUEZ

N

0 0.25 0.5 1 Miles

Figure 3.2.1-3
Proposed Water Quality Sampling Locations Near the Northfield Mountain Tailrace

Path: W:\gis\maps\Study_Plans\Water Quality Study\Figure 3.2.1-3.mxd



FIRSTLIGHT POWER RESOURCES

Proposed Study Plan

FirstLight Power Resources
GDF SUEZ

N

0 500 1,000 2,000 Feet

Figure 3.2.1-4
Turners Falls Impoundment Vertical Profile Location

Path: W:\gis\maps\Study_Plans\Water Quality Study\Figure 3.2.1-4.mxd

3.2.2 Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station

General Description of Proposed Study

Background

Numerous stakeholders requested studies to evaluate how water level fluctuations associated with the Turners Falls Project and Northfield Mountain Project impact various environmental, geologic and recreational resources. Those studies include:

- Study No. 3.1.2 *Northfield Mountain/Turners Falls Operations Impact on Sediment Transport.*
- Study No. 3.3.6 *Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the area of the Northfield Mountain and Turners Falls Projects*.
- Study No. 3.3.10 *Assess Operational Impacts on Emergence of State Listed Odonates in the Connecticut River*.
- Study No. 3.3.13 *Impacts of the Turners Falls Project and Northfield Mountain Project Operations on Littoral Zone Fish Habitat and Spawning*.
- Study No. 3.3.17 *Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitats*.
- Study No. 3.5.1 *Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species* (includes rare plants and tiger beetles).
- Study No. 3.6.6 *Assessment of Effects of Project Operation on Recreation and Land Use*.

Water level fluctuations in the Turners Falls Impoundment can be a function of:

- Hydropower operations including peaking releases from the Vernon Hydroelectric Project, Northfield Mountain Project Pumping and Generating Cycles, and peaking operations at the Turner Falls Project.
- Motorized boat wakes.
- Natural flow variability. More specifically, water levels in the Turners Falls Impoundment will naturally rise and fall when flows exceed the hydraulic capacity of the hydropower facilities.

Water level fluctuations below Cabot Station can be a function of:

- Peaking operations at the Turners Falls Project when flow is within the hydraulic capacity of the facility.
- Peaking operations of several hydroelectric facilities on the Deerfield River.
- Motorized boat wakes.
- Natural flow variability, when the hydraulic capacity of the Turners Falls Project is exceeded.

Study Description

FirstLight proposes to develop a hydraulic model of the Turners Falls Impoundment[8] and bypass reach, and of the Connecticut River below Cabot Station down to Holyoke Dam. The proposed hydraulic model is the one-dimensional HEC-RAS. The purpose of the hydraulic model is to determine for a given flow the corresponding water surface elevation (WSEL) at a given location within the river- typically at a transect that is included in the hydraulic model. In addition to predicting the WSEL for a given flow, the model also yields information on the river's depth and mean velocity at a given location (transect).

The HEC-RAS model can be run in both a steady state (flow is constant) and unsteady state (flow varies over time such as a hydrograph). FERC has requested that FirstLight develop an unsteady state HEC-RAS model in the Turners Falls Impoundment, bypass reach, power canal, and below Cabot Station to the upper limit of the Holyoke Impoundment. FirstLight proposes to develop two hydraulic models covering the a) Turners Falls Dam upstream to Vernon Dam and b) Turners Falls Dam downstream to Holyoke Dam. FirstLight maintains a nearly constant elevation in the power canal, except for periods of dewatering. The PAD contains supporting information on the limited fluctuation in power canal elevations (duration analysis of 10 years of hourly elevations). Given this, FirstLight does not believe a hydraulic model of the power canal is warranted.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The objectives of the hydraulic modeling study include:

- Provide WSEL (depth) and velocity information to help inform other environmental, geologic and recreation studies as listed above. For example, a study will be conducted to locate spawning substrate in the Turners Falls Impoundment. As part of that study, data will be collected on the depth to the spawning substrate. The hydraulic model will be used to assess whether Turners Falls Impoundment fluctuations could impact spawning substrate.

- An existing hydraulic model of the Turners Falls Impoundment will be used to determine the contribution of water level fluctuations in the Turners Falls Impoundment associated with operation of a) the Vernon Hydroelectric Project, b) the Northfield Mountain Project, c) the Turners Falls Project d) naturally occurring high flows, and e) all three projects operating collectively.

- An additional hydraulic model will be developed from the Turners Falls Dam downstream to Holyoke Dam to determine the contribution of water level fluctuations due to a) the Turners Falls Project, b) the Deerfield River Project, c) naturally occurring high flows and d) operations at Holyoke Dam. The rationale for extending the model to the Holyoke Dam is two fold. First the model requires a "downstream boundary condition". In this case the downstream boundary condition could be set at the FERC licensed range of allowable fluctuation at Holyoke Dam of 1.4 feet. The minimum and maximum FERC licensed fluctuation is 99.2 feet NGVD and 100.6 NGVD, respectively, at Holyoke Dam. The other reason for extending the model to Holyoke Dam is that operation (1.4 foot fluctuation) and hydraulic controls between Holyoke Dam and Rainbow Beach may influence water levels where the Puritan Tiger beetle is known to occur.

[8] As noted later, FirstLight has already developed a hydraulic model of the Turners Falls Impoundment and filed on February 22, 2013 a report. Based on the model findings, FirstLight will propose to reduce the current Project Boundary.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

FERC and many resource agencies requested studies to evaluate the impact of project operations – specifically water elevation fluctuations -- on environmental, geologic and recreational resources. This hydraulic modeling study will provide information on the relationship between water level fluctuations and project operations.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information- Turners Falls Impoundment Hydraulic Model

FirstLight has conducted numerous studies in the Turners Falls Impoundment related to erosion. One such study was conducted by Field Geology Services for use in studying fluvial processes/shoreline erosion in the Turners Falls Impoundment. To support the Field study, in 2006, a bathymetric map and two hydraulic models of the Turners Falls Impoundment were developed by Woodlot Alternatives Inc. (Woodlot) as summarized in the report entitled: *Connecticut River Hydraulic Analysis, Vernon Dam to Turners Falls Dam* (Woodlot, July 2007). The two hydraulic models include the one-dimensional HEC-RAS model, and the two-dimensional RIVER2D model.

As explained in FirstLight's report entitled: *Hydraulic Modeling Assessment of the Turners Falls Impoundment (*FirstLight, January 2013*)*[9], FirstLight updated the existing HEC-RAS model for use in evaluating the upstream influence of the Turners Falls and Northfield Mountain Projects. As noted in the report, the influence ends approximately 9,000 feet below Vernon Dam and thus FirstLight is proposing to modify its Project boundary. No new additional information is needed to develop a hydraulic model of the Turners Falls Impoundment.

Existing Information- FirstLight's Water Level Recorders (River Stage)

River stage and flow data at various locations are available to help calibrate hydraulic models. The following sections summarize the data available to assist in hydraulic model calibration.

As noted in the PAD, FirstLight maintains WSEL monitors[10] that record hourly at the following locations in the Turners Falls Impoundment:

- Immediately below Vernon Dam in the tailrace;
- In the Northfield Mountain tailrace;
- At the boat barrier located approximately 1,500 feet upstream of the Turners Falls Dam, and;
- At the Turners Falls Dam.

In addition to the long-term WSEL monitors noted above, for a portion of 2012, FirstLight maintained additional WSEL monitors as described in the PAD (Section 4.3.2.6 2012 Water Level Monitoring Baseline Study) at the following locations:

- In the Turners Falls Impoundment at the Route 10 Bridge and West Northfield Road;
- In the bypass channel above and below Station No. 1 (although the period of available data is limited due to vandalism);

[9] This report was filed with FERC on February 22, 2013.
[10] All of the FirstLight WSEL monitors are on the same vertical datum.

- In the Connecticut River below Cabot Station at the Route 116 Bridge and across from Rainbow Beach.

Existing Information- Additional Flow and Water Elevation Data

There are four USGS gages in the Project area as listed in Table 3.2.2-1.

Table 3.2.2-1: USGS Gages in Proximity to the Project Area

Gage No.	Gage Name	Drainage Area	Notes
01161000	Ashuelot River at Hinsdale, NH	420 mi^2	Drains into the Turners Falls Impoundment approximately 2.1 miles below Vernon Dam. A US Army Corps of Engineers Flood control facility is located above the gage (Surry Mountain Dam).
01166500	Millers River at Erving, MA	372 mi^2	Drains into the Turners Falls Impoundment immediately below the French King Bridge or approximately 3.9 miles upstream of Turners Falls Dam. A US Army Corps of Engineers Flood control facility is located above the gage (Birch Hill Dam).
01170000	Deerfield River near West Deerfield, MA	557 mi^2	Upstream of the gage are two seasonally operated reservoirs (Somerset and Harriman Reservoirs) and several peaking hydroelectric projects.
01170500	Connecticut River at Montague City, MA	7,860 mi^2	Located approximately 1,000 feet downstream from the Deerfield River confluence and approximately 0.74 miles below Cabot tailrace.

In addition to the USGS gages, FirstLight estimates flow at the following locations:

- Flow through the gatehouse is estimated based on the gate rating curves and head differential between the WSEL monitored at the Turners Falls Dam Impoundment elevation and Keith's Bridge located in the power canal.

- Flow passed by the Turners Falls Dam is estimated based on the Turners Falls Dam Impoundment elevation and the rating curves of the bascule and tainter gates.

Existing Hydraulic Model- Flood Insurance Studies

Flood Insurance Studies (FIS) of the Connecticut River are available through the Federal Emergency Management Agency (FEMA). The FIS is used to show the area of inundation under various flood flows such as the 100-year flood. FEMA developed hydraulic models of the Connecticut River, including the reach between Turners Falls Dam and Holyoke Dam. The most recent hydraulic modeling was conducted in the early 1980s and most likely used the USACE's HEC-2 model, the predecessor to HEC-RAS. FirstLight will secure the original HEC-2 input files, and convert them over to the HEC-RAS model to develop a hydraulic model of the reach between Turners Falls Dam and Holyoke Dam. As described below, FirstLight is proposing to reconstruct the hydraulic model developed by FEMA for use in this relicensing effort.

Instream Flow Study Transects

FirstLight is proposing to accelerate Study No. 3.3.1 *Conduct Instream Flow Habitat Assessments in the Bypass and below Cabot Station* such that field data is collected in 2013. As part of that study, FirstLight is collecting depth, velocity and WSEL data at transects locations yet to be determined. The field work

will also include measuring the total flow at these transects. The information collected for this study could be used to supplement the hydraulic model proposed below for the reach below Turners Falls Dam.

Upland Topography

To develop a hydraulic model, the topography of upland areas (river banks and floodplain) is needed, particularly when simulating flood flows. If upland information is needed, FirstLight will rely on the existing upland mapping obtained from USGS National Map Viewer- more specifically, the USGS 10 meter digital elevation model (DEM).

Need for Additional Information

As noted above, FirstLight needs to obtain the FIS hydraulic models developed for the reach between Turners Falls Dam and Holyoke Dam. The hydraulic models are likely in paper format and will require re-entering the data in HEC-RAS. FirstLight is proposing to re-develop the FIS hydraulic models in lieu of developing an original model for the following reasons a) the cost associated with conducting bathymetric mapping in the approximate 35-mile reach between Turners Falls Dam and Holyoke Dam is very expensive and b) re-developing the FIS hydraulic model will provide sufficient information on the relationship between river stage and flow and c) FirstLight installed water level monitors at two locations (Route 116 Bridge and at Rainbow Beach) in this reach during a portion of 2012 and there is also a long term water level monitor at the USGS gage at Montague. Thus, information is already available on the relationship between Turners Falls and Deerfield River Project operations and river stage.

Project Nexus (18 CFR § 5.11(d)(4))

Project operations result in water level fluctuations in the Turners Falls Impoundment and below Cabot Station. These fluctuations may have an impact on various environmental, geologic and recreational resources.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Connecticut River Hydraulic Model from Vernon Dam to Turners Falls Dam

Task 1: Update Turners Falls Impoundment HEC-RAS model

The existing Turners Falls Impoundment HEC-RAS model does not include major tributary inflows, namely the Ashuelot and Millers Rivers. To date, the HEC-RAS model has been used to predict the WSEL under a constant (steady) flow throughout the length of the impoundment- meaning the flow at the Vernon tailrace is the same as the flow at Turners Falls Dam. FERC has requested that the HEC-RAS hydraulic model be operated in an unsteady mode allowing for time varying flow. To simulate time varying flow, the model would require updates including the Vernon Hydroelectric Project discharge hydrograph and flows recorded at the Ashuelot and Millers Rivers USGS gages. In addition, the model will require updates to reflect when water is leaving the impoundment (Northfield pumping) and when water is added to the impoundment (Northfield generating).

FirstLight records on its log sheets hourly Vernon discharges, and Ashuelot and Millers River flows based on the USGS gages to estimate the naturally routed flow through the impoundment. In addition, the log sheets include the hourly magnitude (MW) of pumping and generating, which can be converted to flow using a ratio of design flow (cfs) to capacity (kW) for both pumping and generating (see page 4-33 of PAD).

Task 2: Model Calibration

The hydraulic model would be calibrated to measured WSELs (Vernon tailrace, Northfield tailrace, and Turners Falls Dam) in the Turners Falls Impoundment for select flows. The HEC-RAS model will be operated as steady state with no pumping or generating occurring at Northfield such that flow conditions through the length of the impoundment are relatively steady for several hours. FirstLight has developed a relationship between flow and travel time (in hours) through the Turners Falls Impoundment. As a guide, at flows less than 20,000 cfs, the travel time is approximately 10 hours, and at flows near 80,000 cfs, the travel time is approximately 4 hours. Ideal conditions would be if discharges from Vernon are relatively constant for 12+ hours and Northfield is idle. The HEC-RAS model will be operated for a given flow and the WSELs measured at FirstLight monitoring locations will be compared to the model results. If needed, calibration will consist of adjusting Manning n values (roughness) or adjusting contraction/expansion coefficients within reasonable measures such that the measured and modeled WSELs are reasonably close.

Task 3: Unsteady Flow Model

Once the model is calibrated, it will be updated to simulate unsteady flow conditions. In this case, time varying flows will be simulated to determine changes in the WSEL at select locations in the Turners Falls Impoundment. To evaluate the contribution of water level fluctuations from various sources sensitivity analyses will be conducted. For example, a time varying discharge hydrograph from Vernon Station will be simulated while the Northfield Mountain Project remains idle to determine the contribution of water level fluctuations caused by Vernon Station. Similarly, a constant discharge hydrograph from Vernon Station will be simulated while the Northfield Mountain Project is operated as a pump or generator. Finally, other combinations of flows and operating conditions at the facilities will be evaluated. Output from the model will include WSEL and average channel velocities[11] for various flows simulated.

Connecticut River Hydraulic Model from Turners Falls Dam to Holyoke Dam

Task 4. Contact FEMA and Obtain FIS Hydraulic Model

FirstLight will contact FEMA to obtain the FIS studies in those communities located between Turners Falls Dam and Holyoke Dam. Experience indicates that FIS studies conducted in the early 1980s were conducted using HEC-2, the predecessor to HEC-RAS. Note that the energy equations and computations between both models are the same, although HEC-RAS has more features and graphical displays. It is likely that the original HEC-2 input files are retained on microfiche. FirstLight will obtain the microfiche, and print out the input files. The input files contain the following information which will entered into the HEC-RAS model:

- Channel transect coordinates.
- Mannings “n” values.
- Distance between transects.
- Bridge geometry[12].
- Expansion and contraction coefficients.
- Flood flows.

[11] Note that HEC-RAS model can calculate velocities laterally across the transect based on conveyance. These velocities will reflect average velocities for the transect.
[12] FirstLight will contact MassDOT to obtain any bridge information (pier shape, low chord, etc.) to determine if the bridge data contained in the HEC-2 model reflects today’s bridge geometry.

Task 5. Development of HEC-RAS model and Model Calibration

The data on the printed input files will be entered into the HEC-RAS model. The FIS will be re-constructed and validated by simulating the 100-year flood flow to ensure that the HEC-RAS model output—specifically, the water surface profile—reasonably matches that shown in the FIS. Once the model reasonably matches the 100-year water surface profile, it will used to simulate various steady state flows similar to the methodology described above. For example, a relatively constant flow throughout the 35-mile long reach experienced during the period the FirstLight has WSEL data at the Route 116 Bridge and Rainbow Beach will be simulated. The measured WSEL at these two locations and at the Montague USGS gage will be compared to that predicted by the model. Similar to above, the model will be calibrated by adjusting Manning n values or expansion/contraction coefficients within reasonable measures.

As part of Study No. 3.3.1 *Conduct Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station*, FirstLight will be obtaining additional transect and geomorphic data to support this study. For those locations where transects are obtained, they too will be added into the HEC-RAS model. Also, Study No. 3.3.1 requires collecting stage discharge relationships at transects (final locations yet to be determined) that will be added into the model. These data, along with the WSEL monitoring data obtained in 2012 will be used to calibrate the model to observed WSELs.

Task 6. Unsteady Flow Model

Similar to Task 2 above, once the model is calibrated, it will be updated to simulate unsteady flow conditions. Time varying flows will be simulated to determine changes in the WSEL at select locations in the 35-mile long reach. To evaluate the contribution of water level fluctuations from various sources sensitivity analyses will be conducted. In this case, water level fluctuations could be a function of, or influenced by, the Turners Falls Project, the Deerfield River Project, and the WSEL maintained at Holyoke Dam (1.4 foot fluctuation permitted). For example, a time varying discharge hydrograph from the Turners Falls Project will be simulated while flows from the Deerfield River remain stable to determine the contribution of water level fluctuations caused by the Turners Falls Project. Similarly, a constant discharge hydrograph from the Turners Falls Project will be simulated while the Deerfield River Project discharges vary. Finally, other combinations of flows, operating conditions at the Turners Falls and Deerfield River Project, and starting downstream boundary conditions (Holyoke Dam elevation) will be evaluated. Output from the model will include WSEL and average channel velocities for various flows.

Task 7: Report

A comprehensive report will be developed to include the following:

- Introduction
- Project Layout
- Summary of Existing Data
    - Existing USGS Gage Flow
    - Flow in Power Canal and Passed at Turners Falls Dam
    - Water Level Recorders
- Hydraulic Modeling
    - Connecticut River between Vernon and Turners Falls Dams
    - Connecticut River between Turners Falls and Holyoke Dams
    - Steady State Modeling
    - Calibration

    - Unsteady State Modeling
- Findings
- References

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Projects on water level fluctuations. The HEC-RAS model of the Connecticut River between the Vernon and Turners Falls Dams is essentially complete with the exception of calibrating to observed WSELs and simulating unsteady flow conditions. More time will be spent developing the HEC-RAS model of the Connecticut River between Turners Falls and Holyoke Dams. The estimated cost of this study is between $70,000 and $90,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

Given that this study is not dependent on field work (with the exception of addition in transects from the instream flow study) it could be started after FERC issues its study plan determination letter.

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013, with detailed study plan specific meeting thereafter as noted in the cover letter. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.3 Fish and Aquatic Resources

3.3.1 Conduct Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station

General Description of Proposed Study

USFWS, NOAA, MDFW, NHFG, CRWC, TNC and TU requested that a habitat-based field study, such as the Instream Flow Incremental Methodology (IFIM) be conducted in the Turners Falls bypass reach and in the Connecticut River downstream of Cabot Station. An IFIM study is proposed to quantify the relationship between station operation and aquatic habitat.

FirstLight is proposing to conduct this study in 2013, in advance of the typical two-year study time frame allowed by the ILP (2014-2015).

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The purpose of the study is to assess the potential effects of the range of discharges from Turners Falls Dam, Station No. 1, and Cabot Station on wetted area and aquatic habitat suitability in the Connecticut River between Turners Falls Dam and Cabot Station (the bypass reach) and below Cabot Station downstream to the Route 116 Bridge in Sunderland, MA.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals identified are to:

- Determine an appropriate flow regime that will protect and enhance the aquatic resources in the bypassed reach between Turners Falls Dam and the Cabot Station discharge.

- Determine an appropriate flow regime that will protect and enhance the aquatic resources from the Cabot tailrace of the Turners Falls Project downstream to the Route 116 Bridge in Sunderland, MA.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

In 2012, aquatic habitat mapping and water level monitoring were conducted at the following locations:

Habitat Mapping

- In the Connecticut River bypass reach from Turners Fall Dam to Cabot Station, and;

- In the Connecticut River from Cabot Station approximately 30 miles downstream to a natural hydraulic control located in the vicinity of the Dinosaur Footprints Reservoir (see Figure 3.3.1-1).

Water Level Recorders

- From approximately late April 2012 through mid August 2012, FirstLight installed continuously recording water level loggers that measured the change in water elevations. Two loggers were placed in the bypass reach from Turners Falls Dam to below Cabot Station (although vandalism was an issue), and three loggers were placed below Cabot Station (at the existing Montague

USGS gage, at the Route 116 Bridge in Sunderland, and at Rainbow Beach in Northampton). See Figure 3.3.1-2 for a map showing the logger locations. All loggers were surveyed to a common datum to allow for comparison. Appendix E of the PAD contains weekly plots of the data obtained from these water level loggers.

The 2012 aquatic habitat mapping report entitled "*Aquatic Mesohabitat Assessment and Mapping"* prepared by FirstLight (2012) was filed with FERC on January 8, 2013. It also can be found on FirstLight's relicensing website at http://www.northfieldrelicensing.com.

Project Nexus (18 CFR § 5.11(d)(4))

Per the FERC license, FirstLight is required to release a continuous minimum flow of 1,433 cfs or inflow, whichever is less, below the Turners Falls Project year-round. FirstLight typically maintains the minimum flow requirement through discharges at Cabot Station and/or Station No. 1.

Per the FERC license, a continuous minimum flow of 200 cfs is maintained in the Connecticut River bypass reach starting on May 1, and increases to 400 cfs when fish passage starts by releasing flow through a bascule gate[13]. The 400 cfs continuous minimum flow is provided through July 15, unless the upstream fish passage season has concluded early in which case the 400 cfs flow is reduced to 120 cfs to protect shortnose sturgeon. A 120 cfs continuous minimum flow is maintained in the bypass reach from the date the fishways are closed (or by July 16) until the river temperature drops below 7°C, which typically occurs around November 15th. The 120 cfs flow release was determined in 1993 in consultation with MADFW, NMFS, and USFWS to ensure that an adequate zone of passage exists in the reach during the months when sturgeon may be present and require volitional movement.

Approximately 87% of the inflow to the Turners Falls Impoundment is controlled by discharges from the Vernon Hydroelectric Project. The majority of the remaining 13% percent of inflow to the Turners Falls Impoundment is from the Ashuelot and Millers Rivers. The Vernon Hydroelectric Project has a hydraulic capacity of 17,130 cfs, while the hydraulic capacity of the Turners Falls Project (Cabot and Station No. 1 combined) is approximately 15,938 cfs. When flows are within the hydraulic capacity of the Vernon Hydroelectric Project, inflows to the Turners Falls Impoundment reflect peaking discharges.

FirstLight operates the Turners Falls Project as a peaking facility when flows are in the hydraulic range of the Turners Falls Project and as a run-of-river facility when flows exceed the hydraulic capacity of the Turners Falls Project (15,938 cfs). The Northfield Mountain Project operates as a peaking project.

Project operations have the potential to influence aquatic habitat in the bypass reach and below Cabot Station. Based on water level monitoring studies conducted in 2012, it appears that hydraulic effects of peaking operations may extend downstream to Rainbow Beach, approximately 25 miles below Cabot Station; however, significant habitat effects attenuate rapidly below Sunderland, MA.

The Connecticut River immediately below Cabot Station has been identified as a major spawning area and overwintering area for the Endangered Species Act (ESA)-listed shortnose sturgeon. Other diadromous species such as American shad adults and juveniles, seasonally utilize habitat in this vicinity for spawning and rearing. American eels and Atlantic salmon seasonally rely on this reach as a migration corridor.

[13] The bascule gate used to pass the minimum flow is located at the Turners Falls Dam and is the one closest to the gatehouse.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Background

The scope of this study is to quantify the effects of Project flows on aquatic habitat suitability in the Connecticut River for the aquatic community and its managed fish resources, potentially including diadromous and resident fish species, and aquatic invertebrates. These data will then be used in conjunction with hydrologic, operational and other models to evaluate the costs and benefits of potentially providing alternate habitat-based flows to the Connecticut River in the study area.

Task 1: Consult with Agencies and Interested Stakeholders to Determine Study Area, Study Reaches, and Habitat Suitability Index Curves

Study Area

The Connecticut River segment between the Turners Falls Dam and the Route 116 Sunderland Bridge (Figure 3.3.1-1) was identified by the applicable state and federal fishery agencies (agencies) as the study area for purposes of the habitat based study. Flow in this reach is cumulatively influenced by discharges from upstream tributaries, hydroelectric projects in the upper Connecticut River, the Turners Falls Project and the Northfield Mountain Project. Additional discharges to the study area immediately below Cabot Station include the Deerfield River, which contributes approximately 665 square miles (mi^2) of additional drainage area. The Deerfield River includes several FERC-licensed hydroelectric projects operating as peaking facilities and two seasonal regulated storage reservoirs- Somerset and Harriman Reservoirs in Vermont.

An IFIM study is proposed to develop an understanding of key habitat suitability-flow relationships in the study area. This may be quantified by models such as Physical Habitat Simulation (PHABSIM) or its equivalent. The model(s) will be used to simulate habitat suitability at various flow increments representing selected anadromous and resident fish species, and aquatic biota (i.e., macroinvertebrates). One-dimensional (transect-based) and/or two dimensional (finite elements-based) hydraulic models are required to simulate river channel hydraulics in various areas of interest.

Consistent with IFIM protocol, a study team comprised of licensee and qualified fishery biologists will be formed for the purpose of making technical decisions regarding input parameters and review of study output. Specifically, that study team will collaboratively designate:

1. specific spatial and temporal habitat management goals,
2. boundaries of the study area and reaches,
3. locations of specific representative or critical study sites, and study site transects,
4. Habitat Suitability Index (HSI) criteria for applicable species and lifestages, and
5. calibration flows and range of flows to be assessed.

Study Reaches and Transect Selection (1-D and 2-D Modeling)

The proposed study methodology involves a phased approach beginning with review of recently-mapped mesohabitat distribution throughout the study area. The mapping and characterization of aquatic mesohabitat provides essential information regarding the extent, location, and composition of aquatic habitats that may be affected by Project operation.

Study reach boundaries are typically placed at significant breaks in geomorphic, hydrologic or habitat use in the study area (Bovee et al., 1998)[14]. The study team will consult to define study reaches and select applicable study sites within each reach, as well as cell boundaries and transects in areas of 1-dimensional (1-D) modeling within each study site.

Study sites may represent typical and/or unique but critical habitats within each reach. For 1-D model applications, the study team will select upstream and downstream cell boundaries within each study site based on localized observed shifts in stream width, cover, substrate, and hydraulics. The field crew will subsequently locate a transect within each longitudinal cell defined by the boundaries.

Based on preliminary discussions with the agencies, due to complex flow patterns near the islands above the Cabot tailrace, a 2-D model is proposed from the upstream end of the Rawson Island to just below the Deerfield River confluence (specifically at the USGS Gage at Montague).

Project operations and configuration affect flow and habitat in distinct ways. For this reason, four study reaches are recommended for modeling purposes (see an overview of locations in Figure 3.3.1-1 and a close-up of the bypass reach area in Figure 3.3.1-3). The following study reaches are proposed:

- **Reach 1. Upper Bypass Reach**. This reach is approximately one mile long extending from the Turners Falls Dam downstream to the confluence with the Station No. 1 tailrace. Habitat and flow in this reach are influenced by discharges from the Turners Falls Dam, attraction and fishway flows for the Spillway fish ladder and the Fall River (see Figure 3.3.1-3 for location). Stream channel structure and geomorphology are controlled primarily by bedrock. From the Turners Falls Dam to the just below the Fall River confluence, the bypass channel is quite wide and the thalweg poorly defined, before starting to narrow just upstream of the Station No.1 tailrace. Mesohabitat in this reach includes pool, run and riffle with bedrock overlaid with rubble and cobble substrates.

- **Reach 2. Lower Bypass Reach**. This reach is approximately two miles long extending from the Station No. 1 tailrace downstream, terminating at an island complex and a geological feature including a natural ledge drop known as "Rock Dam". Flow is influenced by both the net discharge from Reach 1, as well as Station No. 1, when generating. Stream channel structure is controlled primarily by bedrock. Reach 2 channel morphology is relatively well defined, and includes pool, run and riffle mesohabitats with bedrock overlaid with rubble and cobble substrates.

- **Reach 3. Tailrace Reach**. The tailrace reach extends from below the Rock Dam/Rawson Island complex downstream to the USGS Gage No. 01170500 at Montague, which includes the confluence with the Deerfield River. Habitat in this reach is influenced by flows from Reaches 1 and 2 as well as generation at Cabot Station including backwatering around the island complex upstream to the toe of Rock Dam. Stream channel structure is comprised of alluvial deposits, including a series of island and split channel complexes both upstream, across, and downstream from the Cabot Station powerhouse. Hydraulic effects are complex, and include backwatering from Cabot Station upstream to Rock Dam as well as flow between islands. Habitat is primarily riffle and run; substrate is dominated by gravel bars and cobble, and includes ledge outcrops at the General Pierce Bridge area.

- **Reach 4. Downstream Reach**. This reach extends from the Montague gage to the Sunderland Bridge (Route 116), which is where backwater influence of the Holyoke Project impoundment

[14] Differences in slope, geomorphology, substrate, and flow influence, suggest that four reaches may be justifiable.

generally is detected. Flow is primarily influenced by outflow from Reaches 1-3 and the Deerfield River. This section of river is alluvial and low gradient, with well defined channel and embankments, and repeating patterns of pool and run habitat. Substrate varies but is dominated by cobble, gravel and fines.

- **Reach 5.** This section of the river extends from the Project Boundary at the Route 116 Bridge to a natural hydraulic control located in the vicinity of Dinosaur Footprints Reservation. It is a low gradient, alluvial reach with limited mesohabitat variability and in many cases very gradual or subtle transitions from one mesohabitat type to the next contiguous type. Over 75% of the mesohabitat in this reach is comprised of run.

Habitat Suitability Index Criteria

FirstLight anticipates the use of habitat suitability index curves (HSI) curves adopted primarily from those previously used in support of recent PHABSIM models conducted at study sites with similar geomorphic and ecoregion characteristics. HSI curves will be obtained and reviewed for applicability, discussed, modified as necessary and approved by the study team. Based on preliminary consultation with agencies, FirstLight proposes to evaluate the following HSI criteria:

Study Reach	Species	Lifestage/criteria
Reach 1 and 2	American shad	zone of passage
	white sucker	zone of passage
	white sucker	spawning, fry, juvenile, adult
	fallfish	spawning, fry, juvenile, adult
	freshwater mussels	host fish zone of passage
	benthic macroinvertebrate	larvae
Reach 3	American shad	spawning and incubation
	shortnose sturgeon	spawning and incubation, overwintering juvenile, overwintering adult
	sea lamprey	spawning and incubation
Reach 4	American shad	spawning and incubation
	sea lamprey	spawning and incubation
	white sucker	spawning, fry, juvenile, adult
	fallfish	spawning, fry, juvenile, adult
	benthic macroinvertebrate	larvae
	shortnose sturgeon	Overwintering juvenile, overwintering adult
Reach 5	To be determined	

Attachment A includes a draft set of proposed HSI curves. Table 3.3.1-1 includes the proposed velocity, depth and substrate habitat suitability criteria and sources. Note that for the American shad and shortnose sturgeon, the HSI curves were obtained from the recent Conowingo Hydroelectric Project relicensing on the Susquehanna River in Maryland. The HSI curves for the remaining species below may require further refinement.

Table 3.3.1-1 Proposed HSI Curves and Sources

Species	Velocity	Depth	Substrate
American shad[1, 2, 3]			
Spawning	Stier & Crance 1985.	Stier & Crance 1985.	ASMFC 2009.
Fry	Stier & Crance 1985.	Stier & Crance 1985.	Stier & Crance 1985.
Juvenile	Stier & Crance 1985.	Ross et al 1993. Greene et al. 2009.	Stier & Crance 1985.
Adult	Stier & Crance 1985.	Stier & Crance 1985.	Stier & Crance 1985.
Shortnose Sturgeon[4]			
Spawning	Crance, J.H. 1986	Crance, J.H. 1986	Crance, J.H. 1986
Fry	Crance, J.H. 1986	Crance, J.H. 1986	Crance, J.H. 1986
Juvenile	Crance, J.H. 1986	Crance, J.H. 1986	Crance, J.H. 1986
Adult	Crance, J.H. 1986	Crance, J.H. 1986	Crance, J.H. 1986
White Sucker[5]			
Spawning	Twomey, et al. 1984	Twomey, et al. 1984	Twomey, et al. 1984
Fry	Twomey, et al. 1984	Twomey, et al. 1984	Twomey, et al. 1984
Juvenile	Twomey, et al. 1984	Twomey, et al. 1984	Twomey, et al. 1984
Adult	Twomey, et al. 1984	Twomey, et al. 1984	Twomey, et al. 1984
Fallfish[6]			
Spawning	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007
Fry	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007
Juvenile	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007
Adult	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007	Gomez and Sullivan, 2007
Sea Lamprey			
Spawning	TBD	TBD	TBD
Fry	TBD	TBD	TBD
Juvenile	TBD	TBD	TBD
Adult	TBD	TBD	TBD
Benthic Macroinvertebrate	TBD	TBD	TBD

1) Stier, D.J., & Crance, J.H.. (1985). *Habitat suitability index models and instream flow suitability curves: American shad*. United States Fish and Wildlife Service Biological Report 82(10.88).

2) Ross, R.M., Backman, T.W.W. & Bennett, R.M. (1993). *Evaluation of habitat suitability index models for riverine life stages of American shad, with proposed models for pre-migratory juveniles* (Biological Report 14. U. S. DOI). Washington, D.C.: U. S. Fish and Wildlife Service.

3) Greene, K. E., Zimmerman, J. L., Laney, R. W., & Thomas-Blate, J. C. (2009). *Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. Habitat Management Series No.9.* Washington, D.C: Atlantic States Marine Fisheries Commission.

4) Crance, J.H. (1986). *Habitat suitability information: Shortnose sturgeon* (U.S. Fish and Wildlife Service Biol. Rep. FWS/OBS-82/10.129).

5) , K.A, Williamson, K.L., & Nelson, P.C.. (1984). *Habitat suitability information: white sucker.* U.S. Fish and Wildlife Service. Biol. Rep. FWS/OBS-82/10.64.

6) Gomez and Sullivan Engineers, P.C. (GSE). (2007). *Glendale Hydroelectric Project FERC Project No. 2801. Final Report Bypass reach aquatic habitat and instream flow study*. Weare, NH: Author.

Task 2: Field Data Collection

The second phase will quantify habitat-discharge relationships for selected species and lifestages in the study area, using standard PHABSIM data collection and flow modeling procedures (Bovee, 1982; Bovee et al., 1998). The modeling approach dictates what field data collection is necessary as explained below.

Data Collection in Reaches 1, 2, and 4 (1-D modeling)

It appears that a 1-D model approach using PHABSIM is suitable for Reaches 1[15], 2, and 4. A 1-D modeling approach will be based on hydraulic data developed from cross-sectional depth, velocity, and substrate measurements following Milhouse et al. (1989), using PHABSIM for Windows (V 1.5.1), developed by the USFWS and distributed by the USGS Fort Collins (CO) Science Center.

The location of each transect will be field blazed with flagging or other appropriate means. Each study site and cell boundary will be mapped sufficiently to quantify the area represented by each transect. The transect headpin and tailpins will be located at or above the top-of-bank elevation, and secured by steel rebar or other similar means. Measuring tapes accurate to 0.1 ft will be secured at each transect to enable repeat field measurements to occur at specific stream loci[16]. Stream bed and water elevations tied to a known datum will be surveyed to the nearest 0.1 ft using standard optical surveying instrumentation and methods.

Depth, velocity, and substrate data will be gathered at intervals (verticals) along each transect. Each vertical will be located to the nearest 0.1 ft wherever an observed shift in depth or substrate/cover occurs. Between 20 and 99 verticals per transect will be established as necessary on each transect. Verticals will be positioned so that no more than 10% of the discharge passes between any pair, to enhance hydraulic model calibration. A staff gage will be located in each study site, and monitored at the beginning and end of each set of hydraulic measurements to verify stable flow during measurements. If flow is found to be insufficiently stable, the related data will be discarded and re-measured once stable flow is established.

Mean column velocity will be measured to the nearest 0.1 ft/second with either a calibrated electronic velocity meter mounted on a top-setting wading rod, or alternatively an Acoustic-Doppler Current Profiler (ADCP) transducer. In water less than 2.5 ft depth, velocity measurements will be made at 0.6 of total depth (measured from the water surface); at greater depths, paired measurements will be made at 0.2 and 0.8 of total depth and averaged.

Each calibration flow will be provided by scheduled releases from the Project via unit operation or in the case of the bypass reach through gate settings. Turbine rating curves, USGS gages, and study-site field gaging will be collectively used to estimate each calibration flow release. The 1-D hydraulic model will be developed from measurements gathered at a minimum of three calibration flows to facilitate extrapolation of hydraulic data across the range of interest. To accomplish calibration, a full set of depth, velocity and water surface elevation (WSEL) data will be gathered at the intermediate flow, and WSEL will be measured at each transect for the low and high flows to calibrate the hydraulic models. At transects with complex hydraulics such as riffles, and/or sites with unusual backwatering or eddy effects,

[15] A 2D model may be required for a portion of the uppermost section of the bypass reach if specific habitat targets are identified in this locale.
[16] Supplemental transects may be located as needed to record water surface and bed elevation data at hydraulic controls to establish backwatering parameters necessary for hydraulic modeling.

supplemental velocity data may also be gathered at the low calibration flow. This will be determined in the field on a case-by-case basis.

For the 1-D model, each calibration flow should ideally be broadly separated to provide a suitable stage-discharge curve for the hydraulic model. The general rule of thumb is the hydraulic model, and hence depths and velocities, can be extrapolated from 40-250% of the calibration (measured) flow. Thus, the following calibration flows and associated flow ranges can be evaluated in the 1-D and 2-D hydraulic models. The suggested calibration flows are listed below.

Reach(es)	Calibration Flow	Targeted Extrapolated Flow Range	WSEL only or Both (WSEL and velocity measurements)
1, 2, *4	300 cfs (low flow)	120 cfs to 750 cfs	Both, at complex hydraulics such as riffles
	900 cfs (intermediate flow)	360 cfs to 2,200 cfs	Both
	2,500 cfs (high flow)	1,000 cfs to 6300 cfs	WSEL
3	2,500-9,000 cfs	1,433 cfs to 22,500 cfs	Both
*Reach 4 calibration flows will be higher due to the contribution of the Deerfield River. FirstLight will work with TransCanada (Licensee of the Deerfield River Hydroelectric Project) during the data collection in Reach 4 to maintain a steady continuous flow from the Deerfield River.			

Data Collection in Reach 3(2-D Modeling)

A two dimensional (2-D) approach will best represent hydraulics in Reach 3 due to the complex channel characteristics and hydraulics.

For the 2-D model, a single calibration flow is required; the exact flow required is not critical but should be one that is representative of hydraulic conditions intermediate throughout the range of flows of interest, including "typical" generating from Cabot Station and an intermediate discharge through the bypass reach. The need for any additional calibration flow data will be evaluated on a case-by-case basis.

A 2-D model will be developed using a combination of terrain (LIDAR and/or 10m DEM, depending on availability) and bathymetric data. This will include a WSEL survey, and flow gaging at the inlet and/or outlet of the study site. To the extent possible, bathymetric data will be provisionally assembled from existing sources including past modeling, surveys, bridges, Project related information, and fishing/recreation maps. It is likely that additional bathymetric data will need to be collected to supplement the existing data coverage. These will be obtained through a combination of depth sounding and RTK-GPS (Real Time Kinematic), as required. In addition, it is expected that a high-level of bathymetric mapping will be obtained in the vicinity of the Cabot tailrace and existing fishway entrance in case future computation fluid dynamic (CFD) modeling are needed in the future.

Task 3: Hydraulic Modeling (Reaches 1-4)

Model boundary conditions (input values for generation at Cabot and Station No. 1, river discharge, spill at Turners Falls Dam, and tributary inflows) will be obtained from observed flow and release records. Modeling scenarios will be developed and run in "steady state" mode to produce data required to support the PHABSIM analyses including water profiles, wetted area, depth and velocity at flow increments of interest.

1-D hydraulic modeling will be accomplished by calibration (correlating each surveyed WSEL set with discharge to develop a stage-discharge relationship for each transect). PHABSIM uses STGQ, MANSQ and WSP models to predict water surface elevations at various calibration flows. It then uses the VELSIM model to predict cellular water velocities based on the calibration dataset(s). The model is calibrated by comparing simulated hydraulics to empirical measurements taken at the calibration flows. Coefficients such as relative stream channel roughness (commonly referred to as Mannings n) are then iteratively adjusted as needed to optimize model accuracy across the full flow range. Once this relationship is established, the model then calculates additional WSELs at other flow increments, and adjusts velocities obtained at calibration flows to other flow increments of interest for which defined water stages have been calculated.

2-D hydraulic modeling, while similar in many ways to 1-D modeling, requires an initial phase of developing and testing of the model grid-space and arrangement. The process is iterative, with a goal of finding the best balance of model stability, accuracy, and performance. This will occur at a single test condition that represents a fairly common flow, including representative hydraulics, and has sufficient supporting input data (*e.g.,* most observations).

Following development and testing of the model grid, the model will then be calibrated and verified. The most common approach for calibration is to provide a discharge value as the upstream boundary condition while the downstream boundary relies on the measured WSEL. Measured WSELs at the survey transects will be used to directly calibrate to a specific steady flow analysis scenario. Calibration is achieved by adjusting the resistance terms in the model to provide predicted WSELs that best match measured WSELs, for a given discharge. Model verification will be conducted by running the calibrated model for other measured flow conditions and comparing the model-predicted results to the independent measured values.

Task 4: Habitat Modeling (Reaches 1-4)

Once the hydraulic model is calibrated, habitat suitability at each flow increment of interest will be quantified by combining the HSI and hydraulic model data using the HABTAE and supporting programs within PHABSIM. These output units of Weighted Usable Area (WUA) for each transect at each flow increment, for each species and lifestage. WUA is an abstract habitat suitability index generated from units of square feet of optimal habitat available per 1,000 feet of represented stream length. The habitat suitability-flow curves across the flow range for all transects in a given study site are then weighted and summed at the study reach level, according to actual linear stream length that each site represents, as mapped in the field.

Task 5: Habitat Time Series (Reaches 3-4)

The WUA information (habitat versus flow) will be merged with HEC-ResSim model results (see Study No. 3.8.1, *Evaluate the Impact of Current and Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation*) for Reaches 3 and 4. Specifically, FirstLight will use the hourly discharge hydrograph(s) below Cabot Station from the HEC-ResSim model. The discharge hydrograph from the model will be merged with the Weighted Usable Area versus flow curves from the IFIM study to yield habitat time series. All habitat time series analysis will rely on flow data from the baseline model, which will be used a basis of comparison. Habitat time series will be developed from any alternative modes of operation using the HEC-ResSim discharge data, which again will be compared to the baseline model habitat time series. The alternative operation scenarios will be developed in consultation with the relicensing stakeholders after the initial study results have been completed.

Task 6: Persistent Habitat Analysis and Mapping (Reach 3)

The objective of the persistent habitat analysis is to evaluate the relationship between short-term hydrologic variability (i.e., peaking flows) and immobile aquatic species' habitat. Immobile aquatic species are those that are considered unable to move from one location to a more suitable location in the time frame of a typical peaking cycle (e.g., mussels, incubating eggs, early fry, etc.). A persistent habitat analysis consists of first identifying "quality" habitat areas (i.e., a model node's combined habitat suitability ≥ 0.5) at each modeled flow, and then matching various low and high flow pairs (e.g., 1,000 cfs and 5,000 cfs) to find the common areas of quality habitat. "Persistent" habitat is then calculated for various flow pairs on a node-by-node basis, where a node is marked as persistent habitat for that flow pair if the high and low flows (as well as any flows in between) are considered quality habitat. The analysis results can be mapped to visualize what areas provide consistently good habitat throughout the target flow range. The results from this task will include a low/high flow habitat matrix for each target species/life stage and a series of maps depicting persistent habitat for a variety of flow ranges covering expected operation flows.

Task 7: Study Report

A draft report will be prepared for study team review and comment, documenting methods and results. The report will quantify flow/WUA relationships for applicable species and lifestages in each study reach. WUA and supporting hydraulic data will be presented in graphic and tabular form, along with an analysis of trends in the data, and documentation of study team consultation. Appendices will also include cross-sectional survey data and reference photographs of study sites. The report will be finalized following receipt of input from the study team.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The estimated cost for the study outlined in this plan is approximately $200,000-$250,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

FirstLight is proposing to commence this study before the FERC Study Plan Determination is issued, which is due by September 12, 2013. In developing this study plan, meetings were held with the state and federal resource agencies including NOAA, USFWS, MADFW, and MADEP to help jump-start the study planning.

However, to ensure all interested parties have input on the study plan, it will be provided to all parties on the mailing list and a meeting will be held to solicit and address issues on the plan on April 16, 2013 at the Northfield Mountain Visitor Center (99 Millers Falls Road, Northfield, MA). For those who cannot attend the meeting, FirstLight requested written comments be sent by April 5, 2013 to the following email address: firstlight@gomezandsullivan.com.

The accelerated schedule for this study is listed below.

TASK	COMPLETION DATE
Finalize flow targets, study reaches, species and lifestages	April, 2013
Finalize HSI curves to be used	May, 2013
Select study sites and cell boundaries	June, 2013
Collect hydraulic and bed profile data	July, 2013

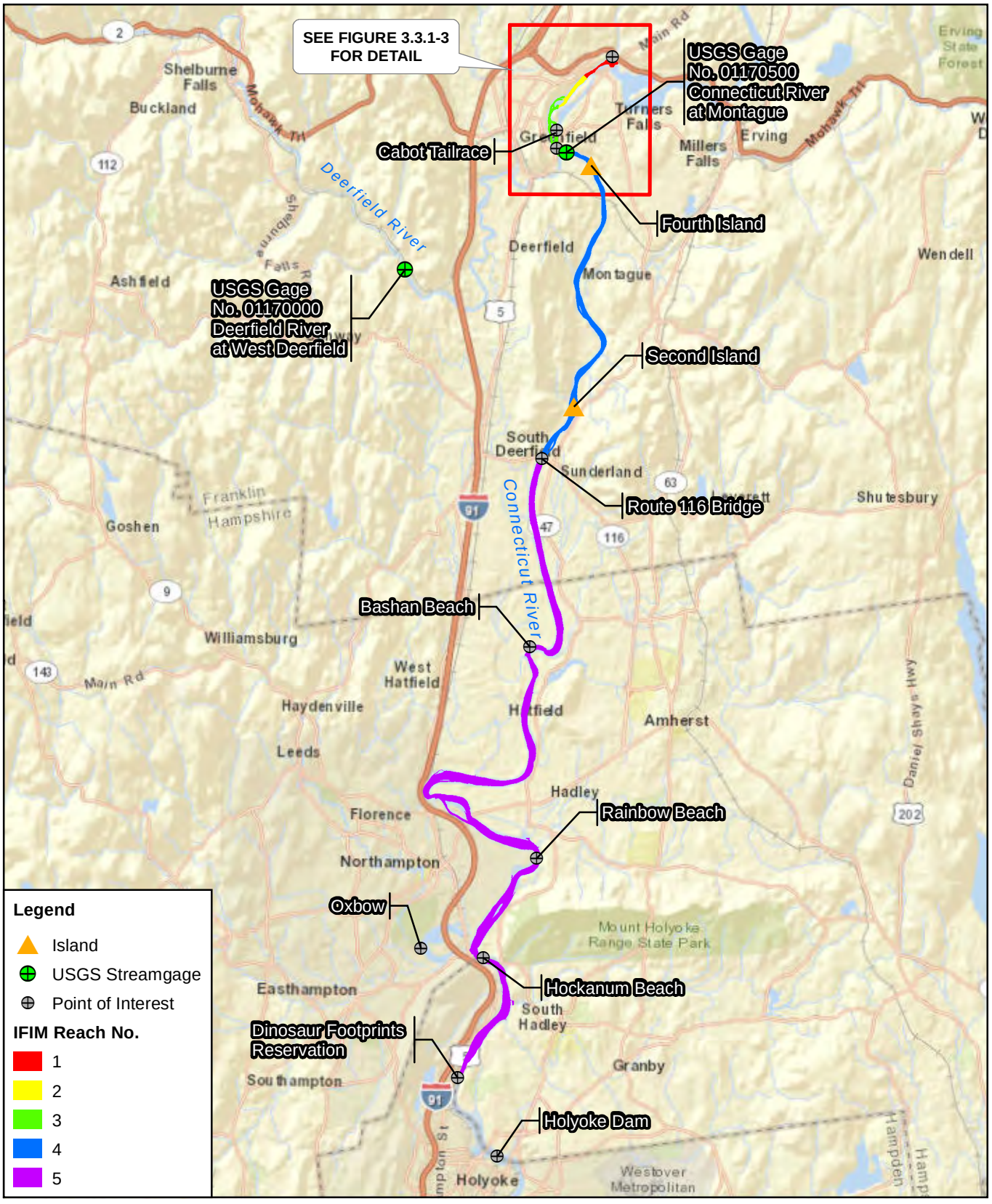
TASK	COMPLETION DATE
Complete modeling	September, 2013
Issue draft report	October, 2013
Issue final report	December 1, 2013

Literature Cited

Bovee, K.D. (1982). *A guide to stream habitat analysis using the instream flow incremental methodology*. (Office of Biol. Service FWS/OBS-82-26). Washington, DC.: USFWS, U.S. Dept. Of Interior.

Bovee, K.D., Lamb, B.L., Bartholow, J.M., Stalnaker, C.B., Taylor, J. & Henriksen, J. (1998). S*tream habitat analysis using the instream flow incremental methodology.* (Biological Resources Division Information and Technology Report USGS/BRD-1998-0004/ viii). U.S. Geological Survey,

Milhouse, R. T., Updike, M. A, & Schneider, D. M.. (1989). *Physical habitat simulation system reference manual: version 2, Instream flow information paper 26* (Biological Report 89(16)). Washington, D.C.: U.S. Fish and Wildlife Service.



FIRSTLIGHT POWER RESOURCES

IFIM STUDY

Figure 3.3.1-1: Proposed Instream Flow Study Reaches

N

0 2 4 8 Miles

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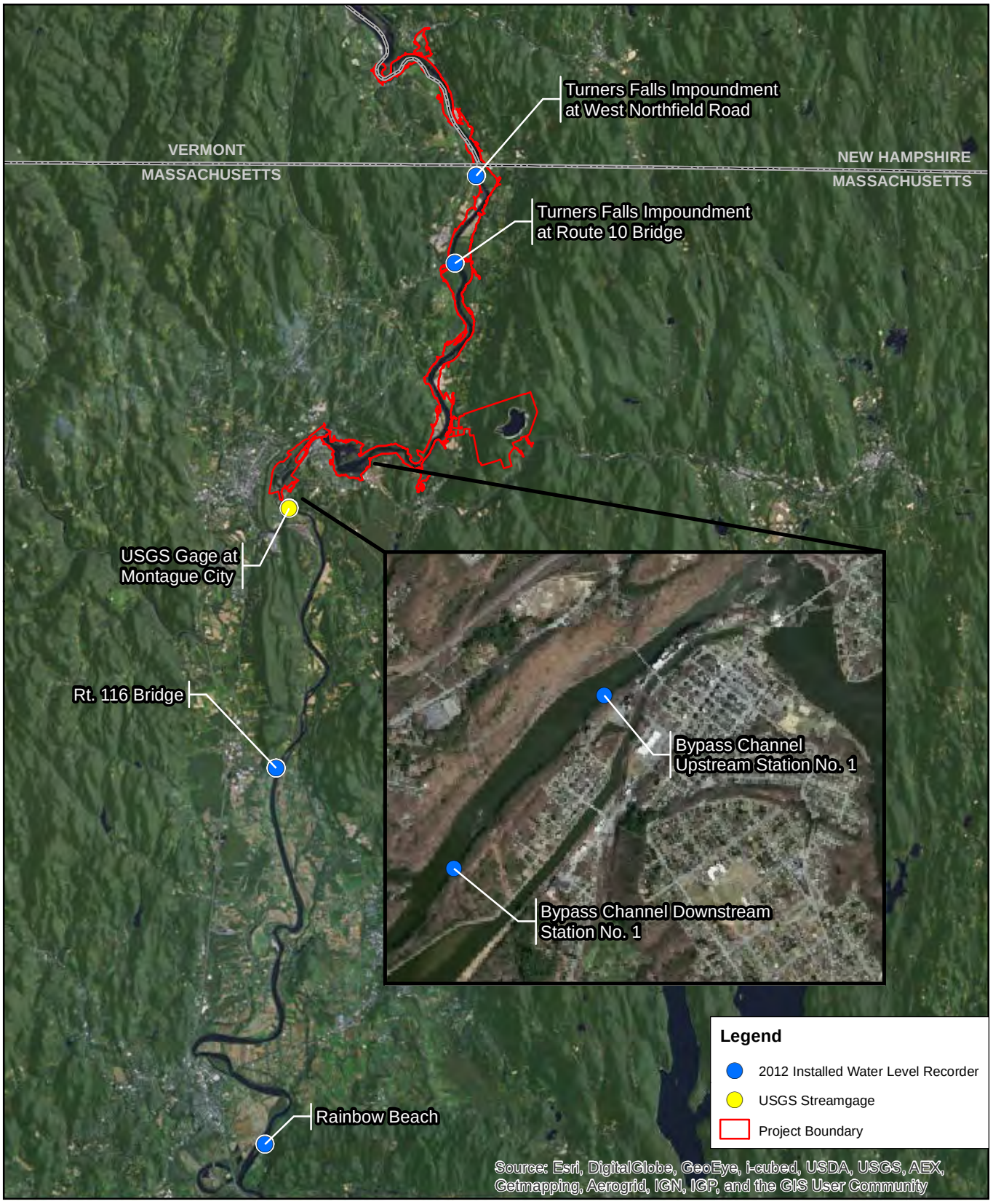

FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

N

0 1.5 3 4.5 6 Miles

Figure 3.3.1-2
2012 Installed Water Level Recorder Locations

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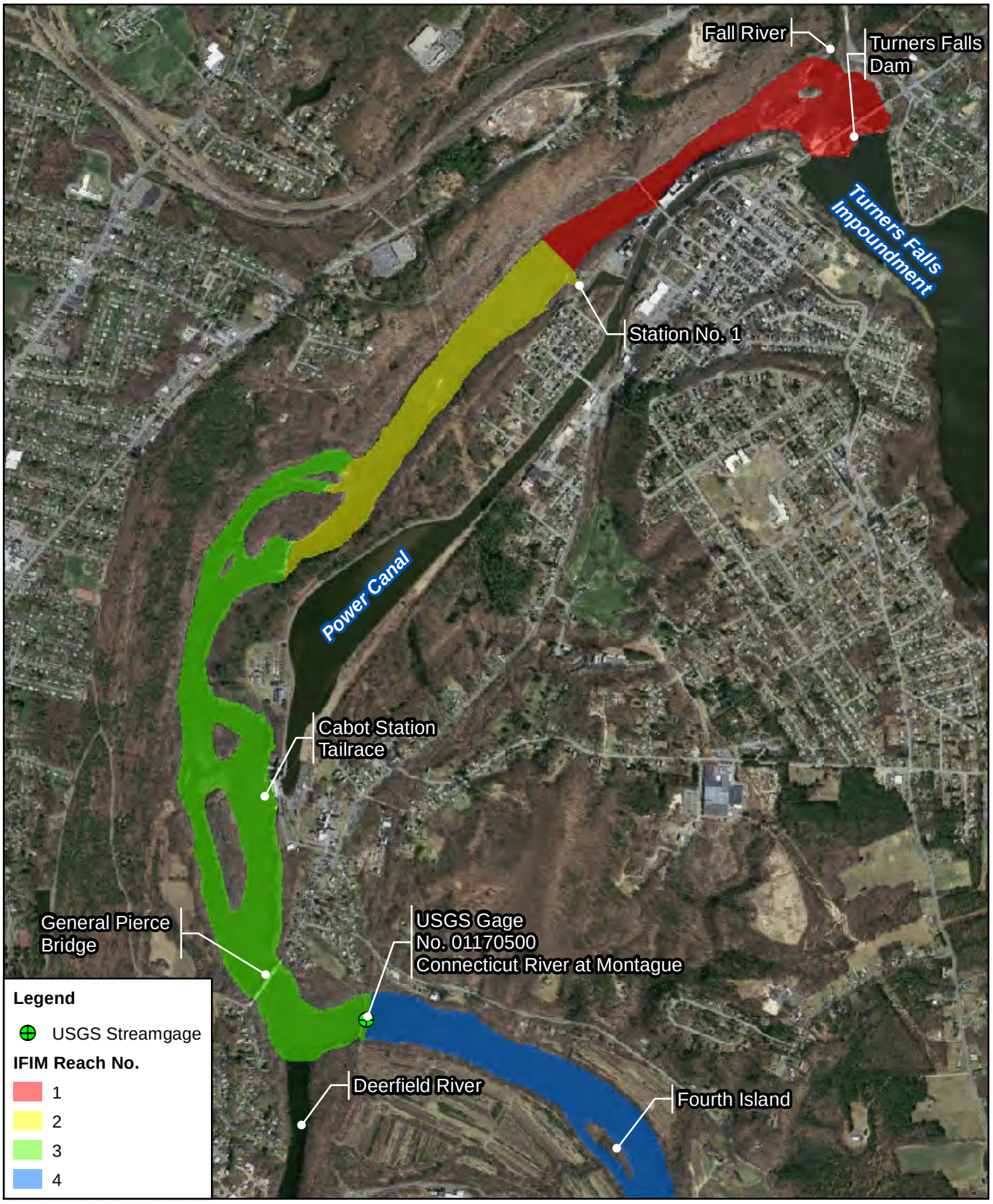

FIRSTLIGHT POWER RESOURCES

IFIM STUDY

N

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Figure 3.3.1-3:
Proposed Instream Flow Study Reaches - Bypass Reach Inset

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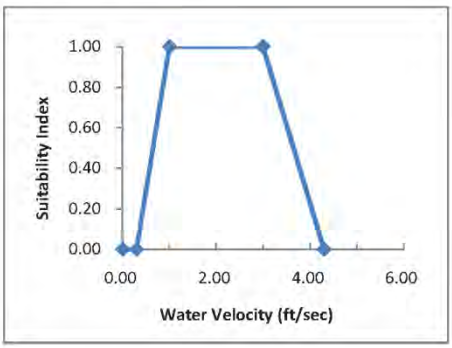
ATTACHMENT A: PROPOSED HABITAT SUITABILITY INDEX CURVES

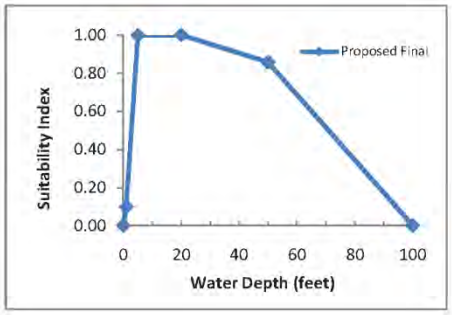
Shortnose sturgeon and American shad HSI source: Susquehanna River, PA

Species: American Shad
Lifestage: Spawning

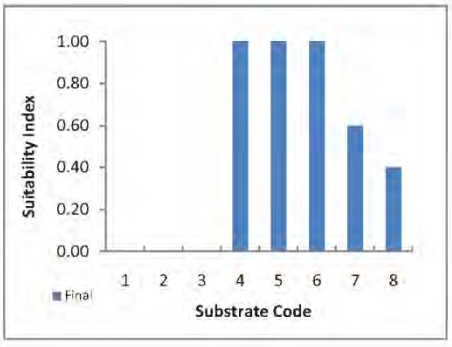
Velocity	SI Value
0.00	0.00
0.30	0.00
1.00	1.00
3.00	1.00
4.30	0.00



Proposed Final Depth	SI Value
0.00	0.00
1.00	0.10
5.00	1.00
20.00	1.00
50.00	0.86
100.00	0.00

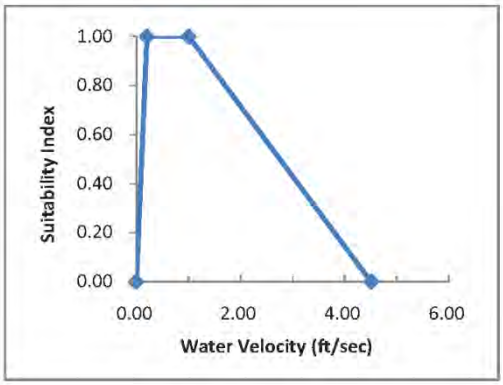


Code	Final SI Value	Type
1	0.00	Detritus
2	0.00	Mud
3	0.00	Silt
4	1.00	Sand
5	1.00	Gravel
6	1.00	Cobble
7	0.60	Boulder
8	0.40	Bedrock

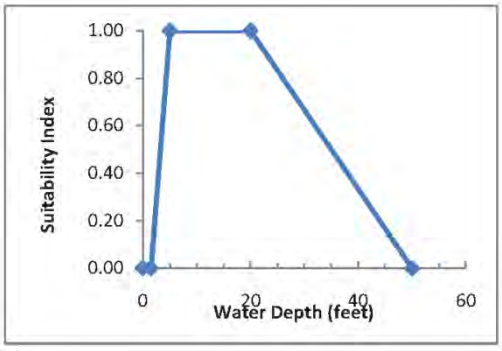


Species: American Shad
Lifestage: Fry

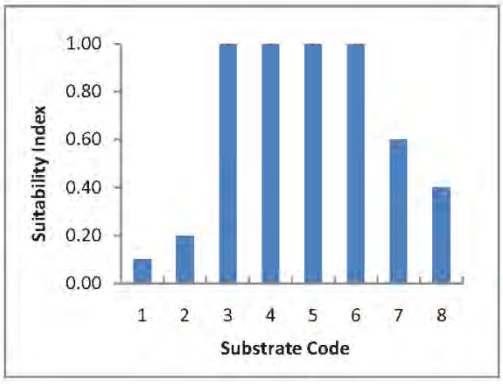
Velocity	SI Value
0.00	0.00
0.20	1.00
1.00	1.00
4.50	0.00



Depth	SI Value
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00

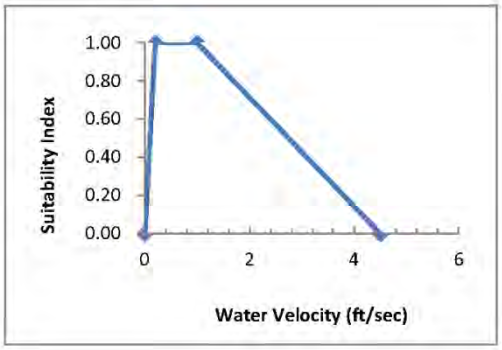


Code	SI Value	Type
1	0.10	Detritus/Organic
2	0.20	Mud/soft clay
3	1.00	Silt
4	1.00	Sand
5	1.00	Gravel
6	1.00	Cobble
7	0.60	Boulder
8	0.40	Bedrock

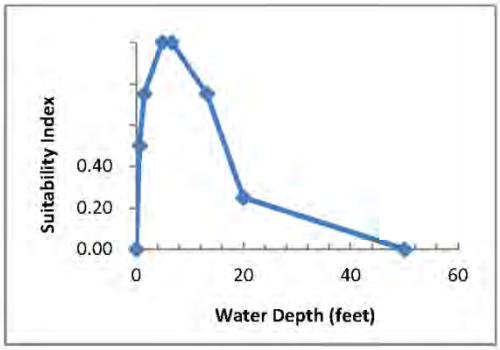


Species: American Shad
Lifestage: Juvenile

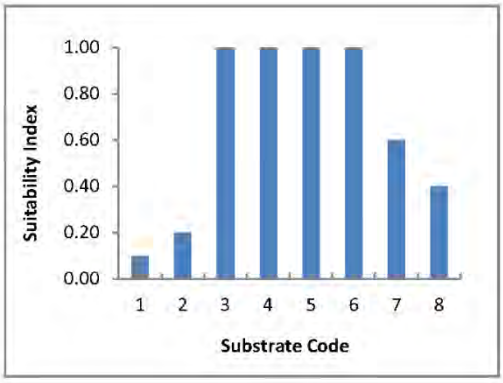
Velocity	SI Value
0.00	0.00
0.20	1.00
1.00	1.00
4.50	0.00



Depth	SI Value
0.00	0.00
0.66	0.50
1.50	0.75
4.90	1.00
6.60	1.00
13.20	0.75
20.00	0.25
50.00	0.00

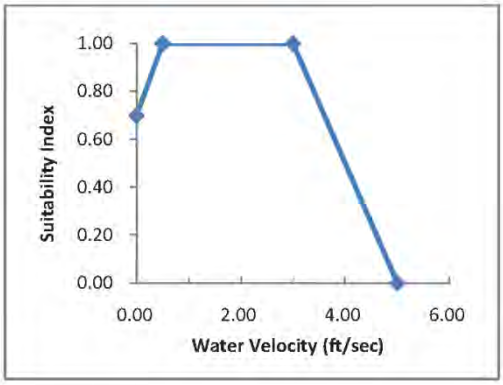


Code	SI Value	Type
1	0.10	Detritus/Organic
2	0.20	Mud/soft clay
3	1.00	Silt
4	1.00	Sand
5	1.00	Gravel
6	1.00	Cobble
7	0.60	Boulder
8	0.40	Bedrock

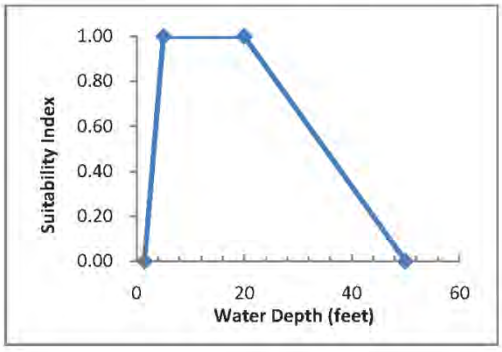


Species: American Shad
Lifestage: Adult

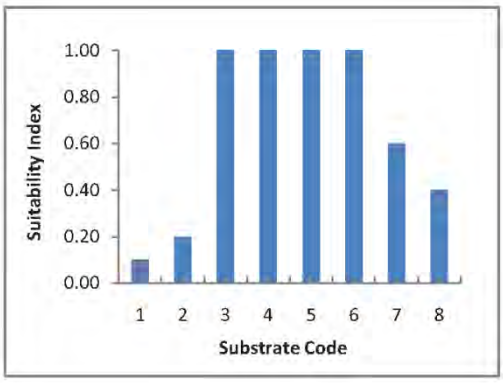
Velocity	SI Value
0.00	0.70
0.50	1.00
3.00	1.00
5.00	0.00



Depth	SI Value
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00

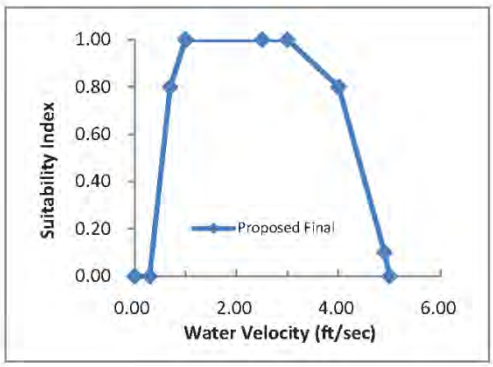


Code	SI Value	Type
1	0.10	Detritus/Organic
2	0.20	Mud/soft clay
3	1.00	Silt
4	1.00	Sand
5	1.00	Gravel
6	1.00	Cobble
7	0.60	Boulder
8	0.40	Bedrock

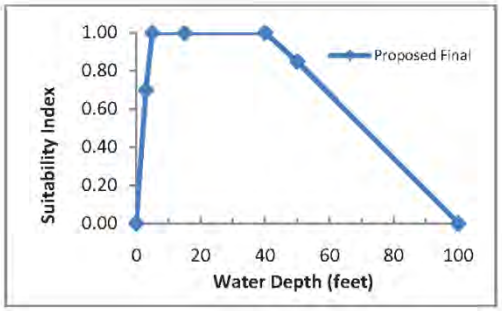


Species: Shortnose Sturgeon
Lifestage: Spawning

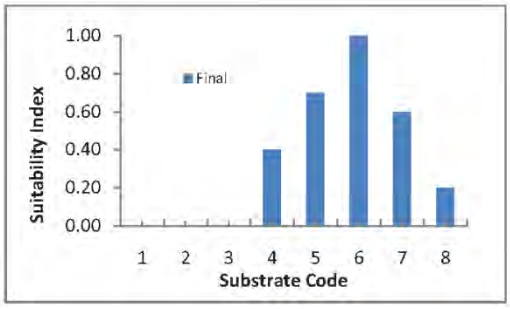
Proposed Final	
Velocity	SI Value
0.00	0.00
0.30	0.00
0.70	0.80
1.00	1.00
2.50	1.00
3.00	1.00
4.00	0.80
4.90	0.10
5.00	0.00



Proposed Final	
Depth	SI Value
0.00	0.00
3.00	0.70
5.00	1.00
15.00	1.00
40.00	1.00
50.00	0.85
100.00	0.00

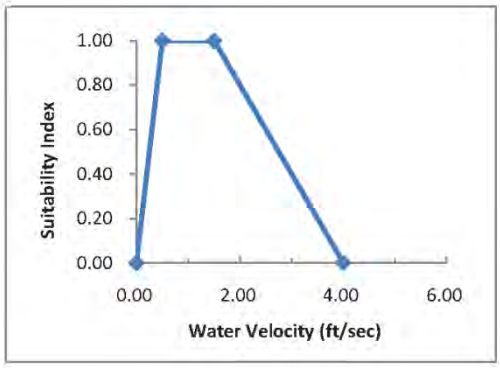


	Final	
Code	SI Value	Type
1	0.00	Detritus/Organic
2	0.00	Mud/soft clay
3	0.00	Silt
4	0.40	Sand
5	0.70	Gravel
6	1.00	Cobble/rubble
7	0.60	Boulder
8	0.20	Bedrock



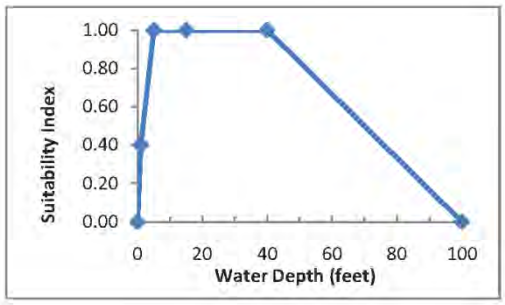
Species: Shortnose Sturgeon
Lifestage: Fry

Velocity	SI Value
0.00	0.00
0.50	1.00
1.50	1.00
4.00	0.00

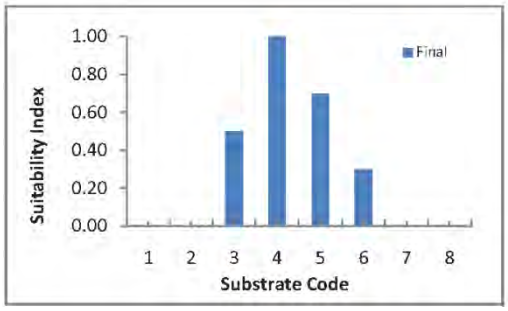


Proposed Final

Depth	SI Value
0.00	0.00
1.00	0.40
5.00	1.00
15.00	1.00
40.00	1.00
100.00	0.00

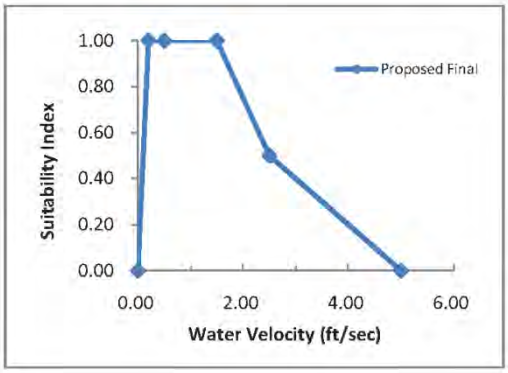


Code	Final SI Value	Type
1	0.00	Detritus/Organic
2	0.00	Mud/soft clay
3	0.50	Silt
4	1.00	Sand
5	0.70	Gravel
6	0.30	Cobble/rubble
7	0.00	Boulder
8	0.00	Bedrock

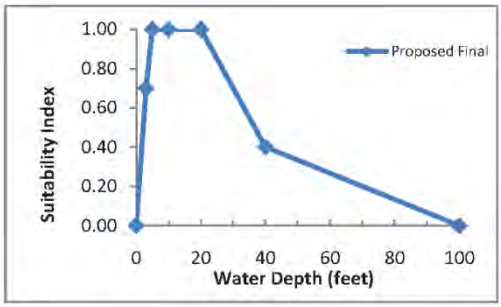


Species: Shortnose Sturgeon
Lifestage: Juveniles

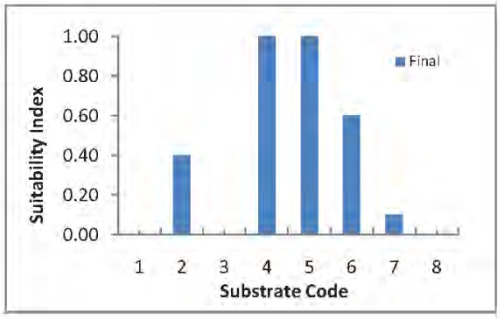
Proposed Final	
Velocity	SI Value
0.00	0.00
0.20	1.00
0.50	1.00
1.50	1.00
2.50	0.50
5.00	0.00



Proposed Final	
Depth	SI Value
0.00	0.00
3.00	0.70
5.00	1.00
10.00	1.00
20.00	1.00
40.00	0.40
100.00	0.00

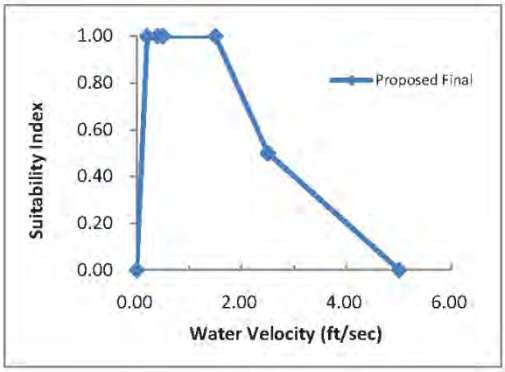


	Final	
Code	SI Value	Type
1	0.00	Detritus/Organic
2	0.40	Mud/soft clay
3	0.00	Silt
4	1.00	Sand
5	1.00	Gravel
6	0.60	Cobble/rubble
7	0.10	Boulder
8	0.00	Bedrock

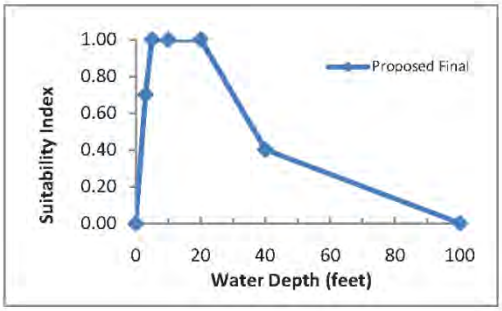


Species: Shortnose Sturgeon
Lifestage: Adults

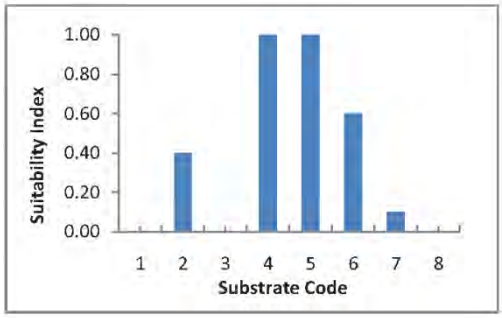
Proposed Final	
Velocity	SI Value
0.00	0.00
0.20	1.00
0.40	1.00
0.50	1.00
1.50	1.00
2.50	0.50
5.00	0.00



Proposed Final	
Depth	SI Value
0.00	0.00
3.00	0.70
5.00	1.00
10.00	1.00
20.00	1.00
40.00	0.40
100.00	0.00



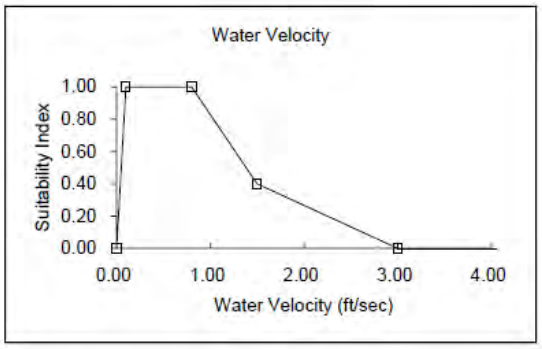
	Final	
Code	SI Value	Type
1	0.00	Detritus/Organic
2	0.40	Mud/soft clay
3	0.00	Silt
4	1.00	Sand
5	1.00	Gravel
6	0.60	Cobble/rubble
7	0.10	Boulder
8	0.00	Bedrock



Species: Fallfish
Lifestage: Adult

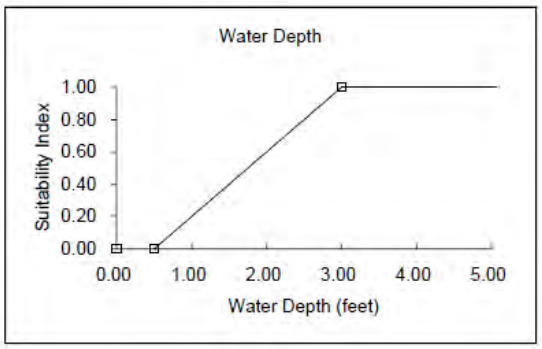
Velocity

Velocity	SI Value
0.00	0.00
0.10	1.00
0.80	1.00
1.50	0.40
3.00	0.00
100.00	0.00



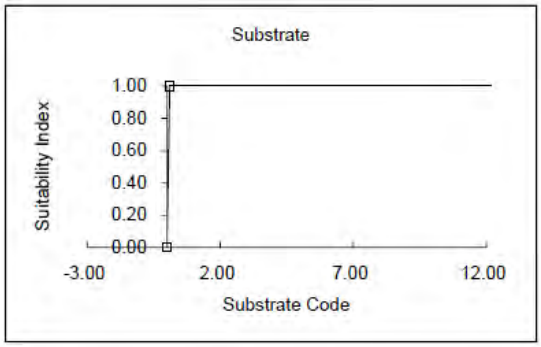
Depth

Depth	SI Value
0.00	0.00
0.50	0.00
3.00	1.00
100.00	1.00



Substrate

Substrate	SI Value
0.00	0.00
0.10	1.00
100.00	1.00

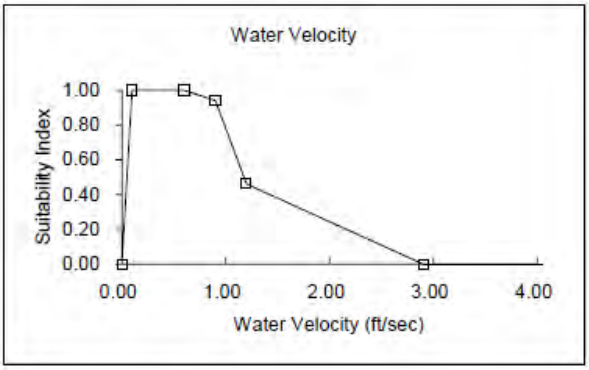


Reference: Modified and accepted by NYSDEC.

Species: Fallfish
Lifestage: Fry

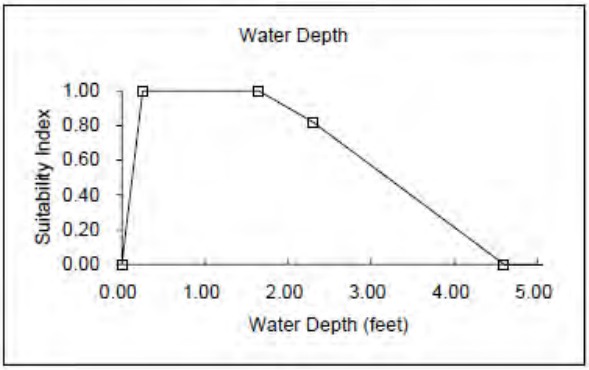
Velocity

Velocity	SI Value
0.00	0.00
0.10	1.00
0.60	1.00
0.90	0.94
1.20	0.46
2.90	0.00
100.00	0.00



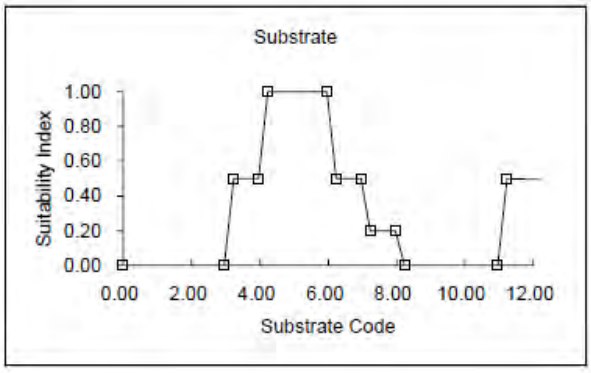
Depth

Depth	SI Value
0.00	0.00
0.25	1.00
1.65	1.00
2.30	0.82
4.60	0.00
100.00	0.00



Substrate

Substrate	SI Value
0.00	0.00
2.96	0.00
3.23	0.50
3.96	0.50
4.23	1.00
5.96	1.00
6.23	0.50
6.96	0.50
7.23	0.20
7.96	0.20
8.23	0.00
10.96	0.00
11.23	0.50
100.00	0.00

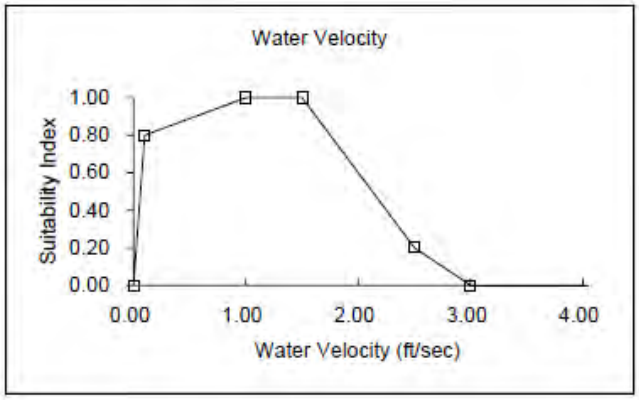


Reference: Velocity & Depth from Brook Trout Fry HSI Curve (Deerfield River Dephi Process)
Substrate developed by Charles Ritzi

Species: Fallfish
Lifestage: Spawning and Incubation

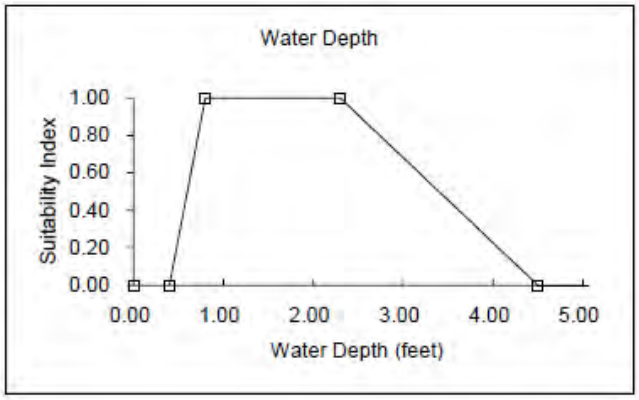
Velocity

Velocity	SI Value
0.00	0.00
0.10	0.80
1.00	1.00
1.50	1.00
2.50	0.20
3.00	0.00
100.00	0.00



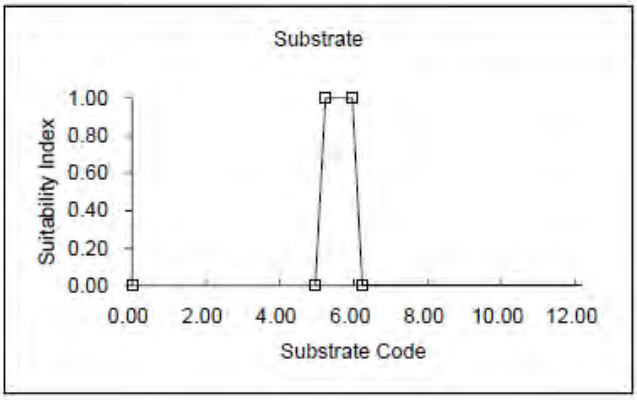
Depth

Depth	SI Value
0.00	0.00
0.40	0.00
0.80	1.00
2.30	1.00
4.50	0.00
100.00	0.00



Substrate

Substrate	SI Value
0.00	0.00
4.96	0.00
5.23	1.00
5.96	1.00
6.23	0.00
100.00	0.00



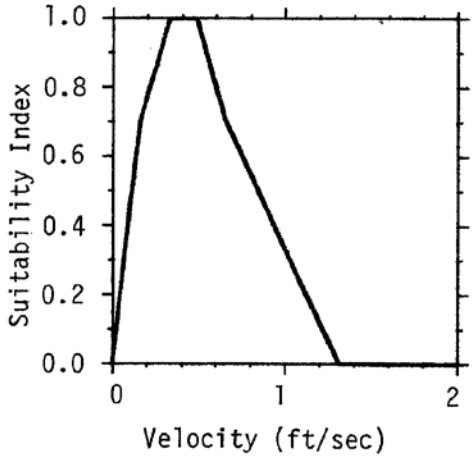
Reference: Modified and accepted by NYSDEC.

Substrate Coding System

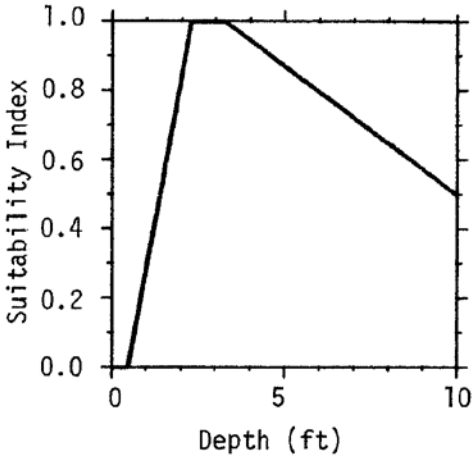
Substrate Code	Embeddedness Code	Cover Code
1- Roots, Snags, Undercut Banks 2- Clay 3- Silt 4- Sand 5- Small Gravel (<2") 6- Gravel (2"-4") 7- Cobble (4"-10") 8- Boulder (10"-2') 9- Boulder (>2') 10- Ledge 11- Detritus, vegetation	.2- Embeddedness (0-25%) .5- Embeddedness (26-50%) .7- Embeddedness (51-75%) .9- Embeddedness (76-100%) Note: Embeddedness refers to the amount of fine material (such as sand) in interstitial spaces.	.03- Few Velocity Refuges .06-Abundant Velocity Refuges
Example Field Code: 5.53= Small Gravel (5), 26-50% Embedded (.5) with Few Velocity Refuges (.03)		

Coordinates

x	y
0.00	0.0
0.16	0.7
0.33	1.0
0.49	1.0
0.66	0.7
1.31	0.0
100.00	0.0



x	y
0.0	0.0
0.5	0.0
2.3	1.0
3.3	1.0
9.8	0.5
16.4	0.0
100.0	0.0



x	y
0.0	1.0
100.0	1.0

Based on assumption that all substrate types are suitable.

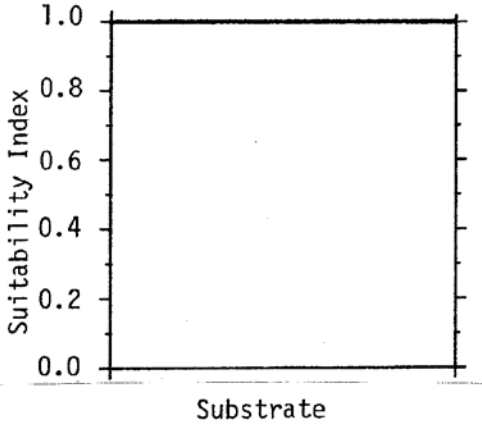


Figure 8. SI curves for white sucker adult velocity, depth, substrate, cover, and temperature.

Coordinates

x	y
0.0	0.1
40.0	1.0
75.0	1.0
100.0	0.5

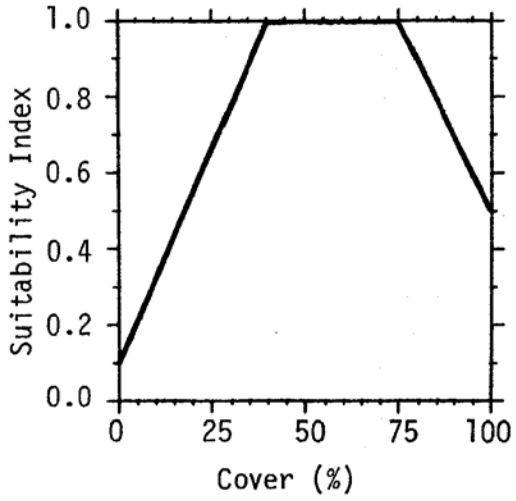


Figure 8 (concluded)

Coordinates

x	y
0.0	0.1
40.0	1.0
75.0	1.0
100.0	0.5

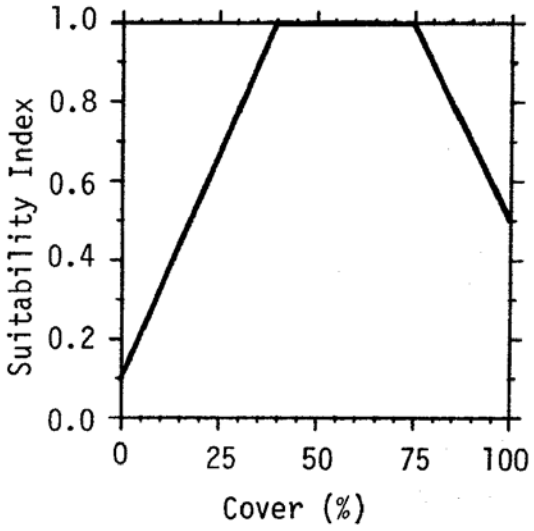
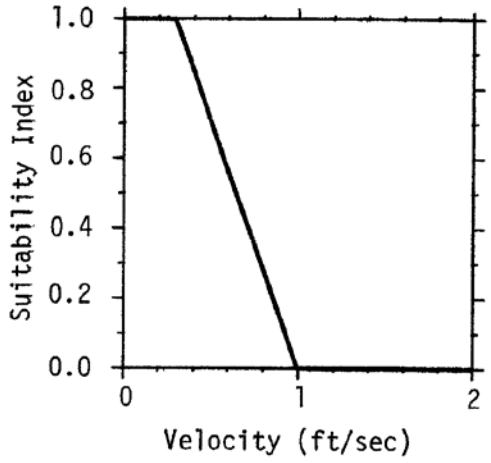


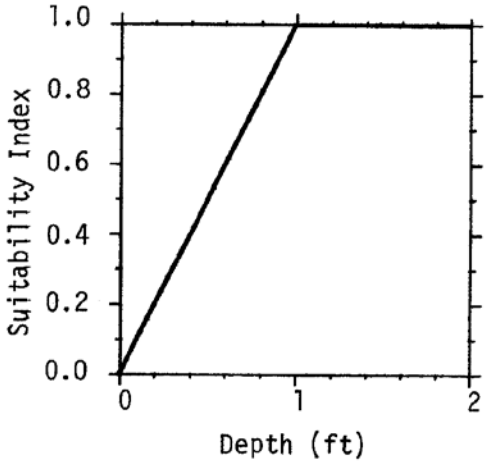
Figure 7 (concluded)

Coordinates

x	y
0.0	1.0
0.3	1.0
1.0	0.0
100.0	0.0



x	y
0.0	0.0
1.0	1.0
100.0	1.0



x	y
0.0	1.0
100.0	1.0

Based on assumption that all substrate types are suitable.

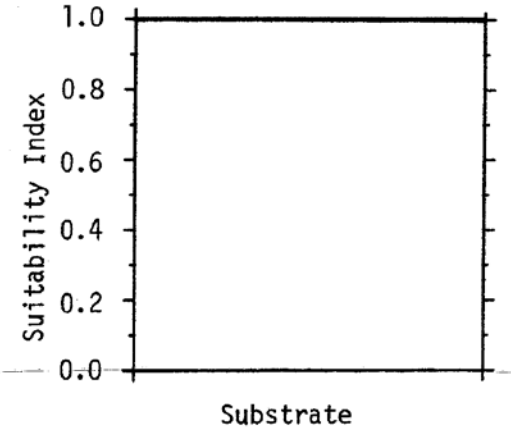


Figure 6. SI curves for white sucker fry velocity, depth, substrate, cover, and temperature.

Coordinates

x	y
0.0	0.1
40.0	1.0
75.0	1.0
100.0	0.5

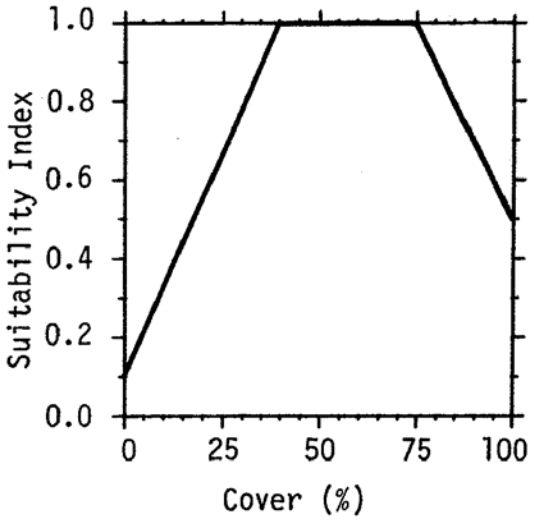
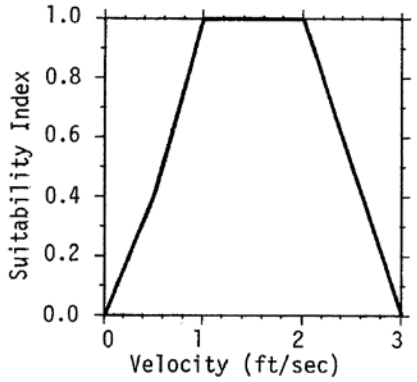


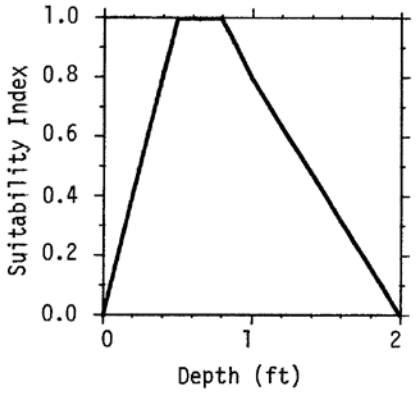
Figure 6 (concluded)

Coordinates

x	y
0.0	0.0
0.5	0.4
1.0	1.0
2.0	1.0
3.0	0.0
100.0	0.0



x	y
0.0	0.0
0.5	1.0
0.8	1.0
1.0	0.8
2.0	0.0
100.0	0.0



x	y
0.000	0.00
0.001	0.00
0.002	0.05
0.009	0.05
0.010	0.80
0.039	0.80
0.040	1.00
0.078	1.00
0.079	0.90
0.156	0.90
0.157	0.50
0.629	0.50
0.630	0.05
100.000	0.05

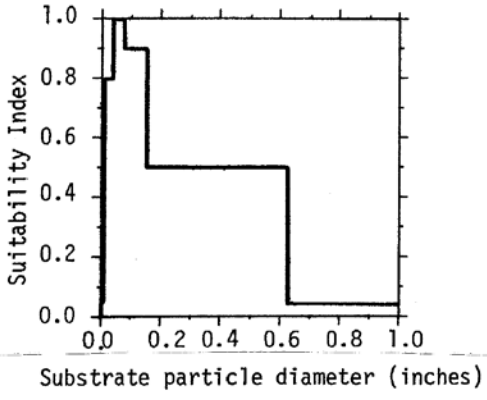


Figure 4. SI curves for white sucker spawning velocity, depth, substrate, cover, and temperature.

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3.3.2 Evaluate Upstream and Downstream Passage of Adult American Shad

General Description of Proposed Study

An evaluation of upstream and downstream passage of adult American shad has been requested by FERC, USFWS, NOAA, MDFW, NHDES, NHFG, VTDEC, CRWC, TU and the Town of Gill. A telemetry study with both radio and Passive Integrated Transponder (PIT) tag types will be conducted to assess behavior, approach routes, passage success, survival, and delay by adult American shad as they encounter the Turners Falls Project and Northfield Mountain Project during both upstream and downstream migrations. Additionally, video recording techniques will be used to evaluate passage efficiency more precisely at the Spillway fishway. FirstLight has spent considerable effort in the past studying adult shad passage at the Cabot and Gatehouse ladder (*see* Appendix E). As an initial phase of this study, FirstLight proposes to evaluate this information relative to the objectives of this study to determine if additional field data collection and analysis in these two specific locations is warranted.

A potential alternative to the current configuration of fishways at the project would be to minimize attraction to the Cabot ladder and operate a single fish lift facility at the dam. For this to be effective, attraction of shad to the Cabot Station discharge and associated delays would need to be overcome. The effect of different levels of dam releases that would induce fish to move past the Cabot Station into the bypass reach and up to the dam will be evaluated. In addition, it is possible that spillway flow releases coupled with a high frequency ultrasound array at the Cabot Station may dissuade shad from entering that tailrace. Study No. 3.3.19 *Evaluate the use of an Ultrasound Array to Facilitate Upstream Movement to Turners Falls Dam by Avoiding Cabot Station Tailrace* proposes to evaluate the use of an ultrasound array to guide fish past the Cabot Station tailrace.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to identify the effects of the Turners Falls and Northfield Mountain Projects on adult shad migration. The study objectives are to:

- Develop a detailed study plan after previously collected data are analyzed;
- Identify migration delays resulting from continued operation of the Turners Falls Project;
- Determine route selection and behavior of upstream migrating shad at the Turners Falls Project under various spill flow levels;
- Evaluate attraction, entrance efficiency and internal efficiency of the spillway ladder for shad reaching the dam spillway, under a range of spill conditions;
- Evaluate migration through the Turners Falls Impoundment;
- Identify impacts of Northfield Mountain operations on upstream and downstream adult shad migration, including delays, entrainment, behavioral changes and migration direction shifts.
- Determine downstream passage route selection, timing/delay, and survival into the power canal and spill flows at Turners Falls Dam; and
- Determine downstream passage route selection, timing/delay in the canal, Cabot Station fish bypass facility effectiveness, and survival of Cabot-bypassed adult shad that enter the Turners Falls power canal.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

In 1992, the Connecticut River Atlantic Salmon Commission (CRASC) developed a draft document titled: *A Management Plan for American Shad in the Connecticut River Basin*.

Management objectives in the plan include the following:

- Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
- Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.
- Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, aims to maximize the number of juvenile recruits emigrating from freshwater stock complexes via the following objectives::

- American shad must be able to locate and enter the passage facility with little effort and without stress.
- Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.
- Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.
- To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g., turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

Based on the CRASC plan, USFWS seeks the accomplishment of several resource goals and objectives through the relicensing process for the Turners Falls Project and Northfield Mountain Project. Specific to American shad movement and migration, the agency's goal is to minimize current and potential negative project operation effects such as migration delays, false attraction, turbine entrainment, survival of project passage routes, and trashrack impingement that could hinder management goals and objectives.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Shad Migration through Turners Falls Impoundment

Adult shad movements within the Turners Falls Impoundment were monitored during 1973-1975, primarily in the vicinity of the Northfield Mountain facility and the Vernon Dam tailrace (Layzer, 1975; 1977); these studies identified four patterns of movement throughout the impoundment and determined that fish were often located in deeper areas. The location with the most shad detections was a deep area below the Northfield Mountain tailrace (Layzer, 1977). A deep, turbulent area known as the Narrows was identified as a location where delay occurred (Layzer, 1975).

Passage through the Turners Falls Complex

Many previous studies have been conducted on shad migration and/or passage within the Turners Falls Complex; for a list of each, see Appendix E. Adult shad movements have also been studied in the Turners Falls power canal starting in the mid-1980's (BioSonics, 1985; ERC, 1987); the Gatehouse fishway was identified as a difficult area of passage. More recently, researchers at the Conte Lab have expended considerable effort monitoring passage at Turners Falls Dam, with PIT, telemetry, or a combination of those methods having been employed from 1999 through 2010. PIT tagging studies, sometimes in combination with telemetry, were conducted during 2000-2003. These studies primarily evaluated shad passage performance through the Turners Fall Complex; areas of evaluation included the Cabot fishway, Spillway fishway, Gatehouse gallery and fishway, the power canal, and the river from Holyoke to Turners Falls (Sullivan et al., 2002; CAFRC, 2003). Further PIT tag assessment of the Cabot fishway (Sullivan, 2004) determined that 57% of shad that enter the fishway do not ascend past the lower third of the fishway, and primary problems within the ladder were identified (Haro & Castro-Santos, 2005). In general, the numbers of fish passing through the Spillway fishway were too low for rigorous evaluation (Haro & Castro-Santos, 2005). Some of the most recent studies have evaluated adult shad passage into the Gatehouse fishway using radio telemetry following modifications intended to improve passage there (Haro & Castro-Santos, 2009; Haro & Castro-Santos, 2010). Passage through the Gatehouse improved after modifications, but the studies were unable to discern the ultimate cause of improved passage because multiple modifications were made. This study also found that fish which were transported from Holyoke exhibited improved passage relative to those which ascended the Cabot fishway, possibly indicating that stress and delay through the Cabot fishway could result in reduced passage at the Gatehouse.

Whole-River Telemetry Studies

In addition, whole-river shad telemetry studies were performed in 2011 and 2012. These data should allow quantification of delay below Turners Falls, and could help guide studies requested above. Preliminary analyses of data through 2011 have been made available to FirstLight and the resource agencies. The whole-river studies have also shown that, at least in 2011, most shad that pass Turners Falls rapidly progress upstream to Vernon Dam. Similar patterns were noted in 2012 (T. Castro-Santos, personal communication). Similarly, concerns relative to the downstream passage of spent shad also remain relative to delays, with existing unpublished USGS telemetry data sets suggesting this is may be issue within the Turners Falls power canal.

The Need for Additional Information

Due to the relatively large amount of data gathered by previous studies, it is possible that some objectives of this study may already be partially satisfied, or that this study could be designed to address questions raised by results of those data; however, the data require further analysis prior to making conclusions regarding how they apply to this study or how the results may alter the design.

Project Nexus (18 CFR § 5.11(d)(4))

Project operations may affect passage route selection, entry into fishways, and create delays to upstream and downstream migration. The project's upstream and downstream passage facilities should be designed and operated to provide effective upstream and downstream fish passage.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The proposed study will build and expand on the information collected by the Conte Lab and FirstLight. Previous data will be used to identify potential locations where further or more detailed information is

required to evaluate shad migration through the Turners Falls and Northfield Mountain projects; after a detailed study design is developed, shad migration will be monitored using telemetry and video monitoring techniques.

Task 1: Review Existing Information

Analysis of previously collected data will be completed in 2013 to help inform the design of subsequent field studies and to determine whether some objectives have already been met with recent existing data. Substantial data have already been collected at Turners Falls Project from multiple years of passage assessments conducted for FirstLight by Conte Lab researchers, which will be useful to determine whether further study of those areas is required or if this study should focus efforts elsewhere. Data were also collected for the 2011 and 2012 full river study conducted by the Conte Lab that address migration and passage questions at the Turners Falls and Northfield Mountain Projects that have not yet been analyzed. Relevant data from the project area will be analyzed as part of this study.

Task 2: Develop Study Design

Once the analysis of existing data is completed in 2013 a detailed study design will be developed in consultation with the resource agencies and will specify sample sizes, tag configurations and receiver configurations. Existing information on captured, handled, and tagged fish performance, along with other factors such as timing of tagging and potentially transport, will be considered to ensure an adequate sample size of healthy tagged fish is available to address study objectives. An array of stationary monitoring stations (radio and PIT) will be designed to address the issues identified among the project areas, and will provide an appropriate level of resolution to fulfill the objectives of the study.

A plan and schedule for dam flow releases will be developed. Flows between 2,500 and 6,300 cfs will be evaluated as they have been identified as the range of flows needed for successful spawning for ESA-listed shortnose sturgeon which occurs at the same time as upstream shad passage.

Task 3: Evaluation of Route Selection and Delay

Radio Telemetry Tracking

Information to address many of the objectives would rely on the tagging of upstream migrating adult shad. Fish will be captured at Holyoke Dam, tagged with radio and PIT tags, and released upstream of Holyoke Dam. Tagged fish will be tracked throughout the study area during both upstream and downstream migration with fixed arrays and via manual tracking; the use of PIT tags in addition to radio telemetry tags will provide an inexpensive safeguard in the event of radio tag loss, and would also allow for precise tracking within fishways if necessitated by Task 2. Use of radio, including PIT telemetry is a widely accepted method to assess fish migratory behavior and passage success and has been used to assess migration and passage issues at the Turners Falls Project, as well as other Connecticut River projects. However, these methods have also been shown to alter the behavior and mortality of tagged fish; consideration of these alterations will be important for determining the adequate sample size during the development of the study design in Task 2.

Additional tagged individuals may need to be released farther upstream (Turners Falls power canal, upstream of Turners Falls Dam), to ensure that enough tagged individuals encounter project dams on both upstream and downstream migrations, that these individuals are exposed to a sufficient range of turbine and operational conditions to test for project effects, and to provide adequate samples sizes in order to address the objectives.

Video Monitoring

Video monitoring will be used for specific study areas such as the Spillway fishway. Use of video monitoring of the Spillway fishway will provide additional overall data on fishway efficiency; all shad attempting to pass would be monitored versus only those shad that have been tagged. FirstLight proposes to conduct video monitoring using the Delta Vision commercial series of underwater video camera and lighting manufactured by Ocean Systems Inc. Video data will be recorded on a dedicated digital video recorder.

Task 4: Evaluation of Mortality

The telemetry study will be designed to use of motion sensor telemetry tags that will give researchers an indication of passage induced mortality. Mortality will be assessed at locations where tagged fish as part of the radio tracking study in Task 3 are subjected to entrainment or passage via spillage.

Task 5: Reporting

A report will be prepared including a summary of the results of the collected telemetry data along with statistically justifiable analyses of American shad migration and behavior throughout the study area in the Connecticut River. Collected biological information, water quality data, river conditions, project operations and flow conditions, and the condition of project facilities during the time of the study will be included in the report. Tagged-shad movements during the study will be graphically displayed. All data used to develop the report will be included in an appendix.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The analysis of existing data and data from the requested study will require a substantial effort and cost to capture, PIT tag, and radio tag a sufficient number of shad at Holyoke to release at upstream locations. We are not aware of any other study technique that would provide project specific fish behavior and migration information to adequately assess existing project operations and provide insight in possible alternative operations and measures needed to address impacts to fish migration success. Cost for the entire multi-project tagging, tracking and data analysis are expected to range from $400,000 to $500,000 based on past Turners Falls Project studies and the 2011 and 2012 shad telemetry studies. Video monitoring of the Spillway fishway would add a modest cost to this study.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

Existing data from prior adult shad telemetry efforts on the Connecticut River will be analyzed in the summer of 2013 and will provide the basis for a detailed study design which will include; sample sizes, tag configurations and receiver configuration. The detailed field study will be designed in consultation with the resource agencies.

Adult American shad migrate into the lower Connecticut River during late March or early April. Fish lift operation at the Holyoke Project, located downstream, typically begins on April 15, with shad reaching Cabot Station in late April or early to mid- May. As such, the telemetry based monitoring system will be deployed, calibrated and tested in late March and early April 2014, prior to the arrival of adult shad to the study area. Test fish will be collected at the Holyoke Project and released at various locations upstream. Prior work conducted in the Connecticut River has shown that early migrating shad have the strongest migratory drive, traveling the farthest upstream (T. Castro-Santos, USGS Conte Lab, personal communication). These early migrants will be targeted for use in the study to maximize the potential for test fish to reach and interact with the Turners Falls and Northfield Projects. American shad migrate up

river when water temperatures are generally between 12 and 20°C; spawning occurs from 14 to 23°C when river flow is generally declining from the spring peak. Spent outmigrants travel downstream shortly after spawning. The exact timing of the out-migration will be dependent on many factors, most notably water temperature. The study is anticipated to conclude by early July. If deemed necessary, a second year of field work may be conducted.

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3.3.3 Evaluate Downstream Passage of Juvenile American Shad

General Description of Proposed Study

An evaluation of downstream passage of juvenile American shad has been requested by USFWS, NOAA, MDFW, NHFG, VTDEC, CRWC, TU and the Town of Gill. A field study of juvenile American shad outmigration in the Turners Falls impoundment and the power canal and at Turners Falls Dam, Station No. 1, Cabot Station, and the Northfield Mountain Project will be conducted to assess juvenile American shad outmigration success.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to determine if project operations affect juvenile American shad outmigration success.

Study objectives:

- Assess the effects of the Projects on the timing, orientation, routes, migration rates, and survival of juvenile shad;
- Determine the proportion of juvenile shad that pass downstream through the power canal versus over the dam under varied operational conditions, including a range of spill conditions;
- Determine the rate of downstream movement within the impoundment, over the dam and through the bypass reach, or through the power canal;
- Determine survival rates for juveniles spilled over/through dam gates, under varied operation conditions, including up to full spill during the annual fall power canal outage period;
- Determine downstream passage timing, route selection, and rate of movement of juvenile shad through the power canal to Station No. 1, Cabot Station, and the Cabot Station bypass;
- Based upon Year 1 study results on route selection, determine the survival rate for juvenile shad entrained into Station No.1; and
- Determine the survival rates for juvenile shad entrained at Cabot Station.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

In 1992, the CRASC developed a draft document titled: *A Management Plan for American Shad in the Connecticut River Basin*.

Management Objectives in the plan include the following:

- Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
- Achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

- Maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, aims to maximize the number of juvenile recruits emigrating from freshwater stock complexes.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

American shad have had access to spawning and rearing habitat upstream of Turners Dams since passage was provided via fishways in 1980. Effective downstream passage and successful spawning and juvenile production are necessary to help achieve shad management restoration goals for the Connecticut River. American shad broadcast spawn with the highest spawning activity occurring in runs and lowest activity in pools and riffle/pools (Ross et al., 1993). Field research by Ross et al. (1993) in the Delaware River further noted that a combination of physical characteristics that seems to be avoided by spawning adults is slow current and greater depth. American shad year-class strength has been shown to depend on parent stock size and environmental conditions during the larval life stages (Creeco & Savoy, 1984). Rate of movement in juvenile American shad outmigration may affect survival rates in the transition to the marine environment (Zydlewski et al., 2003). Juvenile shad outmigration in the Connecticut River begins when declining autumn temperatures reached 19^{o}C and peaked at 16^{o}C (O'Leary & Kynard, 1986). During the peak of the migration, juvenile shad captured by O'Leary and Kynard (1986) averaged 97 – 100 mm in total length.

Juvenile shad abundance has been shown to be negatively correlated with river flow in June (Crecco & Savoy, 1984). Juvenile shad are abundant in many river locations throughout the summer, where they provide a forage base for predatory fish. Although some fish may move downstream through the Project at other times, the peak seaward migration out of the Connecticut River occurs in September through November. O'Donnell and Letcher (2008) examined juvenile shad early life history and migration upstream and downstream of Turners Falls Dam. Their study results led to the decision by the agencies to require earlier operation of downstream fishways to protect early season juvenile shad out-migrants (1 September prior to 2010, 15 August in 2010, and since 2011, 1 August).

Much daily movement occurs in evening hours until about 2300 h but movement can occur round-the-clock. The young migrate to areas in the North Atlantic and remain at sea for four to six years before returning to their native river to spawn.

Downstream juvenile clupeid passage studies at Turners Falls were conducted in the fall of 1991 and 1992 (Harza & RMC, 1992; 1993) which included the objectives of determining the percentage of juvenile shad and herring that pass via the bypass log sluice or that were entrained in the Cabot Station turbines and related data (e.g., catch rates) were compared. It was concluded that only an estimated 54% (average bypass rate, weighted by estimated number bypassed) of the juvenile American shad approaching Cabot Station were bypassed via the log sluice; this estimate was greater during 1992, with 87% of juvenile shad passing through the log sluice after the installation of a new sampling device/bulkhead. A study during fall 1993 determined that a greater percentage of juvenile clupeids (94.4%) passed through the log sluice after the downstream passageway was equipped with artificial lighting (RMC, 1994).

Project Nexus (18 CFR § 5.11(d)(4))

Project operations may affect passage route selection, entry into bypasses, and rate of downstream migration. The project's downstream passage facilities need to be designed and operated to provide effective downstream fish passage.

Adult American shad passed upstream of Turners Falls Dam utilize upstream spawning habitat. Juvenile American shad production occurs in these habitats upstream of Turners Falls Dam on an annual basis. Juvenile American shad require downstream passage to complete their lifecycle and promote recruitment to the basin.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The impact to juvenile shad outmigrants by project operations will be studied by a combination of approaches including hydroacoustic and radio telemetry, and may include the use of turbine balloon tags[17]. The study objectives will be met by a tasked approach and are anticipated to occur over two years of study, 2014 and 2015.

Task 1: Evaluation of Timing, Duration and Magnitude of Migration

The timing, duration, and magnitude of juvenile shad migration at the Turners Fall Project will be evaluated over a range of existing and operational conditions. In advance of the field study, test conditions will be defined in consultation with resource agencies. Hydroacoustics will be deployed in the forebay area at Cabot Station. The exact number and position of the hydroacoustic transducers will be determined in the field but it is anticipated that a surface transducer with a downward orientation would be deployed. Data from the hydroacoustics will provide information on the timing, frequency and magnitude of the migration. Shad migration through the downstream bypass will be sampled concurrently. Concurrent bypass sampling will be conducted over several discreet events such that a statistically robust comparison between the proportion of bypassed fish and those at Cabot Station can be calculated and thus provide an estimate of bypass efficiency.

Hydroacoustic data will be processed with Myriax Echoview or similar software. The data will be reduced by applying an intensity threshold that is representative of the target size and analyzed with an α,β-tracking algorithm, which identifies the series of echoes that were returned by an individual fish over successive pings. The tracking results will be reviewed on the echogram and exported as a database containing time, target strength, and 3-D positional information for each fish detected. Fish counts will be expanded for the non-sampled area of the intake cross-section. An expansion factor will be calculated for each individual fish as a function of its effective beam width at the range it was observed. This effective beam width depends on the acoustic beam pattern and the size of the target. Thus, for a given transducer, at any given range, a large fish can be detected over a wider portion of the intake cross-section than a smaller fish. The expansion factor compensates for this differential detection probability.

Task 2: Evaluate Route of Passage Choice and Delay

Radio telemetry methods will be used to assess routes of downstream passage and occurrences of delay, if feasible. Juvenile shad are fragile and can be difficult to reliably test using methods requiring fish handling and tagging such as telemetry. However, prior telemetry studies conducted with juvenile shad have had success, particularly when large sized (~120mm) hatchery juvenile test fish were used. Most wild out-migrating young of year (YOY) shad do not attain this large of a size prior to exiting the Project area (K. Sprankle, personal communication). As such, FirstLight proposes a phased approach to the juvenile shad telemetry study.

[17] These tags are proprietary to the consultant representing TransCanada on the three hydropower facilities undergoing relicensing on the Connecticut River. It is unknown at this time if these tags will be available for use by FirstLight.

Phase 1 will be conducted in the first year of study in which FirstLight will conduct a proof of concept assessment to investigate the feasibility of tagging juvenile shad. A minimum of 500 juvenile shad will be collected from Connecticut River at the Turners Falls downstream bypass sampler and held for a minimum of 8 hrs in a 1000 gallon pump-through tank to investigate collection related latent mortality. Prior to tagging, test fish will be anesthetized in a solution of water and MS-222 at a concentration of 45.0-50.0 mg/L. According to the manufacturer, this concentration range provides moderately rapid anesthesia and allows fish to be tagged within two minutes of being placed in an anesthetic sink. At this concentration, fish can be placed in the anesthetic for up to 30 minutes without risk of mortality. Test fish will be fitted with an external *dummy* tag that simulates the different types of tags to be tested. Following tagging, test fish will be returned to a dedicated 1000 gallon pump-through tank and held for a minimum of 8 hrs and assessed as; alive, dead or moribund. A survival of greater than or equal to 80% will be deemed to be sufficiently effective for full scale tagging to proceed in Phase 2. Should tagging mortality exceed 20% and no incidental factors such as water quality issues can be identified, then the process will be re-evaluated and refined based on experience from the first tag group. A second test group will be tagged and evaluated. Should tagging mortality exceed 20% and no incidental factors can be identified, then FirstLight will consult with agencies and stakeholders to develop alternatives, if practicable.

If Phase 1 of the study described above indicates tagging is possible, Phase 2 will proceed. In Phase 2, routes of passage will be monitored via a radio telemetry monitoring array such that each route of passage (i.e. over the dam, Station No. 1, Cabot Station, and the fish bypass) is monitored. Study fish will be collected, tagged (radio) and released upstream of the NMPS. The exact number of tagged fish, radio receivers and antenna location, type and configuration will be determined in consultation with the agencies. Further, other previous or concurrent radio telemetry studies will inform the design.

Task 3: Survival

If possible, balloon tags will be used to empirically determine rates of survival for fish entrained at Station No. 1 and Cabot Station as well as those passed over or through the dam's gates, under varied operations, including spill conditions if possible, which typically occurs annually in the fall during the canal outage period.

The feasibility of tagging juvenile shad with balloon tags will be investigated in Task 2. Should the feasibility effort prove actionable, five groups of juvenile shad will be tagged; the sample size for each group will be determined in consultation with the agencies. One group will be injected at each of the four passage routes, dam spill or gates, Station No. 1, Cabot Station and the downstream fish bypass. The final group will provide a control group and will be held in a 1000 gallon pump-through tank over the duration of the evaluation to investigate handling and tagging related mortality.

Task 4: Reporting

The hydroacoustic, radiotelemetry and balloon tag data will be analyzed relative to passage route(s) timing, frequency, magnitude and survival. This information will be compiled into a report and will include the methods used, results, a discussion and conclusions.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the proposed level of effort will adequately address the study objectives. The estimated cost for the study is expected to be between $250,000 and $350,000, with much of the costs associated with equipment (hydroacoustic gear, radio tags, radio receivers, and PIT readers) and related fieldwork labor.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The out-migration of juvenile American shad typically begins in September as water temperature begins to cool. However, recent work conducted by O'Donnell and Letcher (2008) in the Connecticut River suggests that the emigration starts as early as the middle of August. As such, the hydroacoustic monitoring equipment will be deployed, calibrated, and tested in the first half of August becoming operational no later than August 15th. The Phase 1 tagging feasibility evaluation will be conducted in September when the outmigration is expected to be at its peak. Targeting the peak outmigration for collection of Phase 1 test fish will minimize effort in the collection. Information collected in the concurrent hydroacoustic monitoring effort will help to pinpoint the peak migration. Phase 2 study tasks will be conducted during the out-migration season, August 15 through the end of October.

Downstream American eel study efforts (Section 3.3.5) will require hydroacoustic monitoring. These two study efforts will overlap due to the overlap in timing of outmigration of adult silver phase eel and juvenile shad. As such, these studies will be conducted concurrently, within the same study year, to take advantage of cost saving related to monitoring equipment rental, deployment, calibration, data management and analysis.

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

In accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1, the study will be completed according to the milestones below.

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3.3.4 Evaluate Upstream Passage of American Eel at the Turners Falls Project

General Description of Proposed Study

An evaluation of upstream American eel passage has been requested by USFWS, NHFG, MDFW, NHDES, VTDEC, CRWC, and TU. FirstLight proposes to complete a study to assess upstream American eel passage at the Turners Falls Project through visual observations of eel concentration areas and trapping methods. FirstLight anticipates conducting visual surveys for eel concentration areas in 2014 and using this information to inform trap placement in 2015.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to identify and assess potential locations for upstream American eel passage at the Turners Falls Project.

This study has two objectives:

- Identify concentrations of eels staging in pools or attempting to ascend wetted structures; and
- Assess whether eels can be passed in substantial numbers and whether sites are viable for permanent passage structures.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The goals of the Atlantic States Marine Fisheries Commission (ASMFC) management plan for American eel (2000) include: (1) protect and enhance American eel abundance in all watersheds where eel now occur; and (2) where practical, restore American eel to those waters where they had historical abundance but may now be absent by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel (letter from NOAA Fisheries, Comments on FirstLight Power Resources Notice of Intent to File License Application, February 27, 2013). Addendum II contains specific recommendations for improving upstream and downstream passage of American eel, including requesting that member states and jurisdictions seek special consideration for American eel in the FERC relicensing process (letter from NOAA Fisheries, Comments on FirstLight Power Resources Notice of Intent to File License Application, February 27, 2013).

In addition, the CRASC developed a Management Plan for American eel in the Connecticut River Basin in 2005. The goal of the plan is "*to protect and enhance the abundance of the American eel resource to ensure its continued role in the Connecticut River Basin ecosystem."* Management objectives in the plan include the following:

1. Protect and enhance eel populations where they currently exist;
2. Where practical, restore populations to waters where they had historical abundance;
3. Provide effective upstream and downstream fish passage around dams and other barriers within the species' range in the basin, and;
4. Comply with all requirements of the Fishery Management Plan of the ASMFC.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

While eels have been known to ascend the Turners Falls fishways, their efficiency is unknown and they are typically operated only during the American shad passage season. Eels are currently able to pass the

Turners Falls Dam complex (as evidenced by documented presence of eels upstream), but the total number of eels attempting to pass Turners Falls and the proportion successfully passing the Turners Falls Project are unknown (letter from NOAA Fisheries, Comments on FirstLight Power Resources Notice of Intent to File License Application, February 27, 2013).

The Holyoke Project has operated upstream eel passage facilities since 2004. In 2012, these facilities passed over 40,000 juvenile eels (letter from NOAA Fisheries, Comments on FirstLight Power Resources Notice of Intent to File License Application, February 27, 2013). There is eel rearing habitat in the 35-mile reach between the Holyoke and Turners Falls Dams; however, it is likely that some eels will attempt to continue upstream to access habitat above the Turners Falls Dam.

Project Nexus (18 CFR § 5.11(d)(4))

The Turners Falls Project may directly impact upstream American eel as Project structures create impediments to migration.

The investigation area includes the following features of the Turners Falls Project:

- Cabot Station discharge area.
- Station No. 1 discharge area.
- Various canal discharge areas.
- Turners Falls Dam.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The study will be performed in accordance with the following methodologies.

Task 1: Systematic Surveys

Systematic surveys of eel presence and relative abundance will be conducted six times during the 2014 eel upstream migratory season. The first survey will be initiated within one week of eels being observed downstream of the project area at the Holyoke eel pass, with subsequent surveys occurring at night after precipitation events and around new lunar cycles throughout the 2014 migration season. Each survey will consist of visual inspection in areas where eels are likely to concentrate as they attempt to climb structures wetted by spill or leakage flow in the Turners Falls Dam complex area. These locations, shown in Figures 3.3.4-1 and 3.3.4-2, include:

- Cabot Station log sluice (downstream fish bypass).
- Cabot Station spillway (emergency water control gates).
- Cabot Fishway (dewatered state).
- USGS Conte Lab flume outfall.
- Station No. 1 outfall.
- Small turbine and process water outfalls from the Cabot Canal.
- Spillway fishway attraction water stilling basin.
- Leakage points along the downstream face of Turners Falls Dam (as site conditions allow for safety).

Recorded data will include location, observation of eels (presence, absence) and relative numbers, relative sizes, behaviors, and time/date of observation, where applicable.

Task 2: Trap Collections

Areas identified in Task 1 as having eels present in sufficient numbers will be targeted as potential areas for permanent eel trap/passes and will be initially assessed using temporary/portable traps in 2015. At a minimum (regardless of survey results), temporary traps will be installed at the following locations in 2015:

- Cabot fishway attraction flow stilling basin (during dewatered fishway period),
- Station No. 1 discharge, and
- Spillway fishway attraction flow stilling basin (during watered and dewatered fishway period).

The temporary trap/passes will be designed and built for each location, and operated throughout the eel upstream migratory season, beginning within one week of eels being recorded at the Holyoke eel pass and continuing until less than 10 eels are observed across all three traps. Ramp-type traps with supplementary attraction flow will be used. Traps will operate daily (24 hours per day) and will be checked periodically to quantify the catch. Recorded data will include location, trapping interval, numbers of eels trapped, relative eel sizes, and hydraulic and environmental conditions during the trapping period.

Eels collected from trap/pass collections will be transported to and released in the Turners Falls Impoundment.

Task 3: Data Analysis

All field data will be compiled, entered into a database, assured for quality, and archived. Tabular and graphic summaries of eel abundance by location will be developed.

Task 4: Reporting

A report will be prepared describing monitoring methods and results. The report will be submitted as part of the Initial Study Report as per the ILP process schedule.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The level of effort for Task 1 of the American eel study (Systematic Surveys) will include at least six (6) evening surveying events. Cost of this effort including equipment is estimated to be $12,000 to $18,000. The 2015 effort to place temporary ramps at identified concentration areas and checking collection boxes on a routine basis (Task 2) will cost between $25,000 and $35,000. The total cost for this study ranges from $37,000 to $53,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

Systematic surveys and trapping to evaluate eel presence and abundance will be conducted six times throughout the eel upstream migratory season (approximately May 1 to October 15, dependent on river temperatures and observations at the downstream eel pass) in 2014. Results will inform locations for installing temporary trap/passes during the same period during 2015.

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Literature Cited

Harza Engineering Company (Harza), BioSonics, Inc. (BioSonics), and Environmental Research and Consulting (ERC). (1991). *Northfield Mountain Pumped Storage Project 1990 Field Sampling Program*. Report to Northeast Utilities Service Company.

Massachusetts Division of Fisheries and Game (MDF&G). (1978). *Resident fish study, 1971-1976: Northfield Mountain Pumped Storage Hydroelectric Project*. Final Report to Northeast Utilities Service Company.

Schmidt, R.E., O'Reilly, C.M., & Miller, D. (2009). Observations of American eels using an upland passage facility and effects of passage on the population structure. *North American Journal of Fisheries Management 29(3)*, 715-720.

Yoder, C.O., Hersha, L.E. & Apell, B.R. (2010). *Fish Assemblage and Habitat Assessment of the Upper Connecticut River. A Preliminary Report and Presentation of Data* (MBI Technical Report MBI/2009-8-3). Final Project Report to U.S. USEPA, Region I.

FIRSTLIGHT POWER RESOURCES

FirstLight Power Resources
GDF SUEZ

N

Proposed Study Plan

0 250 500 1,000 Feet

Figure 3.3.4-1: Approximate Locations of Systematic Eel Surveys near Turners Falls Dam.

Path: W:\gis\maps\Study_Plans\Upstream Eel\Figure 3.3.4-1.mxd

FIRSTLIGHT POWER RESOURCES

Proposed Study Plan

N

0 50 100 200 Feet

Figure 3.3.4-2: Approximate Locations of Systematic Eel Surveys near Cabot Station

Path: W:\gis\maps\Study_Plans\Upstream Eel\Figure 3.3.4-2.mxd

3.3.5 Evaluate Downstream Passage of American Eel

General Description of Proposed Studies

The USFWS, NHFG, MDFW, NOAA, VTDEC, TU, and CRWC have requested two specific studies regarding downstream passage of adult American eel. The first study request was for a timing evaluation of downstream migratory movements of American eel on the mainstem Connecticut River. The second study request was for an assessment of downstream American eel passage at the Turners Falls Project and Northfield Mountain Project. The study proposed herein will be conducted over two years and will use radiotelemetry and hydroacoustic methods to investigate the timing of silver phase eel outmigration in the Connecticut River and routes of passage through the Turners Falls Project.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goals of these studies are to:

1. Better understand migration timing of adult, silver-phase American eel as it relates to environmental factors and operations of the Turners Falls Project and Northfield Mountain Project.

2. Determine the impact of the Turners Falls Project and Northfield Mountain Project on the outmigration of silver eel in the Connecticut River.

Specific objectives of these studies are to:

1. Quantify and characterize the general migratory timing and presence of adult, silver-phase American eel migrating past the Turners Falls Project and Northfield Mountain Project relative to environmental factors and operations.

2. Quantify movement rates and proportion of eel passing via various passage routes at the Turners Falls Project and Northfield Mountain Project. For the Northfield Mountain Project, the study will evaluate the proportion of eel entrained into the intake. For the Turners Falls Project, the study will evaluate the proportion of eel passing via the available routes of passage at the complex.

3. Evaluate survival of adult silver eel passed at the available routes of passage at the Turners Falls complex.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

Based on management plans developed by the ASMFC and the CRASC, the resource management goals identified by the commenting agencies are to:

- Ensure PME measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.

- Conserve, protect and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Project.

Specific goals with respect to downstream passage of American eel are to:

- Minimize current and potential negative project operation effects that could hinder management goals and objectives.

- Minimize project-related sources of downstream passage injury, stress, and mortality in order to maximize the number of silver eel migrating to the spawning grounds.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

According to the commenting agencies, data on the timing of downstream migratory movements and rates of American eel in the mainstem Connecticut River are sparse and relatively incomplete. Preliminary data on the presence of "eel-sized" acoustic targets have been collected (Haro et al., 1999) within the Cabot Station forebay that were somewhat confirmed by video monitoring at the Cabot Station downstream fish bypass; however, these were short-term studies, with acoustic monitoring only performed from 17 September to 5 October and video monitoring only conducted between 18 September to 22 October. Some daily monitoring of the downstream fish bypass at the Holyoke Dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt Associates, 2005; 2006; Normandeau Associates, 2007); these studies also were of relatively short duration (spanning from October 5 to November 10 in 2004 and September 9 to November 11 in 2005) and the sampler was operated at night. To date, no other directed studies of eel migratory movements have been conducted at any location on the Connecticut River mainstem (letter from MDFW, Comments on FirstLight Power Resources Notice of Intent to File License Application, February 28, 2013).

As discussed in the PAD, 2-D and 3-D telemetry studies were conducted at Cabot Station in 1996, 1997, 2002 and 2003. Results of those studies indicate that a significant proportion of eel entering the Cabot forebay become entrained (90% in 2002, 100% in 2003; Brown, 2005; Brown et al., 2009). The PAD notes that the study done in 2003 determined that 15 of the 29 test eel were detected at the Hadley Falls Station. However, that study was not designed to assess turbine mortality. The approach velocity at the Cabot Station racks is approximately 2.0 feet per second at maximum hydraulic capacity. At Station No. 1, the racks have 2.6-inch clear spacing and an approach velocity of 1.2 feet per second. The intake at the Northfield Mountain Project has 48-foot-deep trash racks with six-inch clear spacing over the intake and an approach velocity of 3.5 feet per second at full pumping capacity (15,000 cfs).

To date, no directed studies of eel mortality at Cabot Station or eel entrainment or mortality at either Station No. 1 or the Northfield Mountain facility have been conducted.

Existing research and literature on the American eel relevant to these proceedings includes the following:

Brown, L.S. (2005). Characterizing the downstream passage behavior of silver phase American eel at a small hydroelectric facility. M.Sc. Thesis, Department of Natural Resource Conservation, University of Massachusetts. Amherst, Massachusetts: University of Massachusetts.

Brown, L., A. Haro, and T. Castro-Santos. (2009). Three-dimensional movement of silverphase American eel in the forebay of a small hydroelectric facility. In J. Casselman et al. (Eds.), *Eel at the Edge: Science, Status, and Conservation Concerns* (pages 277-291). Bethesda, MD: American Fisheries Society.

Electric Power Research Institute (EPRI). (2001). Review and documentation of research and technologies on passage and protection of downstream migrating catadromous eel at hydroelectric facilities. EPRI Technical Report No. 1000730, Palo Alto, California 270 pp.

Haro, A. (2003). Downstream migration of silver-phase anguillideel. Pages 215-222 in: Aida, K., K. Tsukamoto, and K. Yamauchi, eds. Eel Biology. Springer, Tokyo.

Haro, A., D. Degan, J. Horne, B. Kulik, and J. Boubée. (1999). An investigation of the feasibility of employing hydroacoustic monitoring as a means to detect the presence and movement of large, adult eel (Genus *Anguilla*). S. O. Conte Anadromous Fish Research Center Internal Report No. 99-01. Turners Falls, Massachusetts. 36 pp.

Kleinschmidt Associates. (2005). *Factors influencing the timing of emigration of silver-phase American Eel, Anguilla rostrata, in the Connecticut River at Holyoke MA*. Submitted to the City of Holyoke, Holyoke Gas and Electric Department.

Kleinschmidt Associates. (2006). *Holyoke Project (FERC No. 2004) silver-phased American eel flow priority plan*. Submitted to the City of Holyoke, Holyoke Gas and Electric Department. 51 pp.

Normandeau Associates, Inc. (2007). *American eel emigration approach and downstream passage routes at the Holyoke Project, 2006*. Submitted to the City of Holyoke, Holyoke Gas and Electric Department. Final report. Westmoreland, New Hampshire: Normandeau Associates, Inc.,

Project Nexus (18 CFR § 5.11(d)(4))

Project operations may directly or indirectly affect eel outmigration in the fall through entrainment, rate of movement, injury, or mortality. Baseline information related to the timing and passage of outmigrating eel will allow stakeholders to assess project-related effects on eel migratory success and survival.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The sample size of test fish will be determined in consultation with the resource agencies with the intent of reaching an agreement on adequate sample size such that FirstLight and the resource agencies will have confidence in the test results.

Task 1: Evaluate Timing of Downstream Migratory Movements

Task 1 will be conducted in the first year of study (2014) and in tandem with the juvenile shad study (see Section 3.3.3). The timing of eel migration as it relates to environmental factors and operations of the Turners Falls Project and Northfield Mountain Project will be assessed through the use of hydroacoustic techniques. Hydroacoustic equipment will be installed within the Cabot Station forebay to provide information on the timing, magnitude, and duration of adult eel passage through this area. Because eels tend to concentrate in areas of dominant flow[18], the hydroacoustic zone to be monitored will target a portion of the dominant flow through the project (i.e., forebay intake area). Hydroacoustic monitoring will encompass the entire potential migratory season, beginning in mid-August and ending in mid-November. Data will be recorded for later processing and archiving. Concurrent sampling will also occur at the Cabot sampler on at least 10 evenings to ground truth the hydroacoustic data and compare the percent of eels passing via the Cabot sampler and Cabot Station.

In addition, project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, temperature, air temperature, and precipitation amounts) will be monitored following standard methodology throughout the duration of the studies.

[18] Brown et al., 2009; EPRI 2001.

One year of hydroacoustic sampling is being proposed. If the 2014 season is a typical flow/weather season, then that would conclude this effort. If the 2014 season is not typical, then a second season would be considered based upon discussions with the resource agencies.

Task 2: Assessment of Downstream Passage of American Eel

Task 2 will be conducted in the second year of study (2015). FirstLight will assess downstream passage and entrainment survival of adult American eel through use of radio-telemetry techniques. FirstLight will use the findings from the 2014 hydroacoustic study to inform the 2015 studies.

FirstLight will use radio telemetry techniques to monitor adult downstream eel passage at the Turners Falls Project and Northfield Mountain Project. For the Northfield Mountain Project, the study will evaluate the proportion of tagged eel entrained into the intake. For the Turners Falls Project, the study will evaluate the proportion of eel passing via spillways, gates, turbines, and the existing fish bypass at Cabot Station and/or Station No. 1. The route of passage study will be designed with the use of motion sensor telemetry tags that will give researchers an indication of passage-induced mortality.[19] This phase of the study will involve systematic releases of radio-tagged silver phase eels at strategic points above areas of interest to assess general routes of passage (i.e., via spill, fish passageways, or turbines).

Emigrating silver phase eels will be collected at the Cabot bypass sampler or the Holyoke Canal bypass sampler. Eels selected for tagging will meet morphometric (e.g., eye diameter relative to body size - Pankhurst Index of approximately 6.5 or greater) criteria to ensure they are migrant silver phased eels. Collections will be made within the migratory season (late August to mid-October), and eels will be tagged and released within seven days of collection.[20] In addition, project operation (flows, levels, gate openings, number of units operating and operation level) and environmental conditions (river flow, water temperature, air temperature, and precipitation amounts) will be recorded throughout the duration of the studies.

Task 2a: Northfield Mountain Route Selection Study (i.e., Entrainment to Northfield Mountain intakes)

Groups of test fish will be tagged and released approximately 5 km upstream of the Northfield Mountain Project to increase the likelihood that they will move downstream and interact with Project facilities. Approximately three radio telemetry antenna arrays will be strategically placed within or near the intake area to determine times eels are present within the river reach in the immediate vicinity of the Northfield Mountain Project intakes, within the intakes themselves, and whether they are entrained into the upper reservoir.

Task 2b: Turners Falls Dam Route Selection Study

Groups of test fish will be tagged and released approximately 3 km upstream of the Turners Falls Dam. Groups of eels will be released during spill and non-spill periods and during periods of low, moderate,

[19]For example, if an eel goes into an immobile state for a period of 36 hours, the tag's code will be programmed to switch signal transmission patterns (e.g., to a different code or different burst rate).

[20] The timing of collection, tagging, and release will be entirely dependent on migratory patterns and weather/river conditions. All tagged eel will be released at night during inclement weather or with inclement weather pending to increase the likelihood that eel will move soon after release. Though FirstLight will target a seven day hold period, riverine conditions may not be adequate for release, and therefore hold times may last longer than seven days. Migratory movements of silver eel have been noted after hold periods longer than seven days during several recent radio-telemetry studies at hydroelectric facilities in the northeast [(see FERC projects P-2364 (Abenaki), P-2365 (Anson), P-2325 (Weston)].

and high generation conditions if possible. Telemetry receivers and antennas will be positioned to monitor the following potential routes of passage:

- Within the power canal.
- Near the bascule gate(s).
- Near the tainter gate(s), if appropriate to the typical depth of the openings.
- Within the bypass river channel.
- Turners Falls spillway fishway attraction water intake (if operational).
- Station No. 1 turbines.
- Cabot Station log sluice (downstream fish bypass).
- Cabot Station spillway (emergency water control gates).
- Cabot Station turbines.
- Route 116 Bridge.

After the first group of eels is released and tracked through the Project, FirstLight will determine the areas of egress and consult with the agencies to determine if additional releases are warranted.

Task 2c: Mobile Tracking

Modifications to the location and number of receivers/antenna may occur during study set-up due to conditions encountered in the field; however, the intent is to monitor the above-named potential routes of passage. Aerial yagi and/or droppers will be used. Eels released above the Northfield Mountain intake that enter the lower end of the Turners Falls Impoundment (i.e., not entrained at Northfield Mountain) will be used to supplement the release groups. Mobile tracking (i.e., via boat, vehicle, or by foot) in river reaches between release sites and several km downstream of Cabot Station will be performed at regular intervals during and after releases to confirm routes and fates of passed fish, or fish lost to follow-up. Movement rates (time between release and passage) of eels passing the projects by various routes will also be quantified.

Tags will be programmed to transmit on several different frequencies to avoid interference or tag signal collision. Tag pulse will likely be programmed at 2 second intervals with a battery life of approximately 50 days. As possible, DSP-type receivers will be utilized to avoid the need to switch between frequencies, thereby reducing the potential for missed detections. Prior to release of tagged eel, FirstLight will perform testing and range verification during set-up to minimize overlap of detection field while maximizing detection range. As needed, beacon transmitters will be employed at strategic locations to provide a repeated data stamp during the study to verify receiver functionality.

Task 3: Data Management and Analysis

Data from hydroacoustic timing studies (Task 1) will be collected in the field and transferred to an electronic format. All data entry will be assured for quality per existing data QC protocols. These data will be processed with Myriax Echoview or similar software. The data will be reduced by applying an intensity threshold that is representative of the target size and analyzed with an α,β-tracking algorithm, which identifies the series of echoes that were returned by an individual fish over successive pings. The tracking results will be reviewed on the echogram and exported as a database containing time, target strength, and 3-D positional information for each fish detected. Eel counts will be expanded for the non-sampled area of the intake cross-section. An expansion factor will be calculated for each individual eel as a function of its effective beam width at the range it was observed. This effective beam width depends on

the acoustic beam pattern and the size of the target. The expansion factor compensates for this differential detection probability.

Data from the adult eel telemetry study (Task 2) will be collected regularly from the field during the study periods (i.e., at 2 to 3 day intervals). Data will be archived and entered into an MS Access or MS Excel database for sorting and post-processing. All data entry will be assured for quality per existing data QC protocols. To the extent possible, routes of passage will be determined. Route determinations will be based on logical chronological detection of individual eel movements through the telemetry monitoring arrays or in some instances, route of passage determinations will be inferred logically in the event that eel are not detected at all stations in an upstream to downstream direction. Additionally, route-specific survival will be determined by the sensor tag and is based upon an eel resuming typical migratory behavior downstream.

Task 4: Reporting

The report will be submitted as part of the Initial Study Report as per the ILP process schedule.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Projects on downstream passage and timing of adult eel in the investigation area. The estimated cost for this study is approximately between $250,000 and $350,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

Task 1 will be conducted in the first year of study (2014) and in tandem with the juvenile shad study (see Section 3.3.3). Task 2 will be conducted in the second year of study (2015).

In accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1, the study will be completed according to the milestones below.

3.3.6 Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

General Description of Proposed Study

The following stakeholders requested studies to investigate the impact of project operations on shad spawning, spawning habitat and egg deposition within the project boundary: USFWS, MADFW, NHFGD, NHDES, CTRWC, NOAA, the Town of Gill, TU, and VTDEC. Section 4.4.5 of the PAD identifies several migratory species of fish that seasonally occur in the aquatic habitat within the Project boundary. One such species, the American shad (shad), seasonally migrate into the Connecticut River to spawn, reaching Project waters in late April or early to mid- May. Much of the aquatic habitat downstream of Cabot Station is suitable for shad spawning, and the reach of the Connecticut River including the Deerfield River confluence is thought to be particularly productive spawning habitat. This reach is in relatively close proximity to Cabot Station and as such is susceptible to water level fluctuations due to station operational changes. The study described herein, will investigate the effects of operational changes and subsequent flow/water level fluctuations on spawning shad in the Connecticut River.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

Determine if project operations (under the permitted and proposed operational ranges) affect shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream from Cabot Station and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam Impoundment and in relation to Northfield Mountain Pump Storage operations.

Specifically, the shad spawning study will:

- Determine areas utilized by shad for spawning by conducting night-time visual observation of spawning activity,
- Identify and define those areas geospatially, and obtain data on physical habitat conditions effected by project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Determine project operation effects on observed spawning activity, under a range of permitted or proposed project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity;
- Quantify spawning activity as measured by night-time spawning/splash surveys in areas of spawning activity, and downstream of these areas, to further determine project operation effects (location extent of exposure from changing water levels and flows and on associated habitats from project operations).

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The CRASC was established by Congress in 1983 (and reauthorized in 2002 for another 20 years) through the Connecticut River Atlantic Salmon Compact (Public Law 98-138).

The Connecticut River Atlantic Salmon Commission developed *A Management Plan for American Shad in the Connecticut River Basin* in 1992. Management Objectives in the plan include the following:

- Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
- Achieve annual passage of 40% to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, aims to maximize the number of juvenile recruits emigrating from freshwater stock complexes through the following objectives:

- To mitigate hydrological changes from dams, consider operational changes such as turbine venting, aerating reservoirs upstream of hydroelectric plants, aerating flows downstream, and adjusting in-stream flows.
- Natural river discharge should be taken into account when instream flow alterations are being made to a river (flow regulation) because river flow plays an important role in the migration of diadromous fish.
- Ensure that decisions on river flow allocation (e.g., irrigation, evaporative loss, out of basin water transport, hydroelectric operations) take into account instream flow needs for American shad migration, spawning, and nursery use, and minimize deviation from natural flow regimes.
- When considering options for restoring alosine habitat, include study of impacts and possible alteration of dam-related operations to enhance river habitat.

The resource agencies' goals related to aquatic natural resources include:

- Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
- 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.
- Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.
- Conserve, enhance, and restore natural communities, habitats, and species and the ecological processes that sustain them.
- Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.
- Ensure that PME measures are commensurate with Project effects and help meet regional fish and wildlife objectives for the basin.
- Conserve, protect, and enhance the habitats for fish, wildlife, and plants that continue to be affected by the Turners Falls Project.

The resource agencies' goal specific to American shad is:

- Minimize current and potential negative project operation effects on American shad spawning and recruitment.

The agency requests are intended to facilitate the collection of information necessary to conduct effects analyses and to develop reasonable and prudent conservation measures, and PME 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*.), Silvio O. Conte National Fish and Wildlife Refuge Act (P.L. 102-212; H.R.794), the Federal Power Act (16 U.S.C. §791a, *et seq*.), the Atlantic

States Marine Fisheries Compact (P.L. 539, 77th Congress, as amended by P.L. 721, 81st Congress), and the Atlantic Coastal Fisheries Cooperative Management Act (16 U.S.C. 5107).

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Since the construction of the first fish lift facility at Holyoke Dam in 1967, American shad have had access to spawning and rearing habitat upstream from Holyoke Dam. A number of improvements to the Holyoke fishway have occurred since that time, but while the numbers of shad lifted at Holyoke have reached as much as 721,764 and the overall shad population to the river exceeded 1.6 million shad in 1992 (CRASC 1992), total shad population, and numbers of shad passing Turners Falls Dam have not met CRASC management plan objectives.

In preparation of the PAD, fisheries data were compiled on the shad resources in the Connecticut River and can be found in section 4.4.5 of the PAD. American shad seasonally migrate into the Connecticut River in the spring, late March or April, to spawn; typically reaching Project waters by late April to mid-May when river flow is generally declining from the spring peak. Shad passage has been monitored at the Holyoke Dam (Figure 4.4.5-1 of the PAD) and these counts provide a comprehensive record of the number of shad that have access to the Project waters. Seasonal shad passage at the Holyoke Dam peaked at 721,764 in 1992. Population number and passage numbers past Holyoke have declined from their peak, with average Holyoke passage numbers over the last 10 years of 211,850. However, shad numbers have been on the rise since 2005 with over 490,000 shad passing Holyoke Dam in 2012.

American shad typically spawn in water ranging from 3 to 18 ft in depth, in run or glide habitat (FirstLight, 2012). However, depth is not considered a critical habitat parameter for American shad (Greene et al., 2009). Shad typically spawn at night, with males reaching spawning areas prior to females (Greene et al., 2009). Daytime spawning has been documented on overcast days or in turbid water when light intensity is somewhat diminished (Greene et al., 2009). Females are broadcast spawners, preferring to release their eggs over course substrates including cobble, gravel and sand (Greene et al., 2009 and FirstLight, 2012). American shad are highly fecund and spawn repeatedly as they move up river (Greene et al., 2009). They exhibit asynchronous ovarian development and batch spawning with multiple females releasing their eggs at the surface where they will be fertilized by one or more males. The act of spawning can be vigorous with individual breaking the surface and is conspicuous to those that are in the right place at the right time to observe.

Most (~77%) of the 30 mile reach below Cabot Station consists of *run* mesohabitat type with coarse substrates; presence of glide habitat areas are negligible (FirstLight, 2012a). Though habitat suitable for shad spawning is abundant in the 30 mile reach downstream of Cabot Station, the area of the Connecticut River, in the vicinity of the Deerfield River confluence, is thought to be particularly productive. Layzer (1974) identified 6 spawning sites from an area below the mouth of the Deerfield River (river mile 191.9) to river mile 161.7, below the Mill River confluence in Hatfield, MA. The upstream extent of this range is in close proximity (~ 0.7 miles) to Cabot Station and therefore may be susceptible to flow changes that result from Station operation.

In 2012, FirstLight conducted studies in the late spring and summer to examine habitat conditions downstream of the Turners Falls Dam. The study documented that in low flow conditions Cabot Station project operations produced fluctuations in water level elevations that can range over 4 feet in magnitude (daily operation) at the USGS Montague Gage Station, to lower values of 2 to 3 feet at the Route 116 Bridge, Sunderland, MA (PAD).

Project Nexus (18 CFR § 5.11(d)(4))

For the purposes of this study plan the Study Area includes the Connecticut River in reaches downstream from Cabot Station to the upper extent of the Holyoke impoundment and in the project bypass reach of Turners Falls Dam, in the Turners Falls Dam impoundment and in relation to Northfield Mountain Project operations.

American shad are known to spawn at five locations downstream from the Turners Falls Project from an area below the mouth of the Deerfield River (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer, 1974, Kuzmeskus, 1977).

Shad spawning is likely influenced by river flow. Flow fluctuations may impact shad spawning activity by altering current velocities and water depth at the spawning sites. Effects on spawning behavior could include suspension of spawning activity, poor fertilization, flushing of eggs into unsuitable habitat due to higher peaking discharges, eggs dropping out into unsuitable substrate and being covered by sediment deposition and/or eggs becoming stranded on dewatered shoal areas as peak flows subside.

While several shad spawning and egg deposition studies were conducted in the 1970s, that research was aimed at assessing the potential impact of developing a nuclear power station in the Montague Plains section of the Connecticut River. There are no known studies that have been conducted that were specifically designed to determine if a relationship between spawning behavior, habitat use, and egg deposition and project operations effects of the Turners Falls Project and Northfield Mountain Project. Continued Project operation and maintenance activities could, through the manipulation of flow, affect American shad that utilize the project area for spawning. The Agencies are concerned that peaking operations may be altering spawning behavior and contributing to the failure of the Connecticut River shad population to meet management targets. This study will provide information regarding the availability of spawning habitat use and verify the presence or absence of spawning shad within the Study Area as well as spawning behavioral during operational (flow) changes at Cabot Station.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

FirstLight will investigate shad spawning within the study area to determine how operations at Cabot Station may affect spawning behavior. The investigation will include a review of existing information relative to shad spawning in the Connecticut River and a survey of the study area to identify the presence of spawning shad and investigate how flow manipulations, as a result of Project operation, affects spawning behavior.

The field studies will examine known spawning areas downstream of the Turners Falls Project, to determine operation effects on shad spawning behavior, activity, and success. Further, areas utilized for spawning by American shad will be identified in the reach of the river upstream of Turners Falls Dam extending to the Northfield Mountain Project.

Task 1: Development of a Detailed Study Plan

Existing information will be reviewed to provide further insight on shad spawning behavior, habitat preferences and factors that may affect the exact location and timing of spawning in the study area such as, diel effects, water temperature and depth, flow/velocity, and turbidity. Further, counts of shad passed at the Holyoke Dam and Turners Falls will be tracked to pinpoint the most effective timing of field surveys. Concurrent adult shad telemetry studies may also provide insight as to the location of spawning shad.

As a first step, historic data pertaining to Cabot Station discharge and flow data will be collected to provide the basis for determining typical flow regimes during the study period. This information will be provided by FirstLight and obtained from the USGS gage located on the Connecticut River in the city of Montague (USGS 01170500) and the Deerfield River (USGS 01170000) near the town of West Deerfield, Massachusetts. It is important to show the magnitude of flow and corresponding water level fluctuation in the Connecticut River below Cabot Station when flows exceed the hydraulic capacity of the Turners Falls Project. Similarly, it will be important to show the same, when flows are within the hydraulic capacity of the Turners Falls Project.

FirstLight is developing a hydraulic model of the Connecticut River from the Turners Falls Dam to the Holyoke Dam- see Study No. 3.2.2 *Hydraulic Studies of Turners Falls Impoundment, Bypass Reach, and below Cabot Station*. The hydraulic model developed for the reach between Turners Falls Dam and Holyoke Dam will be used to further inform this study. More specifically, the hydraulic model will simulate water elevations in this reach under the historic flow ranges during the spawning season. Flow data will be obtained from the Montague USGS gage. The model will be run in an unsteady mode to simulate the peaking operations of the Turners Falls Project during the spawning season. The intent of the modeling is to understand the relationship between the magnitudes of water level fluctuations due to peaking operations within the context of flows normally present during the spawning season. The hydraulic model and previous water level data collected at Route 116 Bridge and at Rainbow Beach may also place bounds on the geographic extent of the study. For example, peaking operations may have a greater impact on the magnitude of water level fluctuations closer to Cabot Station than further downstream. Based on the water level monitoring conducted at the USGS gage in Montague, Route 116 Bridge and at Rainbow Beach, the magnitude of water level fluctuation decreases and attenuates further downstream.

Task 2: Examination of Known Spawning Areas Downstream of Turners Falls Dam

Field surveys will be conducted in two phases at night from shore or by boat during periods of anticipated spawning and will be based on information collected in Task 1; Phase 1 will identify spawning locations where shad are actively spawning, and project effects will be evaluated in Phase 2. In the study area, spawning typically occurs between early May to mid-June. As such, field surveys of spawning shad will occur during this period or after a minimum of 5,000 shad have passed the Holyoke Project, located downstream. Initial surveys will concentrate on the lower study reach and progress upstream with the movement of the shad. The level of effort will be dependent on the density of spawning shad within the study area, with initial surveys to be conducted twice weekly to identify peak spawning activity.

During the peak spawning period, survey efforts will be increase to three times per week. Surveys conducted below Cabot Station will concentrate on the five known spawning locations downstream of the Deerfield River confluence (river mile 191.9) and ten other locations downstream to river mile 161.7 below the Mill River in Hatfield (Layzer, 1974, Kuzmeskus, 1977).

Phase 1 of the surveys will employ methods described by Ross (1993) with the exception of egg collection and identification. Ross et al. (1993) collected eggs to further verify that the observed spawning activities were being conducted by shad rather than white sucker. This verification can be accomplished by observing adult shad during the act of spawning and thus egg collection is unnecessary to achieve the goals of this study. Adult spawning shad will be observed and quantified by counting spawning splashes over 5-min intervals between sunset and 01:00 hours. Spot lights will be used to verify that such splashes were made by spawning American shad. The species and number of fish observed and their behavior will be recorded. We assume that, though every splash may not represent actual spawning and every spawning may not be accompanied by a splash, the level of surface activity is strongly correlated with actual spawning (Ross et al., 1993). Other parameters to be measured during observed spawning events include;

spawn timing and location (GPS); water temperature, dissolved oxygen (DO), pH, conductivity, turbidity, depth and surface velocity; and predominant substrate type. All data will be recorded on a dedicated data sheet. The data sheet will include aerial reference images and/or maps of the study area to document the relative position of observed spawning shad and provide the information necessary to estimate the total area used for spawning as well as an index of spawning activity. The data collected in the field will be correlated to Cabot Station discharge and river flow as a function of time.

In Phase 2, the impacts of flow fluctuation on spawning shad will be investigated during the peak spawning period at spawning locations identified in Phase 1 as being affected to the greatest degree by water level fluctuations. These areas will be targeted for observations during periods of discharge fluctuation at Cabot Station. Prior to flow manipulation, data will be collected to provide a quantitative baseline of shad spawning rate. FirstLight will then manipulate discharge at Cabot Station to investigate impacts to spawning. Shad spawning rate will be investigated over a range of expected seasonal flow fluctuations based on historic discharge data at Cabot Station. Several discharge manipulations may be investigated but will begin with the most extreme fluctuations scenarios. Baseline spawning rate and behavior will be compared to those observed during periods of flow manipulation to investigate potential impacts to spawning.

Task 3: Identification of Spawning Areas Upstream of Turners Falls Dam

Less is known about spawning locations upstream of the Turners Falls Dam and the study described herein should provide insight on spawning locations upstream within the study area. As such, upstream surveys will target areas of suitable habitat for spawning, including those containing flowing waters over coarse substrates. The methodology for these surveys will focus on identifying spawning areas via splash surveys consistent with Phase 1 of Task 1.

Task 4: Examination of Identified Spawning Areas Upstream of Turners Falls Dam

If results from Task 2 indicate that project operations alter spawning rates and/or behaviors of American shad downstream of Turners Falls Dam, further investigation of areas identified upstream will be performed. Because the effects of project operations are different in the Turners Falls Impoundment relative to areas below the dam, different alternative scenarios will need to be developed and evaluated for further study. Regardless, the methodology will be consistent with Phase 2 of Task 1.

Task 5: Data Analysis and Reporting

Information collected during this study will be compiled and presented in a report, which will include a map of the study area depicting the locations of observed spawning shad; materials and methods; results; a discussion of observed spawning behaviors; and, if applicable, impacts due to operational changes.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort will adequately assess the potential effects of continued Projects operations on spawning shad and their habitat within the study area. One year of the study is anticipated to cost between $50,000 and $60,000. Should a second year of study be required, year two cost is anticipated to be between $30,000 and $40,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

FirstLight will conduct this study during the 2014 spawning season, April to mid-May. The exact timing of the field survey will depend on a variety of seasonal and site specific factors but water temperature is

the primary factor that triggers spawning. Other factors include photoperiod, water flow and velocity, and turbidity. The timing of the survey will be further refined using information obtained from shad passage data collected downstream at the Holyoke Project fish lift and Turners Falls Project fish ladders. Further, information collected during concurrent shad migration investigations may also provide insight to the locations and timing of spawning.

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3.3.7 Fish Entrainment and Turbine Passage Mortality Study

General Description of Proposed Study

The following stakeholders requested a field study to assess fish entrainment from the Connecticut River at the Northfield Mountain Project: USFWS, NMFS, NHFG, MDFW, CRWS, TU, and Town of Gill, MA. The requested objective is to quantify the number of resident and migratory fishes entrained on an annual basis as a means to evaluate potential impacts to riverine fish populations in the Turners Falls Impoundment and transient diadromous fish populations passing though the study area. The FERC has requested a literature-based assessment of fish impingement, entrainment and survival at the Northfield Mountain and Turners Falls Projects.

Entrainment field studies of the type requested by the agencies, by themselves, provide only an estimate of annual turbine fish passage and survival, but are not sufficient to determine population-level impacts on riverine resident fish populations (FERC, 1995). In recent years, desktop entrainment analyses have been found to be adequate by the FERC for characterizing annual fish entrainment loss at hydroelectric projects. Therefore, FirstLight proposes to conduct a *desktop* fish entrainment and turbine mortality assessment of the Northfield Mountain Project. For the purposes of this desktop entrainment mortality assessment, the study area includes the Turners Falls Impoundment and the Northfield Mountain Project.

The proposed study described herein will assess the potential entrainment and turbine mortality risk of both resident and diadromous fish species within the study area. This assessment will be supplemented by radio telemetry studies of American shad and American eel proposed under other study plans (see Study Nos. 3.3.2, 3.3.5, and 3.3.6), which will provide information necessary to evaluate the impacts of entrainment and turbine mortality as a result of continued Project operation.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to assess fish impingement, turbine entrainment, and turbine passage survival at the two Projects.

The specific objectives of this proposed study include:

- Estimate the potential impacts of entrainment, impingement, and turbine mortality on fish at the Northfield Mountain Project and Turners Falls Project by developing a qualitative scale of entrainment risk for resident and migratory fish species.
- Conduct a quantitative assessment of the potential impact of entrainment and turbine mortality of American shad and American eel.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The Connecticut River is home to riverine species of fish and also serves as a migratory corridor and spawning and rearing habitat for diadromous species such as Atlantic salmon and American shad. In 1967, Federal (USFWS and NMFS) and state (VT, NH, MA, CT) agencies formed a cooperative program called the Connecticut River Anadromous Fish Restoration Program (Restoration Program). The goal of the Restoration Program is to restore anadromous fish to the Connecticut River. In 1983, Federal legislation passed and gave jurisdiction over the Restoration Program to the CRASC, which also continues to work toward American shad restoration in the Connecticut River under the jurisdiction of the Restoration Plan. Further, investigating the potential impacts of continued Project operation on fisheries resources in the study area will provide the necessary baseline information to evaluate the need for mitigation measures.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

In preparation of the PAD, existing information was compiled regarding the physical characteristics of the Northfield Mountain Project and Turners Falls Project to be evaluated. Factors that affect the potential for entrainment at a hydroelectric project include the size and depth of the intakes, the hydraulic capacity and configuration of the turbines, the velocity of water as it enters the intake relative to fish swim speeds, the location of the intake relative to fish habitat, and the characteristics of fish species present in the study area. Further, the PAD identified those fish species that are likely to occur in the study area and, therefore, may be potentially susceptible to entrainment and turbine mortality. The fish assemblage within the study area is comprised of both riverine and diadromous species. For more information regarding the local and transient fish assemblage please see section 4.4.5 of the PAD.

Prior entrainment studies conducted at the Northfield Mountain Project include an entrainment study targeting juvenile American shad in 1992 (LMS, 1993), a strobe light exclusion efficiency study (Cook, et al., 1994) and a guide net exclusion efficiency study (NUSCO, 1999). These studies were conducted to evaluate and mitigate the impacts of the Project operation on anadromous fish species in the Connecticut River. Methods included radio telemetry, entrainment netting, and mark/recapture to investigate the probability of entrainment, and did not investigate turbine mortality.

Downstream juvenile clupeid passage studies at Turners Falls were conducted in the fall of 1991 and 1992 (Harza & RMC 1992; 1993) which included the objectives of determining the percentage of juvenile shad and herring that pass via the bypass log sluice or that were entrained in the Cabot Station turbines and related data (e.g., catch rates) were compared.

Project Nexus (18 CFR § 5.11(d)(4))

Continued Project operation could potentially affect riverine and migratory fish species that utilize the aquatic habitat within Project area. This study will provide information regarding the local and migratory fish assemblage that is likely to occur in the Project area, and thus be susceptible to entrainment and turbine mortality at the Northfield Mountain Project and Turners Falls Project. This information will provide insight on the effects of continued Project operations to the fisheries resources in the Project area.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The proposed study methodology involves both a qualitative and quantitative approach to estimating entrainment for the Northfield Mountain Project and Turners Falls Project. The qualitative approach will consist of a desktop entrainment analysis, whereas the quantitative approach will be specific to adult and juvenile American shad and adult American eel.

Task 1: Qualitative Assessment of Entrainment and Impingement

A qualitative scale of entrainment potential ranging from “Low” to “High” will be developed for each species or guild recorded within the Turners Falls Impoundment during the baseline fish assemblage assessment (Study No. 3.3.11). This approach was developed by EPRI (1997) and provides reasonable seasonal and annual estimated entrainment risk estimates for fishes of three size groups, small (<8”), medium (8-15”) and large (>15”). River resident species composition and length frequency distribution will be derived from fish survey data collected in the Turner Falls Impoundment as part of Study No. 3.3.11.

Assessing the probability of entrainment at the Northfield Mountain Project and Turners Falls Project will include an examination of the characteristics of the Northfield Mountain Project and Turners Falls Project

relative to life history and behavioral traits of key species. These factors and various comprehensive reviews of entrainment data (FERC, 1995, EPRI, 1997) suggest that the following factors will influence the risk of entrainment:

- **Intake adjacent to shoreline:** Near-shore intakes typically entrain fishes at higher rates than offshore intakes, as fish tend to concentrate in littoral areas, and/or follow shorelines or orient to physical structure associated with shorelines.

- **Intake location in littoral zone:** The littoral zone is the most productive region of a reservoir and most fish rear in the shallower littoral areas.

- **Abundant littoral zone species:** Fishes such as centrarchids that spawn, rear, and spend most of their lives in shallow near-shore waters tend to be among the most abundant species in a fish assemblage.

- **Abundant resident clupeids:** Entrainment rates trend highest at projects with clupeids such as gizzard shad and threadfin shad.

- **Presence of obligatory migrants:** Resident fishes are usually entrained relative to their use of near-intake habitat. Migrants into or out of freshwater systems must locate a passage or exit route such as turbine intakes or draft tubes. Such structures provide the flow cues used by migrating fish and may attract such fish if no other flow outlets are present.

- **Shallow intake depth:** Fish are usually more abundant in shallower portions of a reservoir throughout most of the year.

- **Large hydraulic capacity:** More water passed through intakes relative to project inflow will potentially present a higher entrainment risk.

- **High approach velocity:** Approach velocities may positively correlate with entrainment risk. Resident species may become involuntarily entrained if intake velocities exceed their volitional escape swimming speed.

FirstLight will develop a summary of the life history traits and habitat requirements of key resident species as they relate to these factors affecting entrainment at the Northfield Mountain Project and Turners Falls Project. Swimming performance, behavior, and life stages, for example, are factors affecting the entrainment potential of resident species. This process will index which species and lifestages of resident fish are most and least prone to involuntary entrainment. The potential for entrainment of the most susceptible species will be assessed by comparing swim speeds to intake velocity.

Impingement is defined as the involuntary contact and entrapment of fish on the surface of an intake trashracks. Impingement on an intake trashrack may result in injury or death for fish. After determining which fish species have the potential to be present in the area of the intake structures, the sizes of fish species that could physically fit through the existing intake protection devices, based on body dimensions, will be evaluated. An analysis will be performed to estimate the body length of fish that would be physically excluded by the bar rack spacing at each intake structure, and, thus, at risk for potential impingement.

Task 2: Quantification of Shad and Eel Entrainment and Survival

In addition to the qualitative analysis, FirstLight proposes to quantify entrainment rates of American shad and American eel. Entrainment rates (*i.e.* the percentage of fish entrained through a given structure) will be derived from data collected during proposed tagging studies (Study Nos. 3.3.2, 3.3.3, and 3.3.5).

Turbine mortality may occur as fish move through hydroelectric turbines; a percentage may be killed due to blade strikes, shear forces, and/or pressure changes. Turbine passage survival studies have been independently performed at numerous hydroelectric projects throughout the country (Franke et al., 1997). As a result, quantitative turbine mortality estimates can be derived from strike probability equations based on the design characteristics of Project turbines. Suitable source studies will be selected for transfer of turbine mortality data for each Project turbine. Applicable turbine survival data will be obtained from the literature, and associated field data collected from the studies listed above, and used to estimate fish turbine passage mortality. The following turbine characteristics will be used as criteria in this analysis:

- Turbine design type
- Operating head
- Runner speed
- Turbine diameter
- Blade number and spacing
- Peripheral runner velocity

Entrainment loss will be estimated by multiplying fish entrainment rate estimates by turbine mortality rates for both species (and multiple life-stages, where applicable).

Task 3: Reporting

Results will be presented in a summary report, and will be discussed in regards to overall effects to fish populations based upon fish assemblage structure results from Study No. 3.3.11 along with fish passage count data. A tentative table of contents for this study will include:

- Introduction
- Methodology
- Description of Project Features
- Fisheries Community
- Susceptibility to Entrainment and Impingement
- Quantitative Results for American shad and American eel
- Effects of Entrainment and Impingement on Fish Populations
- Conclusions

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort will adequately assess the rate of entrainment and turbine mortality at the Northfield Mountain Project and Turners Falls Project. The proposed approach is consistent with methods accepted by FERC at other hydroelectric projects, such as the Muddy Run Pumped Storage Project (P-2355), Conowingo Project (P-405), Niagara Power Project (P-2216), and the St. Lawrence-FDR Power Project (P-2000); the study will provide information necessary to assess potential impacts of continued project operation on fisheries resources within the study area. The estimated cost for this one-year study effort will be approximately $50,000 to $60,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. Because a portion of this study draws upon data from radio telemetry and baseline fish assemblage studies, this assessment will be completed upon analyses of the field-based studies.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

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3.3.8 Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

General Description of Proposed Study

The USFWS, NHFG, MDFW, NOAA, CRWC, and TU requested a study utilizing Computational Fluid Dynamics (CFD) Modeling in the vicinity of the fishway entrances and the powerhouse forebays to evaluate flow field conditions. The Turners Falls Project consists of two hydroelectric facilities, Station No. 1 and Cabot Station, which utilize flow from the power canal to generate power. Migratory and resident fish may reside in the canal throughout the year. Upstream fish passage at the Project consists of three passage structures: the "Spillway ladder" (located at the Turners Falls spillway), the "Gatehouse ladder" (located at the Turners Falls Dam gatehouse), and the "Cabot ladder" (located at Cabot Station). These fish ladders provide an opportunity for upstream passage to migratory and resident fish. Downstream passage at the Turners Falls Project include over the dam, through the powerhouses, or through the downstream fish passage sluice adjacent to Cabot Station. CFD modeling in the vicinity of the fishway entrances and powerhouse forebays is proposed to evaluate flow field conditions.

Bathymetry surveys, required for the CFD models, will be conducted at the Spillway and Cabot fishway entrances and in front of the two powerhouse intakes (Figure 3.3.8-1). The bathymetric data collected from these surveys will be used to develop three-dimensional CFD models. Once developed, various model production runs will be executed to analyze the hydraulic characteristics (depth, velocity) found in these areas.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The study goal is to use CFD modeling to:

1) Obtain information that will assist in designing effective upstream fishways for upstream migrating trust species;

2) Reduce impingement, entrainment and delay for downstream migrating fish;

3) Direct as many downstream migrating fish as possible towards the uniform acceleration weir and downstream bypass; and

4) Maximize the number of upstream migrating fish that find and enter the fishway entrances.

The study objectives are to:

1) Conduct bathymetric surveys at the entrances of the Spillway ladder, Cabot ladder, Station No. 1 intake and Cabot intake. FirstLight is not proposing CFD modeling at the Gatehouse ladder as such modeling was recently completed (Alden, February 2012). The Alden report summarizing CFD modeling at the Gatehouse ladder can be found in Appendix F;

2) Develop three-dimensional CFD models of:

    a. The power canal in front of the Station No. 1 powerhouse intakes

    b. The power canal in front of the Cabot Station powerhouse intakes

    c. The Cabot fishway entrance

d. The spillway fishway entrance

3) Execute production runs (flow scenarios) to understand and evaluate the hydraulics of current (existing) conditions and any changes to:

   a. Fishway attraction flows;

   b. Turbine operations; and

   c. Spill gate operations

4) Develop a series of velocity maps at select discharges. Relative to upstream passage, the CFD modeling will show approach velocities and flow fields that may create a response in fish;

5) The CFD modeling will be coupled with the telemetry study and passage counts to understand which conditions are preferable for guiding migrating fish to the entrances; and

6) With respect to downstream passage, the CFD modeling will provide information on velocities and flow fields in front of the powerhouse intake. At Cabot, the results will indicate whether fish are directed to the surface bypass weir. At Station No. 1 the goal is to have a better understanding of velocity in front of the powerhouse intake.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

This study was requested by NHFGD, MDFW, NOAA NMFS, USFWS, CRWC, and TU. As outlined in their study request letters, the management goals of this study are:

"…to obtain information that will help assist in designing effective upstream fishways for upstream migrating trust species and to *reduce impingement, entrainment and delay for downstream migrating fish. CFD models are a relatively cost effective way to analyze existing and future conditions. As such, changes in the amount of attraction water, changes in which turbines are operating and which spillway gates are releasing water can all be examined. This study's results are intended to be analyzed in coordination with the data generated from the telemetry study. The combined analysis from these two data sources can help assess which flow conditions are most advantageous for migrating trust species to enter the fishway under current and proposed conditions.*

As for downstream migration of adult and juvenile shad, and adult eel, the results from the models will reveal flow magnitude and direction in front of each powerhouse. Given the limited information that currently exist on survival through Cabot and Station 1, the agency management goal is to direct as many downstream migrating fish as possible towards the uniform acceleration weir and downstream bypass. With respect to upstream passage, it is the goals of the agencies to maximize the number of fish that find and enter the fishway entrances.

Agency study requests are intended to facilitate the collection of information necessary to conduct effective analyses and to develop reasonable and prudent conservation measures, and protection, mitigation, and enhancement measures pursuant to 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.)."

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

As noted above, a CFD model of the Gatehouse fish ladder at the Turners Falls Dam is completed and can be found in Appendix F. Methodology defined and data collected during this effort will act as supplemental information for FirstLight's CFD modeling. FirstLight believes this recently completed model will be adequate for the required analysis and, as such, is not proposing to develop a new model for the Gatehouse fish ladder. However, additional model runs may be considered using the existing model, if necessary.

Existing GIS elevation data (i.e. contours, DEM, TIN) and Project drawings, combined with field collected data, will be used for the model input. In order to obtain the level of detail required of a three-dimensional model, and bathymetry survey of the study area will be conducted. Data collected during this effort will include: river bed elevation, water surface elevation, water depth, and velocity. Bathymetry data collected will be used for the model input, to calibrate the model, and to validate the model prior to executing production runs.

Project Nexus (18 CFR § 5.11(d)(4))

The Turners Falls Project consists of two hydroelectric stations (Station No. 1 and Cabot Station), a power canal, bypass channel, and dam. In order to provide upstream and downstream fish passage through the bypass channel and power canal fish ladders were constructed at the Turners Falls Spillway, the Gatehouse at Turners Falls Dam, and at Cabot Station. Due to a variety of hydraulic influences related to Project operations and/or naturally occurring hydraulic conditions CFD modeling is required to evaluate potential fish passage barriers in the study area. This study will focus on the hydraulic influences at the Spillway and Cabot Station fish ladders as related to fish passage effectiveness. The Gatehouse fish ladder will not be included in this study due to the fact that a CFD model was previously developed in 2011-2012.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

CFD models will be developed and various production runs will be executed to gain a better understanding of the hydraulic influences and fish passage effectiveness at the Cabot Station and Turners Falls Spillway fish ladders as well as the Station No. 1 and Cabot Station forebays. Prior to development of the models, bathymetric surveys will be conducted at the entrances of the fish ladders and the powerhouse forebays to collect the necessary model input data. In order to effectively meet the requirements of this study, four key tasks have been identified. These tasks include: 1) bathymetric survey of the study area; 2) compile model input datasets in CAD; 3) construct the three-dimensional model; and 4) execute model production runs. These tasks are described in more detail below.

Task 1: Bathymetric Survey of the Study Area

Water surface elevations, water depths, and water column velocities will be collected throughout the study area. For the purpose of this study, the study area will be defined as originating at the fish ladder entrance and extending downstream a predetermined distance. Data will be collected throughout the study reach, including in the forebays, in navigable waters along a number of evenly spaced transects and longitudinal profiles. Figure 3.3.8-1 shows the proposed modeling and data collection locations.

Task 2: Compile Model Input Datasets in CAD

Utilizing existing ArcGIS elevation data and the bathymetry data collected in Task 1, three-dimensional surfaces of the study area river bed will be constructed in AutoCAD Civil 3D. Project drawings will then

be used to develop three-dimensional representations of the fish ladders and pertinent Project facilities. Once completed, the three dimensional surfaces and Project facilities models will be compiled into one CAD file (per area) to depict a full physical representation of that area. The composite CAD files will then be used to create the input files for the CFD models.

Task 3: Construct Three-Dimensional Model

The input CAD files developed in Task 2 will be used to build three functional three-dimensional FLOW3D hydraulic models. Once built, various test scenarios will be run utilizing the bathymetry data collected in Task 1. Test scenarios will include model calibration using field collected water surface elevations and model validation using field collected water column velocity data.

Task 4: Execute Model Production Runs

Once the models have been satisfactorily calibrated and validated, production runs utilizing various input parameters will be developed and executed. The results of these model runs will provide a better understanding of potential fish passage barriers resulting from Project operations at various flows, river conditions, and other hydraulic influences.

Task 5. Report

A report will be developed summarizing the findings of the study.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort defined above is adequate to conduct CFD modeling in the study area. Due to the location of the powerhouses and fish ladders along the power canal/bypass channel, three separate bathymetry surveys will need to be conducted and three separate CFD models will need to be developed (Spillway ladder entrance, Station No. 1 forebay, and Cabot ladder/forebay). As such, the total cost to conduct this study is approximately $200,000 to $240,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

FirstLight will conduct this study during the 2014 study year. The bathymetric survey, and any other pertinent field efforts, will be completed during the spring or early summer of 2014 provided there is an adequate amount of flow present in the study reach. Assuming field efforts are completed by early June, data post processing and CAD model development will be completed by mid to late August. Once all model input data has been created, CFD model testing and production runs will occur throughout the fall 2014. All modeling efforts are intended to be complete by the end of the 2014 study year.

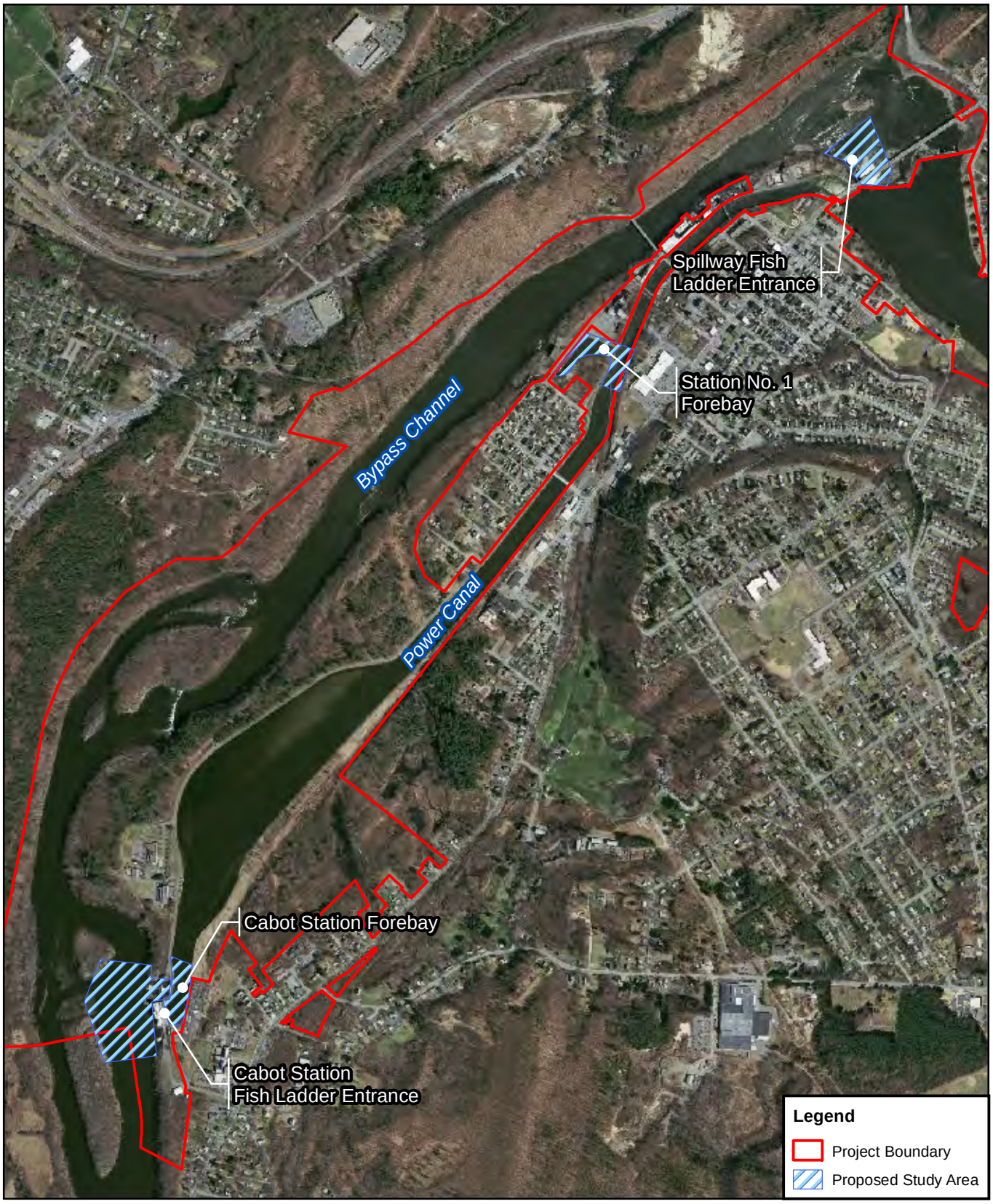

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Figure 3.3.8-1: CFD Modeling Locations in the Vicinity of the Turners Falls Power Canal and Bypass Channel

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3.3.9 Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace.

General Description of Proposed Study

The USFWS, NHFG, MDFW, CRWC, TU, LCCLC, and the Town of Gill requested similar studies utilizing CFD modeling in the vicinity of the Northfield Mountain Project intake/tailrace channel and in the Connecticut River upstream and downstream of the intake/tailrace to evaluate flow field conditions. The Northfield Mountain Project discharges water from its upper reservoir into the Connecticut River when generating and withdraws water from the Connecticut River to the upper reservoir when pumping. Pumping and generating associated with Project operations utilize the same pipes, at the same location (Figure 3.3.9-1). To better understand potential Project operations impacts, River2D software will be utilized to conduct two-dimensional modeling of the study area.

In 2007, Woodlot Alternatives developed a two-dimensional model of the Turners Falls Impoundment from Vernon Dam to Turners Falls Dam, including the majority of the proposed study reach. The 2007 Woodlot model was developed using 2006 bathymetry data collected by HydroTerra. A modified version of this model will be used to satisfy the objectives of this study. In order to modify the existing model, new supplemental bathymetry data will be collected in the vicinity of the Northfield tailrace and input into the model. FirstLight will collect the new supplemental bathymetry data as part of this study.

Once the model is updated, various model production runs will be conducted to analyze the hydraulic characteristics (depth, velocity) found in the study area over a range of conditions.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

Goals and objectives of this study are to:

- Model flow characteristics upstream and downstream of the Northfield Mountain Project under existing Project operations (pumping/generating), at several representative river flow levels, and at proposed changes to operations such as those discussed in Section 3.4.4 of the PAD;
- Assess velocities and flow fields at, and in proximity to, the Project 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 the potential for Project operations to create undesirable attraction flows to the intake/discharge area 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; and
- Model and then evaluate flow characteristics under alternative Project operations. The alternative operation scenarios will be developed in consultation with the relicensing stakeholders after the initial study results are complete.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

This study was requested by MDFW, USFWS, NHFGD, Town of Gill, LCCLC, CRWC, and TU. The Town of Gill, LCCLC, CRWC, and TU are not resource agencies.

The MDFW, USFWS, and NHFGD all state that the goal of this study is to determine the potential impacts (both project-specific and cumulative) of the Northfield Mountain 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 entrainment 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.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Project operations data including pumping, generation, water surface elevation, and other pertinent information are currently collected and maintained by FirstLight.

In 2007 a two-dimensional flow model for the Turners Falls Impoundment, including the majority of the study area, was developed by Woodlot Alternatives. Although not originally developed to meet the scope of this proposed study, the data used to develop the original model, combined with updated data where needed, can be utilized to satisfy the goals and objectives previously discussed. As part of the 2007 modeling work, a bathymetric survey of the Turners Falls Impoundment, including the study area, was conducted in 2006 by HydroTerra. The bathymetry data collected as part of that survey, combined with newly collected data in the vicinity of the Northfield tailrace, will be used to update the existing two-dimensional model where required.

Due to the extensive amount of existing information in the study area, FirstLight is not proposing to develop a new two-dimensional model or bathymetric survey. FirstLight instead proposes to review and update the existing model with supplemental field data collection as needed.

Project Nexus (18 CFR § 5.11(d)(4))

The Northfield Mountain Project discharges water during generation and withdraws water during pumping from a channel adjacent to the mainstem of the Connecticut River. Pumping and generating associated with Project operations utilize the same pipes, at the same location. Existing Project operations affect instream flows in this area. Potential impacts of Project operations may include: passage of migratory fish near the pump/discharge area, the potential for entrainment during pumping operations, and the potential for creating flow reversals in the Connecticut River during pumping cycles which may confuse migratory fish attempting to pass the Project.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The 2007 Woodlot Alternatives two-dimensional model will be updated and various production runs will be executed to gain a better understanding of the potential impacts of Northfield Mountain Project operations within the study area. For the purpose of this effort, the study reach will include the Northfield Mountain Project intake/discharge channel and the Connecticut River 1 km upstream and downstream of the channel (Figure 3.3.9-1). In order to effectively meet the requirements of this study, four tasks have been identified, including: 1) review existing data and identify data gaps; 2) conduct a bathymetric survey of areas identified in Task 1, post process field collected, and post process model input data; 3) build and

calibrate the two-dimensional model; and 4) conduct steady-state model runs using River2D software. These tasks are described in more detail below.

Task 1: Review Existing Data and Identify Data Gaps

Input bathymetric data used to create the original 2007 model will be reviewed for accuracy and completeness. All data gaps will be identified to ensure the entire study reach, including the intake/discharge channel, are accurately represented in the final model. Areas found to be lacking adequate bathymetric coverage will be supplemented with newly collected bathymetry data.

Task 2: Bathymetric Survey Update & Post Processing

As part of this study, new bathymetry data in the vicinity of the Northfield tailrace will be collected. Water surface elevations, water depths, and water column velocities will be collected along a number of evenly spaced transects and longitudinal profiles.

Task 3: Build and Calibrate 2D Model

The original model input files and the additional field collected data will be merged into one dataset to build a functional two-dimensional model using River2D software. Once built, the model will be calibrated to existing water surface elevation data. Successful calibration will yield results within ±0.15 ft of field-measured water surface elevations for at least one calibration scenario.

Task 4: Conduct and Analyze Production Runs

Once the model has been calibrated, production runs representing various operating scenarios will be run. The runs will reflect steady-state hydraulic conditions. The model run results will include two-dimensional water depths and velocities. These outputs can be used to provide a better understanding of potential fish passage barriers resulting from Project operations at various flows, river conditions, and other hydraulic influences.

Task 5. Report

A report will be developed summarizing the findings of the study.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort defined above is adequate to conduct River2D modeling in the study area. The results of the River2D model production runs will provide the data necessary to satisfy the goals and objectives previously outlined. The estimated cost for this study is approximately $40,000 to $50,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

FirstLight will conduct this study during the 2014 study year. Existing data will be reviewed for accuracy and completeness and data gaps will be identified during the late winter, early spring of 2014. All field efforts required to update the existing bathymetry and model input data will be conducted in the spring or early summer provided there is an adequate amount of flow present in the study reach. Assuming field efforts are completed by early June, data post processing will be completed by mid August. Once all model input data has been created, the two-dimensional model will be calibrated and production runs will

be executed throughout the fall 2014. All modeling efforts will be completed by the end of the 2014 study year.

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Feet

Figure 3.3.9-1:
Two-Dimensional Modeling at Northfield Mountain Intake/Tailrace

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3.3.10 Assess Operational Impacts on Emergence of State-Listed Odonates in the Connecticut River

General Description of Proposed Study

MADFW requested a study investigating the impacts of Project operations on the emergence of riverine odonates, with an emphasis on state-listed species. MADFW requested that these studies be conducted in the upper reservoir, the Turners Falls Impoundment, and a 13-mile reach from the Turners Falls Dam to the Route 116 Bridge in Sunderland. FirstLight is limiting the study area to the Turners Falls Impoundment and 13-mile reach below the Turners Falls Dam. The near-complete lack of a shallow vegetated littoral zone and rocky substrate in the upper reservoir, together with its characteristic water level fluctuations, would likely preclude state-listed odonates (particularly riverine species, which are the focus of this study). The study will include synthesis of existing data, field surveys, and the use of a hydraulic model (see Section 3.2.2) to assess potential effects of water level fluctuations on factors related to odonate emergence/eclosure behavior.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

This study has two objectives:

5. Synthesis of existing data, supplemented with field surveys, to characterize the assemblage structure and emergence/eclosure behavior of odonates in the project area.

6. Determine if project operations affect the emergence and eclosure success of state-listed odonates, and the potential implications for the odonate assemblage in affected areas, particularly state-listed species.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The Massachusetts Natural Heritage & Endangered Species Program (NHESP), part of the MADFW, is charged with ensuring the conservation and protection of species listed under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) as Endangered, Threatened, or of Special Concern. The resource management goals identified by the NHESP/MADFW are to:

- Ensure that PME measures are commensurate with Project effects and meet MESA requirements for the Project.

- Conserve, protect, and enhance the habitats for state-listed species that will be affected by Project operations.

The MADFW study request is intended to facilitate the collection of information necessary to conduct impact analyses and develop reasonable conservation, PME measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Clean Water Act (33 U.S.C. §1251 *et seq.*), the MESA, and the Massachusetts Wetlands Protection Act (WPA).

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

State-listed Odonate Species Composition: The status of state-listed odonate species is well documented for the Turners Falls Impoundment due to several studies conducted 2001–2010 (Morrison et al., 2001; 2004; 2006; Mclain et al., 2004; 2006; Martin, 2007; 2010). Six state-listed species have been observed within reaches above the dam—Cobra Clubtail (*Gomphus vastus*), Stygian Shadowdragon (*Neurocordulia yamaskanensis*), Spine-crowned Clubtail (*G. abbreviatus*), Skillet Clubtail (*G. ventricosus*), Riverine Clubtail (*S. amnicola*), and Midland Clubtail (*G. fraternus*) (McLain et al., 2006). Cobra Clubtail and Stygian Clubtail are the most abundant state-listed species encountered in this area. In contrast to the Turners Falls Impoundment, survey effort below the dam has been far less intensive; this region of the Connecticut River represents an information gap with regard to rare odonate species composition and abundance.

Based on odonate studies conducted in the Turners Falls Impoundment, as well as both published and unpublished research on the life history and ecology of these species, we have a basic understanding of emergence and eclosure, including when emergence occurs, how high above the water eclosure takes place, how long the process takes, what substrates are typically used, and how these factors differ by species or family groups. To some extent, a thorough review of existing information will provide adequate biological information for an impact assessment using the hydraulic model (see Study No. 3.2.2 *Hydraulic Study of the Turners Falls Impoundment, Bypass Reach and below Cabot Station*), but field observations are planned to fill critical knowledge gaps by conducting surveys in both the Turners Falls Impoundment and downstream from the Turners Falls Dam. For example, because much of the odonate research in the Turners Falls Impoundment was initiated due to riverbank stabilization efforts, some habitat types (e.g., the lentic environment near Barton's Cove) have not been well surveyed for odonates, and the emergence/eclosure behavior of odonates in these different habitat types is not well understood.

Impact of Water Level Fluctuations: It is not well understood the extent to which water level fluctuations disrupt odonate emergence and eclosure. The concern is whether emergent larvae ascend a great enough vertical distance, and quickly enough, to avoid being inundated after eclosure begins. This will depend on a variety of factors, such as the propensity of a species to travel far or climb high, the timing of emergence compared to the timing of water level fluctuations at that particular site, bank slope, and substrate. Related research in the Connecticut River by Martin (2010) and others (McLain et al., 2004, 2006; Morrison et al., 2001) have investigated the factors that influence the distance nymphs travel before eclosure; air temperature, substrate, and water velocity were among factors identified. Studies have found that coarse substrate on the riverbank, especially riprap, discouraged travel of some odonate larvae. The furthest nymphs were recorded traveling during these studies on any substrate is about 40 feet (Martin, 2010), but many eclose after traveling just a few feet.

The effect of water level fluctuations on aquatic habitat parameters in the Turners Falls Impoundment and downstream from the Turners Falls Dam is not well documented. A separate study plan is proposed to produce a hydraulic model of these areas (see Study No. 3.2.2 *Hydraulic Study of the Turners Falls Impoundment, Bypass Reach and below Cabot Station*).

Project Nexus (18 CFR § 5.11(d)(4))

The timing, rate, and magnitude of releases from the Projects may have adverse effects on state-listed riverine odonate tenerals (newly emerged) although the degree of these effects is unknown. In order to fill this information gap, an empirical study is proposed to provide information on the relationship between Project operation and the effects of water level changes on emerging odonate tenerals. Results will be used by the MADFW to determine appropriate recommendations to protect and/or enhance state-listed odonates and their habitats.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Review of Existing Information

Existing information on the species composition of odonates in the proposed study reach of the Connecticut River will be gathered from a variety of sources (see Literature Cited in this section). The life history and ecology of these species and species groups will be summarized, and significant data gaps related to habitat preference and emergence/eclosure behavior will be identified.

Task 2: Finalize Study Plan and Attain Collection Permit

Because the study is focusing on state-listed odonate species, FirstLight will work with NHESP to finalize the study plan and attain the necessary permit to handle/collect state-listed odonates. FirstLight will comply with the conditions and reporting requirements of the collection permit.

Task 3: Qualitative Surveys for Larvae and Exuviae

Odonate larvae and exuviae will be surveyed between the Turners Falls Dam and the Route 116 Bridge in Sunderland, and in the Turners Falls Impoundment near Barton's Cove, to establish a qualitative baseline for the odonate assemblage in these areas (Figure 3.3.10-1). Aside from the Barton's Cove area, surveys above the Turners Falls Dam are not necessary due to the intensive survey effort in this area from 2001 to 2010. The survey will be conducted just prior to spring emergence (late May to early June) to maximize detection of all species, under conditions of average to below-average river flows. One representative 200-meter reach will be surveyed in Barton's Cove. Three representative 200-meter reaches will be surveyed downstream from the Turners Falls Dam: one study reach will be located at the confluence of the Connecticut River and the Deerfield River, one will be just upriver of the Route 116 Bridge, and one will be at a location in between (to be determined). Collection methods will include aquatic D-nets or other nets appropriate for conditions at each site, as well as collection of tenerals or exuviae on the riverbank (if emergence has started). Collections will be made while wading or snorkeling in shallow water, SCUBA diving in deep water, or while walking along the riverbank. At each site, aquatic, riparian, and upland habitats will be photographed and the following parameters will be recorded.

Aquatic Parameters: water depth, water velocity, dominant substrate types, species composition and coverage of aquatic plants, presence and coverage of fine and coarse organic material;

Riparian Parameters: bank slope, bank height, bank stability, dominant substrate types, plant species composition and cover, tree canopy height, tree canopy density;

Upland Parameters: land use/land cover, dominant vegetation.

Task 4: Quantitative Surveys of Emergence/Eclosure Behavior

Quantitative surveys to determine the emergence/eclosure of odonate species will be conducted at four study reaches. Through consultation with NHESP, two study reaches will be selected from the Turners Falls Impoundment and two will be selected from downstream of the Turners Falls Dam. The specific reaches will be selected to represent a range of aquatic and riverbank habitat conditions and hydraulic characteristics. The two reaches selected in the impoundment will have different habitat than the sites associated with riverbank stabilization that were monitored from 2001 to 2010.

Six transects will be established within each study reach, for a total of 24 transects. Transects will be monumented with PVC pipe or rebar along their length. Each transect will be perpendicular to the river, 1

m wide, and will extend upslope approximately 12 m (i.e., the greatest distance recorded in earlier studies of odonate emergence in this area). The following habitat data will be collected at each transect: GPS location of both ends, slope, elevation of the upslope and water ends, elevation of the mean high water mark, types and percent cover of each substrate type, substrate embeddedness, species composition and percent cover of aquatic and upland plants, and anything else noteworthy about conditions at each transect. All transects will be photo-documented. In addition to these transect-specific data, aquatic, riparian, and upland habitat will be characterized for each of the four reaches, as described under Task 3.

Surveys for emerging larvae, exuviae, and tenerals will be conducted at each transect every two weeks from June through August, and will be timed to coincide with weather and flow conditions that are conducive to emergence, and during times that are generally considered peak emergence periods for odonates that occur in these areas. The time of day, weather, water level, and a qualitative assessment of boat traffic will be recorded at the time of each survey. For each exuvia and teneral found, the emergence distance from the water, elevation, and the structure/substrate it was found upon will be recorded. All exuviae will be collected in individual vials, labeled with site information and date, and preserved for later species identification. If possible, emerging larvae will be watched/tracked as they progress upslope, and the time it takes for them to stop and eclose will be recorded.

Water level data will be used to identify the zones along each transect that have low, moderate, to high inundation frequency. The abundance, density, and species composition of emerged odonates will be compared along a gradient of inundation frequency (taken from water level data). In addition, the influence of water level, habitat characteristics (substrate, vegetation cover, elevation), and weather conditions on emergence distance will be determined using correlation and regression analyses.

Task 5: Water Fluctuation Impact Assessment

A hydraulic model, which will be developed for the whole study area independent of the odonate study, will be used to determine if water level fluctuations affect the emergence and eclosure success of state-listed odonates. The field data gathered during Task 4, particularly the timing (e.g., when species emerge) and distance travelled (both horizontal and vertical) for species and/or species groups will be used in concert with the hydraulic model to determine which species are most vulnerable to fluctuating water levels, and under what conditions they are most susceptible.

Task 6: Report

A report will be prepared describing the survey and modeling methods and results. A tentative table of contents follows:

- Introduction
- Study Area
- Methods
  - Larval Surveys
  - Exuvia Surveys
  - Water Level Impact Assessment
- Results
  - Larval Surveys
  - Exuvia Surveys
  - Water Level Impact Assessment
- Discussion
- Conclusions

- Literature Cited

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The methods and analyses proposed are consistent with other studies of this nature, and build upon knowledge gained from other studies to focus specifically on the effects of water level fluctuations. The estimated cost for this study may range from $40,000 - $60,000 (not including the hydraulic modeling completed as a separate study). Task 3, which can be considered a first phase of fieldwork that would inform the quantitative surveys, would cost in the range of $8,000 - $10,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

Field work for this study will occur in 2014. A final study plan for the quantitative survey and hydraulic/habitat analysis would be developed in cooperation with NHESP.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Literature Cited

Martin, K. (2006). Impact of bank stabilization technique, boat wake, water level rise, and predation on the mortality rate, and eclosure success of odonate nymphs in Gill, MA: Results of the 2006 field season. Unpublished report (MA Natural Heritage and Endangered Species Program, New England Environmental, Inc.)

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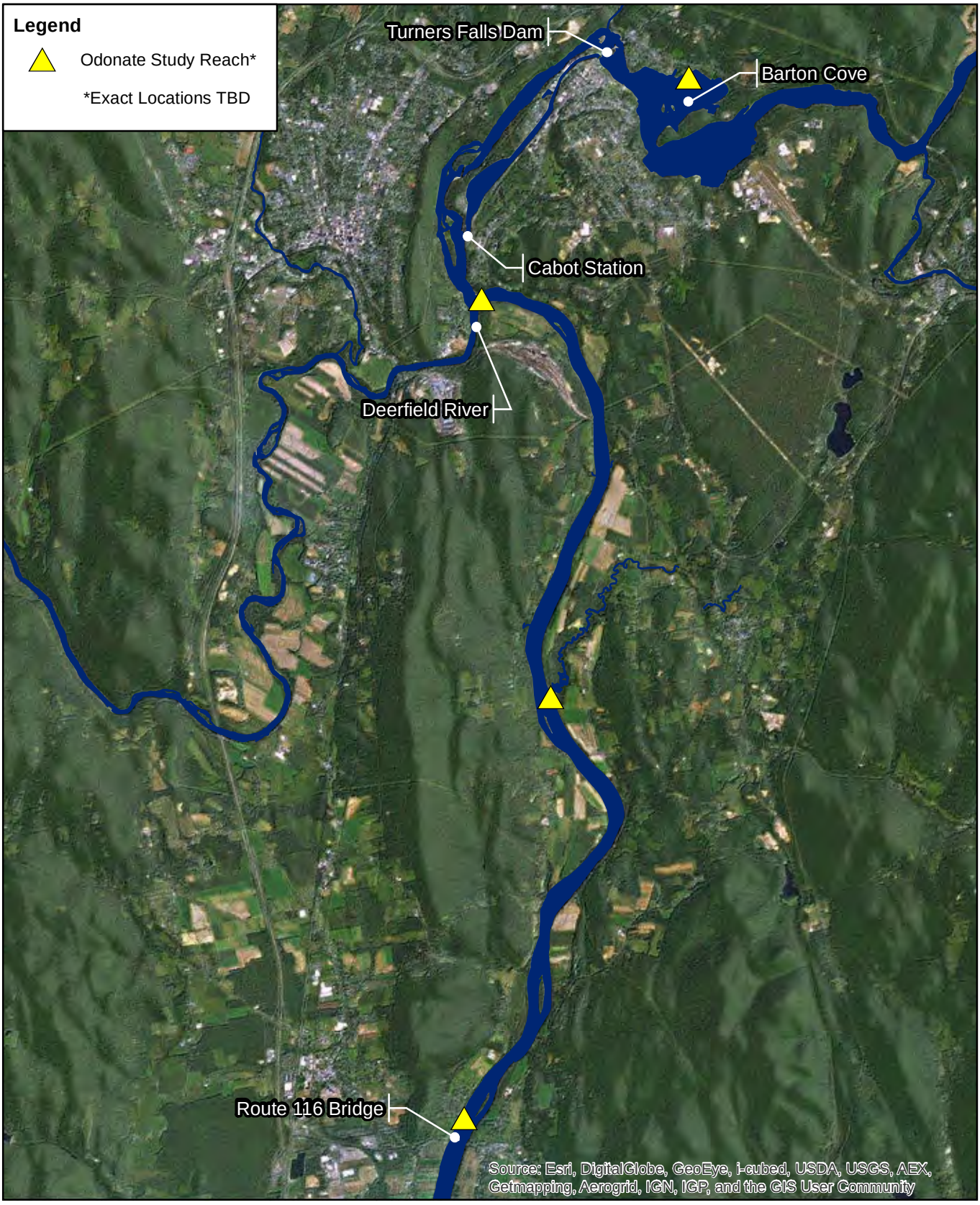

FIRSTLIGHT POWER RESOURCES

Proposed Study Plan

FirstLight Power Resources
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0 0.5 1 2 Miles

Figure 3.3.10-1: Approximate Reach Locations for Odonate Surveys.

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3.3.11 Fish Assemblage Assessment

General Description of Proposed Study

In the study request letter from the FERC, a baseline fisheries population study was requested. The request included sampling within the Turners Falls Impoundment, tailwater areas, the bypassed reach, and downstream riverine corridors via electrofishing surveys. The FERC also requested targeted eel sampling of upstream and downstream migrating American eel. Targeted eel sampling will be conducted as part of Study No. 3.3.4 – *Evaluate Upstream Passage of American Eel at the Turners Falls Project* and silver-phase eel abundance and migration will be evaluated in Study No. 3.3.5 – *Evaluate Downstream Passage of Eel*; thus, additional targeted eel sampling is not being proposed for this study.

In their study request letters, USFWS, MADFW, NHFGD, CRWC, Town of Gill, TNC, TU, VANR each requested a fish assemblage assessment to determine the occurrence, distribution, and relative abundance of fish species within the project areas and to compare study results to historical records. They requested a comprehensive assessment of fish assemblages, employing multiple gear types to randomly sample a variety of habitats throughout the study area during spring, summer, and fall as part of a robust sampling design. The proposed study will include a statistically rigorous and comprehensive stratified-random design similar to what has been used successfully on large rivers a high degree of spatial heterogeneity (Kiraly, 2012).

MADFW further requested that the study include state-listed fish species as well as host fish species of the Dwarf Wedgemussel (*Alasmidonta heterodon*), federally- and state-listed as "Endangered"; the Yellow Lampmussel (*Lampsilis cariosa)* state-listed as "Endangered"; and the Eastern Pondmussel (*Ligumia nasuta*), state-listed as "Special Concern." MADFW requested that the study should assess the occurrence and abundance of mussel larvae on resident host fish. FirstLight is not proposing to evaluate mussel larvae on host fish because the relationships are already well understood (Table 3.3.11-1); The level of effort proposed will provide data on the distribution and relative abundance of state-listed fish species and host fish species.

The PAD for the Turners Falls Project and Northfield Mountain Projects identifies 22 species of fish that occur in the aquatic habitat within the Project boundary. The study described herein, will document fish species occurrence, distribution and relative abundance within the Turners Falls Project and Northfield Mountain Project areas. FirstLight believes that the level of effort will provide baseline fish assemblage data and that the overall sampling design will provide useful data that can be used to inform other proposed studies.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to provide baseline information pertaining to the fish assemblage structure within the study area. Specific objectives include:

- Document species occurrence, distribution, and relative abundance of resident and diadromous fish within the project area along spatial and temporal gradients.
- Describe the distribution of resident and diadromous fish species within reaches of the river and in relationship to data gathered by the Aquatic Habitat Mapping Study.
- Compare historical records of fish species occurrence in the project area to results of this study.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The MADFW, NHFGD and the VTFWD each have, as a mission, the protection and conservation of fish and their habitats. Riverine fish species are an important component of the river's ecology and are the basis for the sport fishery. Furthermore, several of the states' SGCN have been documented in the project area.

The conservation and protection of species state-listed as Endangered, Threatened, or of Special Concern under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) is an important objective of the Natural Heritage & Endangered Species Program of the MADFW. State-listed species and their habitats are protected pursuant to the MESA and its implementing regulations (321 CMR 10.00), as well as the rare wildlife species provisions of the Massachusetts Wetlands Protection Act (WPA) (310 CMR 10.59). The Division seeks to accomplish the resource goals and regulatory requirements of the MESA in order to:

- Ensure that PME measures are commensurate with Turners Falls Project and Northfield Mountain Project affects and meet MESA requirements for the Turners Falls Projects and Northfield Mountain Project.
- Conserve, protect, and enhance the habitats for state-listed species that will be affected by Turners Falls Project and Northfield Mountain Project operations.

The agencies requests are intended to facilitate the collection of information necessary to conduct impact analyses and develop reasonable conservation, PME measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq*.), the Federal Power Act (16 U.S.C. §791a, *et seq*.), the Clean Water Act (33 U.S.C. §1251 *et seq*.), the MESA, and the WPA. Specific to state-listed fish and mussel species, the Divisions goals are to:

- Protect, enhance, or restore diverse high quality aquatic habitats in the Connecticut River watershed and mitigate for the loss or degradation of these habitats.
- Minimize current and potentially negative effects of Turners Falls Project and Northfield Mountain Project operations on state-listed species and their habitats.

Determining species occurrence, distribution, and abundance of fish species will better clarify what species occur in the project area both spatially and temporally relative to habitats which may be affected by operation of the Turners Falls Project and Northfield Mountain Project. This information will better inform results from other study requests that will be examining the effects of operations of the Turners Falls Project and Northfield Mountain Project on various aquatic habitats, water quality, and other related concerns such as entrainment concerns at the Northfield Mountain Project. This information will be used to make recommendations and provide full consideration for all species, including those that might not otherwise be known to occur in the project area and impacts that may affect their population status through direct or indirect effects of the Turners Falls Project and Northfield Mountain Project.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

A study of resident fish species in the Turners Falls Impoundment was conducted by the Commonwealth of Massachusetts from 1971 to 1975. Eight stations in the impoundment were sampled every other week from April through October with electrofishing equipment (MDF&G, 1978). Because many changes have occurred throughout the watershed during the last four decades, these data may not be an accurate representation of the current fish assemblage.

In 2008 the impoundment was surveyed via electrofishing; this survey, conducted by Midwest Biodiversity Institute (MBI), was part of a larger USEPA effort to sample the entire Connecticut River from its headwaters at Lake Francis to the freshwater extent of the tidal estuary (Yoder et al., 2009). The 2008 survey did not have the same goals and objectives as this study; thus, data collected is not sufficient to assess the abundance, occurrence, or distribution of fish within the study area or in relation to project operations. Neither study employed the use of alternative gear types; while electrofishing is considered to an effective method for capturing fish in littoral areas of flowing water, capture probabilities are typically lower for small fish or those lacking swim bladders. It is also not effective at capturing fish from deep water unless modified. A total of 22 fish species were identified in the project area based on historical data, but several species reported to occur within the project area were not documented, including northern pike, burbot, eastern silvery minnow, and channel catfish.

As referenced in the PAD, Section 4.4, two state-listed fish species are known to occur in the Connecticut River, including the Eastern silvery minnow (*Hybognathus regius*) and burbot (*Lota lota*), both of which are state-listed as "Special Concern." Currently, there are only two known populations of the Eastern silvery minnow in Massachusetts, both located in the Connecticut River. Burbot are also rare in Massachusetts, with only a few individuals having been collected in the Connecticut River watershed.

The tessellated darter is one of only three fish species in the Upper Connecticut River that serve as hosts for the glochidia of Dwarf Wedgemussel, the others being the slimy sculpin (*Cottus cognatus*) and the Atlantic salmon (*Salmo salar*) (Nedeau, 2008). Tessellated darters are a relatively sedentary benthic insectivorous fish with small home ranges and short, fast bursts of speed.

Based on data collected by Yoder (2009), sampling at 4-5 transects distributed throughout the Turners Falls Impoundment was sufficient to capture most but not all species detectable by electrofishing the shoreline of the impoundment (Figure 3.3.11-1); a closer inspection via rarefaction of individual transects surveyed indicates that the number of fish captured at some transects may not have been high enough to document most species within a reach (Figure 3.3.11-2). Based on the rarefaction curves from all transects electrofished, a minimum of 100 fish per reach would ensure that most species within a reach were captured, but four out of the five transects electrofished contained a sample of less than 150 fish (N = 9-75), with only one containing a sample greater than 150 fish (N = 580). This may have been due to too little sampling effort within a reach and/or that the transect may not have been representative of the entire reach. Therefore, effort per reach in the Turners Falls Impoundment needs to either be 1) greater than 1.0 km of shoreline sampled; 2) conducted along more than one transect to account for spatial heterogeneity within a site; or 3) performed with a combination of greater total sampling effort divided among a greater number of spatial replicates. While the study design proposed is different than from Yoder (2009), those data provide a starting point with which to estimate the level of electrofishing effort required for precise estimates of relative abundance that includes most species within a river reach.

Project Nexus (18 CFR § 5.11(d)(4))

Operation of the Turners Falls Project and Northfield Mountain Project has the potential to directly affect fish populations, biological interactions, and habitat quantity and quality. For example, headpond and tailwater water level fluctuations could dewater spawning areas, limiting productivity of certain fish species through direct impacts to their spawning success, ultimately resulting in alterations to fish assemblage structure. An understanding of the current fish assemblage is needed in order to examine potential effects. Determining species distribution and abundance will clarify what species occur in the Turners Falls Project and Northfield Mountain Project areas, spatially and temporally, relative to habitats that may be affected.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The study area includes the Connecticut River from the upstream reaches of the Turners Falls Impoundment to approximately five miles downstream of Cabot Station and will be divided into six strata (Figure 3.3.11-3 and Table 3.3.11-2). Strata on the Connecticut River will be delineated based on a combination of general river morphology, project structures, and size in order to incorporate spatial variability into the sampling design (see Kiraly, 2012). Within each stratum, a minimum of three randomly selected locations will be sampled via boat electrofishing and trap netting during the early summer and again in the fall. Early summer sampling will be performed when spawning anadromous species are present; fall sampling will be performed when most juvenile fish are large enough to sample. Due to the high degree of variability in water level and flow, different locations will be sampled during each sampling event rather than sampling at the same locations multiple times. This process avoids any time-related, site-specific bias that could be introduced at sampling locations due to habitat changes between surveys; analyses will therefore be performed at the stratum level rather than the sampling-location level.

Task 1: Sampling Location Selection

Prior to field sampling, shorelines within all strata will be delineated into 500 meter segments using ArcGIS. Randomized lists will be created for all sites within each stratum; this will allow field surveyors to randomly select alternative sampling locations in the event of a site being inaccessible or otherwise impossible to sample.

Task 2: Fish Capture

Daytime boat electrofishing will be conducted along a minimum of three randomly selected 500 meter transects within each stratum. Boat electrofishing can effectively sample fish from most near-shore littoral habitats present within the Connecticut River. If fewer than 150 fish are collected among all three transects combined within a stratum, additional random transects will be electrofished until a 150 fish sample is exceeded. This will ensure that most species within a stratum that are detectable by electrofishing are captured; because areas with low fish density require less time to sample than areas with high fish density, additional sampling due to low densities of fish encountered is not expected to increase the level of field effort by personnel, and the randomized selection of additional sites will improve precision without adding bias. Boat electrofishing effort will be standardized to distance (km) and time (s) of electrofishing.

Trap nets can be used to sample mobile species, including those that reside in areas too deep and/or too far from shore to effectively capture via electrofishing; thus, trap netting surveys will be used to supplement boat electrofishing data. Trap netting will be conducted at suitable locations along transects selected for electrofishing; the exact location of net placement will be determined in the field, with the intent to sample areas containing depths greater than 8 feet, if present. Trap nets will be placed perpendicular to shore and set overnight (approximately 8 hours); one trap net will be fished per 500 meter transect (a minimum of three per stratum). Trap netting effort will be standardized by net-hours.

All fish captured will be identified to species, measured (total length), weighed, and released; if large numbers ($n > 25$) of small fish are captured, they will be grouped by size class, enumerated, and batch-weighed with length measurements only taken from one large and one small representative specimen within each group. Digital photographs will be taken to document species that may be difficult to identify in the field, such as cyprinids.

In addition to biological data, supporting data will also be collected for each sample site including; location (GPS), sampling gear type, sampling effort (soak time and/or seconds fished), mesohabitat type, average depth, average velocity, river flow, water temperature, predominant substrate, time of day, day of year, presence of cover, and proportion of vegetation cover. All data will be recorded on dedicated data sheets. Upon return from the field, data sheets will be review for quality assurance and archived.

Task 3: Data Analysis and Reporting

Catch per unit effort (CPUE) will be calculated for each species, stratum, and sampling technique. Values of CPUE for each segment will be calculated as the sum of catch from all samples within a stratum divided by the sum effort expended within that stratum. The CPUE, effort will be consistent among samples, thus sample standard error will be calculated to determine confidence intervals in order to facilitate comparisons among strata and season. Additionally, if both sampling designs are used consistently and in the same manner among all strata, whole-sample CPUE will be calculated by combining electrofishing and trap netting data and dividing by the number of locations sampled; this will allow direct comparisons of all data among strata.

Information collected during this study will be compiled and presented in a final report. The report will include a map of the study area and will depict the location of sample sites and contain results for fish species occurrence, distribution and relative abundance. Comparisons will be made with historical records. Results will be described in relation to studies described in study plans 3.3.14 – *Aquatic Habitat Mapping of the Turners Falls Impoundment* and 3.3.13 – *Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat*.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort will adequately address the objectives by documenting fish species occurrence, distribution and abundance within the project area along spatial and temporal gradients. FirstLight estimates the cost of this study to be $55,000 to $75,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The study described herein is scheduled to be conducted in the summer and fall of 2014, with Task 1 occurring prior to field studies.

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Williams, J.D., Warren Jr. M.L., Cummings, K.S., Harris, J.L., & Neves, R.J. (1993). Conservation status of Freshwater mussels of the United States and Canada. *Fisheries 18(9),* 6-22.

Yoder, C.O., Hersha, L.E., & Appel, B. (2009). *Fish assemblage and habitat assessment of the Upper Connecticut River: preliminary results and data presentation*. Final Project Report to: U.S. EPA, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria. Columbus, OH: Midwest Biodiversity Institute.

Table 3.3.11-1: Freshwater mussel and glochicial host fish relationships

Freshwater Mussel	**Connecticut River Glochidial Host Fish**
Dwarf Wedgemussel	Tessellated darter, slimy sculpin, juvenile and parr Atlantic salmon
Yellow Lampmussel	White perch, yellow perch; banded killifish, chain pickerel, white sucker, smallmouth bass, and largemouth
Eastern Pondmussel	Unknown; reported to parasitize centrarchids (sunfishes and bass) as well as banded killifish

Table 3.3.11-2: Numbers and descriptions of strata for fish assemblage sampling

Stratum	Description
1	Upper End of Turners Falls Impoundment
2	Middle of Turners Falls Impoundment
3	Northfield Vicinity
4	Lower End of Turners Falls Impoundment
5	Bypass Reach
6	Downstream of Projects

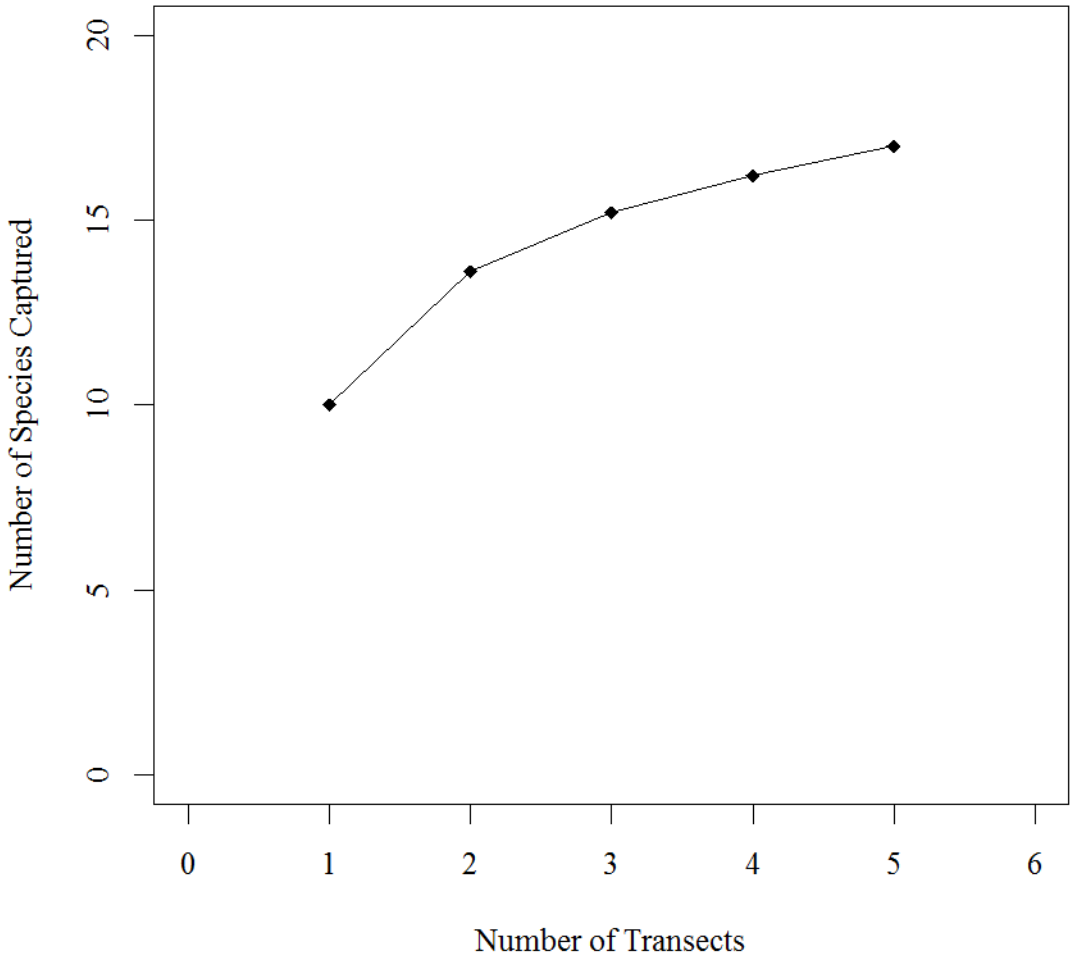

Figure 3.3.11-1: Species-accumulation curve derived from Yoder (2009) boat electrofishing data within the Turners Falls Impoundment

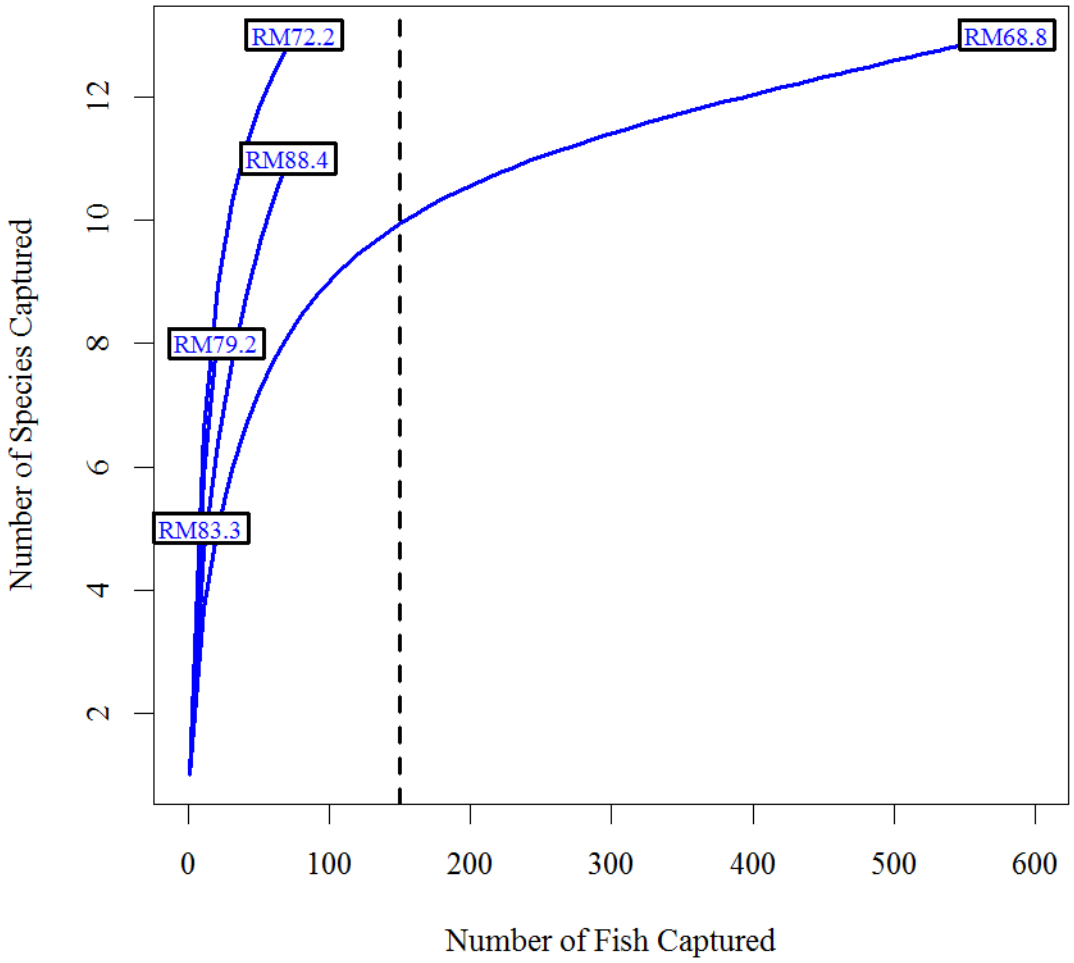

Figure 3.3.11-2: Rarefaction curves derived from each transect sampled by Yoder (2009). Labels indicate locations (River Mile) within the Turners Falls Impoundment where fish were sampled. The dashed vertical line indicates the proposed minimum sample size (n = 150 fish) per reach sampled.

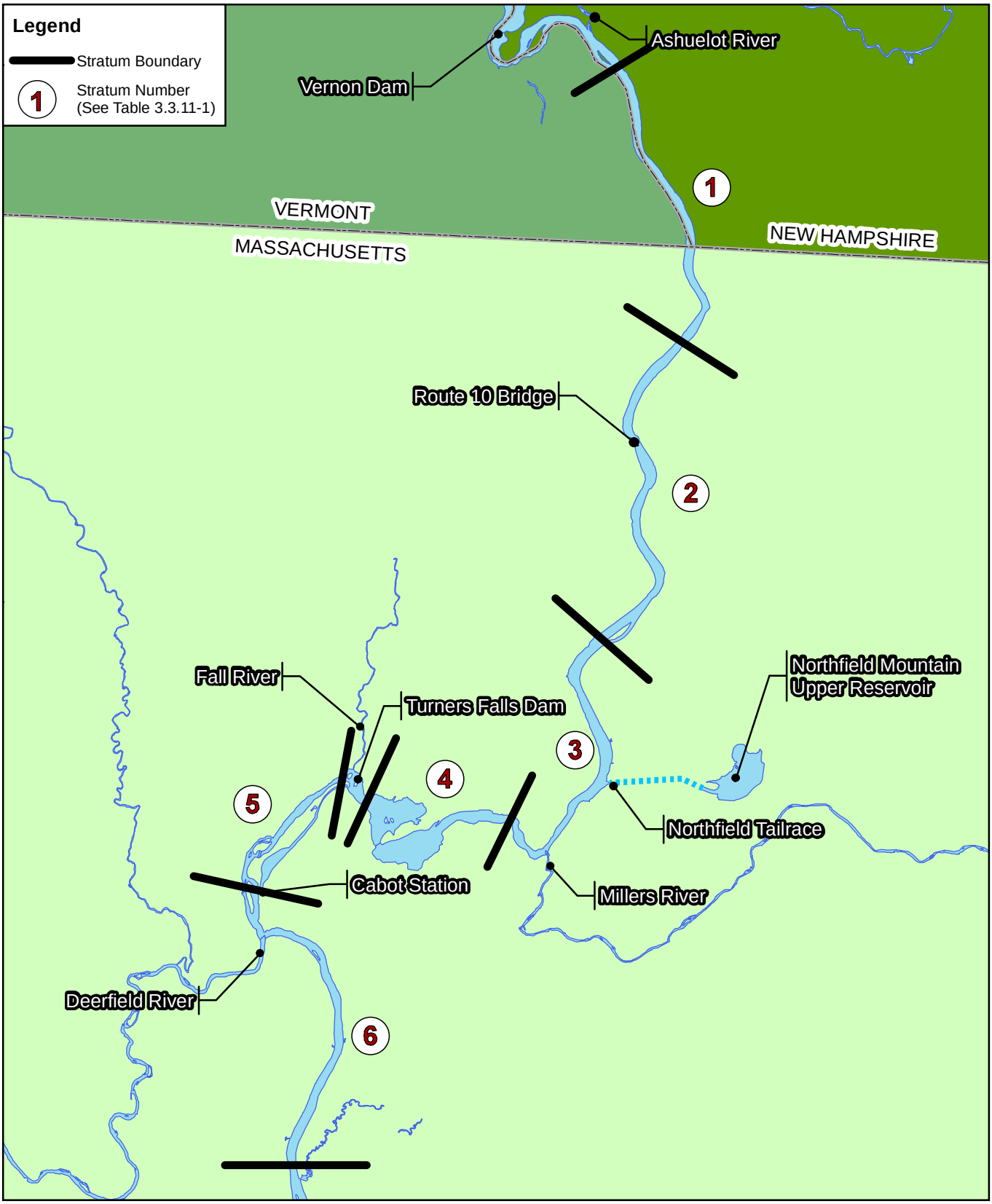

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Figure 3.3.11-3
Overview of Proposed Strata for Fish Assemblage Sampling

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3.3.12 Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

General Description of Proposed Study

In their study request letters, the USFWS, NMFS, NHFGD, and CRWC each requested a study to assess the impact of sediment disturbance and excessive velocities resulting from emergency water control gate discharge and bypass flume spill events on shortnose sturgeon spawning and incubation habitat in the Cabot Station tailrace and downstream areas.

This study is a field assessment of water velocity and sediment transport conditions during spillage events at Cabot Station to describe potential impacts on shortnose sturgeon and to inform potential mitigation.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to determine appropriate scenarios for operation of the emergency water control gates and bypass flume that will be sufficiently protective of shortnose spawning and rearing below Cabot Station from excessive water velocities and exposure to abrasive sediments dislodged and transported across spawning and rearing areas.

The objectives of the study are to:

1. Determine the frequency that the emergency water control gates are operated to discharge large quantities of water.

2. Understand the operation of the bypass flume that results in bypass flume spill events.

3. Evaluate the impact of these events on sediment transport and bottom velocities within known shortnose sturgeon spawning and rearing habitat below Cabot Station.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The USFWS and NMFS seek to understand current emergency water control gate and bypass flume operations and associated impacts to determine potential operation scenarios that avoid or minimize negative effects on shortnose sturgeon spawning and rearing.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

During monitoring of shortnose sturgeon spawning, researchers at the S.O. Conte Anadromous Fish Research Center [Conte Lab] have observed spillage at the emergency water control gate and the bypass flume that increased velocity over the rearing area downstream of Cabot Station and may have also resulted in a debris plume (Kieffer and Kynard, 2007; Kynard et al., 2012). The frequency of these events has not been studied, nor has the impact on shortnose sturgeon spawning and early life-history stages.

Ten gates are present at the Cabot spillway, two of which are used for attraction flow at the Cabot Fishway. The Cabot spill gates open automatically if the forebay water surface elevation gets too high to prevent emergency overtopping of the power canal. The gates will also open if changes in elevation indicate that a canal breach may have occurred. Operators can intervene manually when it is necessary to partially open a gate to help move debris off the trash boom.

The bypass flume is utilized as a downstream fish passage facility at Cabot Station and is generally open for fish passage from April through mid-November in accordance with a schedule provided by CRASC. The bypass flume (also referred to as the log sluice) can also be used to pass debris downstream.

Data are available from FirstLight from 2008-2012 regarding the timing and magnitude of gate openings for both structures; however, no data exist that relate operations to potential impacts on sturgeon spawning and rearing such as bottom velocities and sedimentation rates.

Project Nexus (18 CFR § 5.11(d)(4))

One of the two critical shortnose sturgeon spawning and rearing areas in the Connecticut River is located within the Cabot Station tailrace, within an area impacted by project discharges (Figure 3.3.12-1). Spillage events through the emergency water control gates and bypass flume have been observed to create flow dynamics that may not be sufficiently protective of shortnose sturgeon spawning and rearing in this area. Results of this study will provide recommendations for operation of the emergency water control gates and the bypass flume that will avoid or minimize sedimentation and improve bottom velocities that are sufficiently protective of shortnose sturgeon spawning and rearing.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The design of this study will document potential impacts of spillage at the emergency water control gates and the bypass flume at Cabot Station on shortnose sturgeon spawning and rearing through field verification of conditions to which spawning and early life history stages of sturgeon are exposed. These methods will evaluate a variety of flow conditions, and will attempt to separate the effects of releases at the emergency water control gates and the bypass flume through the use of control locations upstream. This study will be performed on simulated events, which will be evaluated concurrently with the instream flow study and associated bypass reach flow scenarios, as timing and schedule dictates. Flow scenarios and associated measurements will be performed separately for the emergency water control gate and the bypass flume, and will be evaluated during the fall to avoid impacts to sturgeon spawning.

Task 1: Analysis of Existing Data and Scenario Development

To evaluate the frequency of spill events at different magnitudes during sturgeon spawning and rearing, operations data provided by FirstLight of gate opening levels will be analyzed. Time series data during April 15th through June 22nd from 2008-2012 for both the emergency water control gates and the bypass flume will be plotted and examined to determine the appropriate number and gate opening values of spill categories for further analysis.

Frequent spill events will then be categorized into separate routine operating and/or maintenance scenarios; emergency scenarios will not be evaluated in this study because changes in operation during emergency events are not anticipated by FirstLight. Routine operating and maintenance scenarios that involve spillage will be agreed upon prior to field work and will include various combinations of up to three flows through the emergency water control gates and the bypass flume tested separately under two bypass flow rates, and two generation flow rates for a total of up to 12 total scenarios for each of the spill locations.

Task 2: Field Verification of Conditions

Simulated events, with spillage rates described by Task 1, will be evaluated in the field by measuring bottom velocity and capturing sediment. To quantify bottom velocities at the known sturgeon spawning/rearing area (*see* Kynard et al., 2012), a sample of ten random locations within the spawning

area will be selected where the average water velocity will be measured at 1.5 feet from the bottom for 30 seconds. Additionally, average velocities will be measured in the same manner at ten random locations within the same area and under the same river flow and operational conditions, except in the absence of spillage.

To quantify sediment transport, it is envisioned that five bottom-set drift nets will be placed at random locations within the known spawning/rearing area (*see* Kynard et al., 2012); mesh size and soak time will be determined in collaboration with resource agencies and the Conte Lab. Velocity measurements will be taken at the mouth of each net upon setting, spillage stabilization, and removal to aid in calculations of volume of water sampled. As a control, three nets of the same design will be placed in random locations on a shoal upstream of Cabot Station determined to be distant enough from spillway locations to be independent from spill effects; spill has been documented to induce temporary flow reversal during low discharge (Keiffer and Kynard, 2007). Samples will be strained of large-sized organic material, visually inspected, and categorized to evaluate general content, photographed, and delivered to a laboratory for subsequent analysis of dry weight.

Task 3: Data Analysis and Reporting

Descriptive statistics (mean, standard error) of measured variables will be calculated. Multiple linear regression and analysis of variance (ANOVA) will be used to determine whether conditions measured at the sturgeon spawning and rearing area are correlated with and differ significantly among spillage levels, and to determine whether and/or how covariates such as river flow or spillway operational status affect the results.

If spillage at Cabot Station is found to increase the amount of sediment flowing over the sturgeon spawning area, results from this study will be compared to the 2-D hydraulic model developed during the instream flow study in order to assess a broader range of potential mitigation measures.

A preliminary report containing results will be presented after the 2014 sampling data are collected and analyzed; if river flows are conducive for evaluating all proposed scenarios during 2014, then all field data collection will be performed during 2014 and the data analysis and a final report will be completed by late 2014. In the event that river flows are not conducive to evaluating all flow scenarios, a preliminary report will be provided during late 2014, field work will also be performed during 2015, with a final report that includes comparisons with hydraulic model results prepared by late 2015.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of spillage at Cabot Station on sturgeon spawning and rearing habitat. The estimated cost for this study is approximately $35,000 to $45,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

Existing data will be analyzed prior to field work. Field work will be performed during 2014 and potentially during 2015 if river flow is not conducive for evaluating all scenarios. The final report will be submitted during late 2015.

Literature Cited

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Figure 3.3.12-1: Location of the Shortnose Sturgeon Spawning and Rearing Area Near Cabot Station

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3.3.13 Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat

General Description of Proposed Study

In their study request letters, the USFWS, NHFG, MDFW, VTDEC, Town of Gill and CRWC each requested a study of the impacts of the Turners Falls and Northfield Mountain Projects on littoral zone fish spawning and spawning habitats. FirstLight proposes a study to determine if project operations and water level fluctuations in the Turners Falls Impoundment negatively impact anadromous and resident species and to determine if negative impacts are occurring so that appropriate mitigation measures may be developed, if warranted, to protect and conserve the species utilizing project waters. Fish that may be potentially impacted includes sea lamprey, white sucker, fall fish, smallmouth bass, yellow perch, spottail shiners, bluegill, black crappie, chain pickerel, northern pike, common sunfish, and walleye. A study plan to assess sea lamprey spawning within the Turner Falls and Northfield Mountain project areas can be found in Section 3.3.15. This study will focus on the resident populations of temperate basses, perches, suckers, minnows and pike/pickerels in the Turners Falls Impoundment. Additional information relevant to this study will be obtained from other proposed studies, including the fish assemblage (Section 3.3.11), habitat mapping (Section 3.3.14), and tributary access (Section 3.3.17) studies.

It is anticipated that this study will occur during the spring and early summer of 2014 when the resident species typically spawn. Should river discharge or temperature during this period prove to be atypical (e.g., outside of 25-75th percentile of average weekly flows/temp), then FirstLight will consider repeating the study in 2015 to ensure representative conditions occur during sampling to reduce bias in observations.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to determine if project operations negatively impact fish species so that appropriate mitigation measures may be developed, if warranted, to protect and conserve the species utilizing project waters.

Specific objective of this study are to:

- Assess timing and location of fish spawning in the littoral zone.
- Delineate, qualitatively describe (e.g. substrate composition, vegetation type and relative abundance), and map shallow water habitat types subject to inundation and exposure due to project operations.
- Evaluate potential impacts of impoundment fluctuation on nest abandonment, spawning fish displacement and egg dewatering.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals identified are to:

1. Maintain, restore, and recover populations of species of conservation and management concern to self-sustaining levels.

2. Maintain and restore the ecological composition, structure, and function of natural and modified ecosystems to ensure the long-term sustainability of populations of species of conservation and management concern.

3. Protect and conserve fish and their habitats.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Resident fish species, as well as anadromous species, identified in project waters are discussed in Sections 4.4.2-4.4.4 of the PAD. Under the FERC license, the Turners Falls Impoundment elevation may fluctuate between 176.0 ft msl and 185.0 ft msl, as measured at the Turners Falls Dam. Additionally, a bathymetric map of the Turners Falls Impoundment based in field data collection in July 2006 was developed by Hydroterra Environmental Services, LLC (see Figure 3.2.1-4 of the PAD) is available for reference.

Project Nexus (18 CFR § 5.11(d)(4))

Project operations have the potential to impact fish species by influencing spawning success and spawning habitat quality and quantity. For example, water level changes due to Project operations could create conditions where fish eggs are exposed to air, where spawning habitat is dewatered, and/or where fish abandon nests containing eggs.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Information and data obtained though the proposed the fish assemblage study (Section 3.3.11), aquatic habitat mapping study (Section 3.3.14), and tributary access (Section 3.3.17) study will likely be used to address some of the objectives of this study.

FirstLight anticipates that this study will be conducted in the spring and early summer of 2014.

Task 1: Literature Review

Prior to conducting the field investigation, a desktop literature review will be performed to determine when resident species known to occur in the Turners Falls Impoundment typically spawn. In addition to the timing of spawning, the literature review will also be helpful for identifying typical habitat-types used by resident species for spawning, as well as spawning behavior or habits to aid in subsequent field identification.

Task 2: Field Surveys

Once spawning periods have been identified, the field survey effort will be scheduled to maximize potential observations of different species spawning activities. FirstLight anticipates a minimum of two surveying events (one in early spring and one in early summer) to capture of the spawning periods of the resident species. The exact number of surveys will be determined upon completion of the desktop literature review of Task 1.

Considering the impoundment elevation may fluctuate up to nine feet due to project operations, to the extent practical, attempts will be made to conduct this study of the littoral zone when conditions are close to the minimum water surface elevation of 176.0 ft msl to ensure all areas impacted by project-related water level changes are readily observable. For the purpose of this investigation, the littoral zone will be considered the area extending from the edge of the water line at the shore out to a depth of approximately six feet. This will be a general guideline, as the observable characteristics of the littoral zone can vary

with water clarity, water level, time of day, and the prevailing weather conditions. The areas typically wetted when the impoundment is at the maximum allowable water surface elevation (El. 185.0') will also be observed during the field survey(s). Additionally, tributaries identified in PSP 3.3.17 as accessible during spawning seasons will be observed during the field surveys.

Assuming the water clarity is conducive for visual assessment, field sampling will be conducted by systematically traversing the littoral zone (depth < 6 feet) of the Turners Falls Impoundment via boat and/or foot (wading) to visually identify any fish nests, egg masses/deposits, and/or spawning habitat. Additional necessary equipment and data collection will include:

- a digital camera for photo-documentation of habitat types, egg deposits, and identified nests;
- an underwater Atlantis™ Panning Camera to identify spawning nests/habitats in those instances where they cannot be easily identified from the surface;
- a handheld GPS unit to geo-reference the locations of identified habitats, egg deposits, and nests;
- a handheld water quality meter to measure water temperature;
- a Marsh-McBirney flow meter to measure velocity at identified spawning habitats, egg deposits, and nests;
- a secchi disk to estimate water clarity;
- a stadia rod and/or depth meter for recording depth of identified spawning habitats, egg deposits, and nests; and
- data sheets for recording water quality parameters, general observations, weather conditions, and other relevant descriptive information (e.g., sediment/grain sizes associated with nests, approximate diameter of identified nests, presence of fish at nests, presence of aquatic vegetation, nest abandonment, etc.).

These data will be recorded on standardized, waterproof field data sheets. Upon completion of the field survey, all data sheets will be reviewed for quality assurance. Data necessary to develop a map of the observed spawning habitat, egg deposits and fish nests relative to the areas subjected to dewatering due to project operations will be electronically transcribed. A report containing a discussion of the impacts of water level fluctuations on the resident species spawning and spawning habitat, including potential nest abandonment, spawning fish displacement and egg dewatering, in the Turners Falls Impoundment will be produced.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Northfield Mountain Project and Turners Falls Project on fish spawning and spawning habitat in the investigation area. The estimated cost for this one-year study is approximately $30,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's

PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

FirstLight anticipates that this study will be conducted in the spring and early summer of 2014, after high spring flow conditions have subsided.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.3.14 Aquatic Habitat Mapping of Turners Falls Impoundment

General Description of Proposed Study

FERC requested aquatic habitat mapping of the Turners Falls Impoundment, which compliments requests by other stakeholders as described in Study Nos. 3.3.13, and 3.5.1. FirstLight proposes to conduct a habitat field survey to delineate aquatic littoral and demersal habitat in terms of substrate and cover in the Turners Falls Impoundment.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The purpose of the study is to map the distribution and abundance of aquatic habitat within the Turners Falls Project impoundment in the Connecticut River, evaluate the types of aquatic habitats that occur there, and identify any potential effects of operations of the Turners Falls Project and Northfield Mountain Project on this habitat. The habitat mapping and accompanying characterization of aquatic mesohabitat will provide essential information regarding the character and extent of aquatic habitat that may potentially be affected by Project operation. The quantified spatial data generated by this survey will help to provide a framework for upcoming data analysis efforts relative to operations and impoundment modeling.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The FERC must decide whether to issue a new license to FirstLight for the Turners Falls and Northfield Mountain projects in the Connecticut River. Any license issued shall be best adapted to a comprehensive plan for improving or developing a waterway or waterways for all beneficial public uses. Aquatic habitats in the Connecticut River support a sustainable riverine ecosystem that provides public opportunities, including a sport fishery. Ensuring that the effect of project operations pertaining to this resource is considered in a reasoned way is relevant to the Commission's public interest determination.

Several resource agencies have submitted applicable management goals in their study request letters. Resource management goals for this study are consistent with those identified in Study No. 3.5.1 *Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species.*

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

No prior habitat mapping information is available to document the habitat resources of the Turners Falls Impoundment. Mapped locations of aquatic habitats in the Turners Falls impoundment is needed to evaluate the potential influences of the Turners Falls and Northfield Mountain Project on aquatic resources.

Project Nexus (18 CFR § 5.11(d)(4))

Water levels in the Turners Falls impoundment fluctuate due to operations of the Turners Falls Project and because the impoundment also serves as the lower reservoir for the pumped-storage operations of the Northfield Mountain Project. As a result, littoral aquatic habitat and aquatic species that utilize the habitat may be affected by water level fluctuations. This study will establish a baseline condition and the health of the aquatic habitat and aquatic species of the Connecticut River in the Turners Falls Impoundment under current operations.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

FirstLight proposes to map the distribution and abundance of littoral aquatic habitat within the Turners Falls Project impoundment in two phases. During the first phase, major aquatic habitat types will be delineated. During the second phase detailed microhabitat data will be collected on representative transects. These data will then be used in conjunction with operational and other models to evaluate project effects on aquatic resources in the study area.

Task 1: Field Survey

Lentic aquatic habitat suitability is defined primarily by substrate, cover and depth. Each of these habitat parameters will be assigned specific attributes to be used for field delineation. These will generally include:

- **substrate:** fines (sediment, organic detritus, mud, etc.), sand, gravel, cobble, boulder, bedrock, rubble
- **cover type:** object cover (*i.e.* boulder, woody debris, riprap, etc.), overhead cover (overhanging limbs, structures, etc.); vegetative cover (emergent, submerged)
- **cover density:** absent, low, moderate, high
- **depth (at normal pool):** surface to substrate (ft)

Task 1a: Delineation

Delineation of the 20-mile-long impoundment will be conducted by boat and will occur during summer during a period of relatively stable impoundment levels so that aquatic vegetation is established, and so that observations of depth relative to substrate and cover can be observed under consistent conditions, to the extent practical.

Habitat delineation will be conducted by a boat traveling through the littoral zone parallel to shore. The prevailing water elevation at the beginning of the survey will be documented by bench-marked survey. Staff gages will be established throughout the study area so that changes in water elevation during the survey can be accounted for. The field crew will methodically record habitat attributes and geo-reference with GPS each boundary where a pronounced change in substrate and/or depth occurs. We anticipate that cover will occur in patches rather than broad linear boundaries. Therefore, a centroid GPS waypoint will be collected at key cover nodes.

Additional relevant biological and geomorphic characteristics will also be collected where appropriate including readily observable aquatic fauna; channel geometry (including bank and shoreline slope); etc. The data will be recorded on data sheets, a dedicated field book, or via a pentop computer. Upon completion of the survey, all data will be rechecked for quality control and archived.

Task 1b: Microhabitat

Transect data will be gathered within representative littoral areas. The distribution and number of transects will be dictated by the variability detected during the delineation phase, but the goal would be to have one transect accounting for each major type of shoreline slope/littoral substrate/cover/depth condition documented during delineation. Each transect will extend from El. 185' to El. 176' and include the area to a water depth of approximately six feet. Verticals will be located along each transect to depict the following elevations:

- top of bank
- normal high water
- upper elevation of pool (if different than normal high water)
- normal pond elevation
- toe of bank
- elevation 6 ft below normal low pool elevation.

Additional verticals will be established at intervals wherever micro-changes in slope, substrate embeddedness, or cover are encountered. Elevations will be surveyed in project datum so that data can be integrated with other project operation data for analysis. The locations of all transects will be geo-referenced with GPS and transect headpins marked with blazing.

Task 2: Analysis and Report

Geospatial mesohabitat data will be transferred to a GIS format and used to develop both visual maps depicting distribution as well as tabular information quantifying the abundance and distribution of habitat features in the study area. A summary report will be developed that will include survey methods, GIS maps showing the mesohabitat spatial distribution in the impoundment, and a discussion of observations. The report will provide a narrative discussion of habitat use by aquatic fish and macroinvertebrates native to the study area. It is anticipated that data gathered during Study No. 3.3.17 *Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitat* will also be used to develop the habitat map and discussion for this summary report.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The estimated cost for the study outlined in this plan is approximately $30,000-$45,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

It is anticipated that the aquatic mesohabitat assessment and mapping survey will be conducted in July – August 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.3.15 Assessment of Adult Sea Lamprey Spawning within the Turners Falls Project and Northfield Mountain Project Area

General Description of Proposed Study

NOAA requested an assessment of adult sea lamprey spawning within the areas of the Turners Falls and Northfield Mountain Projects. FirstLight will conduct a field study to assess adult sea lamprey spawning within those areas during the late spring or early summer of 2014, but is proposing to substitute the methods described below in lieu of the telemetry methods suggested by NOAA.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to determine the impacts that operations of the Turners Falls Project and Northfield Mountain Project may have on sea lamprey spawning activity. Specific objectives of the study are to:

- Identify areas within the Project area where suitable spawning habitat may exist for adult sea lamprey.
- Conduct spawning surveys to confirm use of areas identified as containing suitable spawning habitat.
- Describe spawning mound characteristics, including location, size, substrate, water depth, and velocity.
- Determine if operations of the Turners Falls Project and Northfield Mountain Project are adversely affecting spawning areas (*i.e.,* if flow alterations are causing dewatering and scouring of lamprey spawning area).

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

Sea lamprey are a federal trust resource, and as such, NOAA Fisheries is charged with protecting the species and reducing threats to maintain its population. According to NOAA Fisheries, sea lamprey within the Connecticut River drainage are one of New Hampshire's and Vermont's Species of Greatest Conservation Need (SGCN). As outlined in Vermont's Wildlife Action Plan, research and monitoring needs for SGCN include monitoring and assessing populations and habitats for current conditions and future changes, and identifying and monitoring problems for species and their habitats.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Sea lamprey are an anadromous species known to spawn in the Connecticut River within the Turners Falls and Northfield Mountain Project Areas. They use mainstem and accessible tributary habitat consisting of gravel and cobble substrate in areas with flowing water in which they construct nests during spawning (NOAA, 2013). Sea lamprey pairs or groups (multiple fish may form an aggregate nest) can be observed building nests (or recently completed nests can be observed) in late-June (Hartel et al., 2002; NOAA, 2013). Lamprey spawning has been observed from the Sunderland Route 116 bridge upstream to the base of the Cabot Station in shallow water habitats where preferred substrate occurs and where water velocities are increased due to a riverine physical characteristics (*e.g.,* shifts in depth contours, channel meanders, or islands) (NOAA, 2013). According to NOAA, the Connecticut River Coordinator (K. Sprankle, USFWS) has observed sea lamprey spawning in the Connecticut River mainstem upstream of the Turners Falls Dam within close proximity of the Vernon Dam (suitable habitat adjacent to Stebbins

Island, both sides of island) (NOAA, 2013). Sea lamprey are also known to utilize lower reaches of tributaries, such as the Ashuelot River, Hinsdale, New Hampshire and mainstem gravel bar and shallow water habitats within the Turners Falls Impoundment (*e.g.,* Massachusetts State Line) (NOAA, 2013).

In 2012, 14,089 sea lamprey were passed upstream of Holyoke Dam, whereas 4,503 were passed at Turners Falls Dam. To date, no studies have been conducted that identify sea lamprey spawning habitat and/or activity or the effects of operations of the Turners Falls Project and the Northfield Mountain Project on spawning (NOAA, 2013).

FirstLight conducted studies in the late spring and summer of 2012 to examine habitat conditions downstream of Turners Falls Dam, including substrate composition. Habitat mapping indicated there is limited gravel-riffle spawning habitat in the mainstem downstream of Cabot Station or within the bypassed reach below Turners Falls Dam (FirstLight, 2012).

Project Nexus (18 CFR § 5.11(d)(4))

Operations of the Turners Falls and Northfield Mountain Projects have the potential to affect sea lamprey spawning activity, spawning habitat, and spawning success. If adult sea lamprey are actively spawning in the project area, it is important to assess whether Project operations are having any adverse effects (*i.e.,* dewatering and scouring) to these spawning activities, their nests, and spawning habitats.

The investigation area includes the following:

- Suitable gravel or cobble riffle habitat within the Connecticut River mainstem from Cabot Station downstream to Sunderland Bridge.
- Suitable gravel or cobble riffle habitat the Turners Falls bypassed reach (Connecticut River mainstem).
- Suitable gravel or cobble riffle habitat within the riverine portion of the upper Turners Falls Impoundment that is subjected to flow or elevational regulation resulting from project operations. Specifically, surveyors will focus in on the following two areas:
    a. The Connecticut River mainstem within close proximity of the Vernon Dam (habitat adjacent to Stebbins Island, both sides of island).
    b. Mainstem gravel bar and shallow water habitats within the Turners Falls Impoundment (*e.g.*, at or near the Massachusetts State Line).
- Suitable gravel or cobble riffle habitat within tributary confluence areas that are or may be affected by the current operational protocols, including:
    a. The Deerfield River confluence with the Connecticut River.
    b. The Millers River confluence with the Connecticut River.
    c. The Ashuelot River confluence with the Connecticut River.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Field Data Collection

Assessment of Sea Lamprey Spawning Activity and Habitat – Because sea lamprey nests and spawning pairs are generally readily observable (S. Coghlan, Assistant Professor of Freshwater Fisheries Ecology, University of Maine, personal communication, March 15, 2013) spawning activity will be determined via wading or boating surveys within the investigation area. Given sea lamprey life history and spawning patterns, it is anticipated that spawning ground surveys will be performed in late May or June, depending on water temperature and river flow. Surveyors will:

- Delineate areas of suitable habitat for lamprey (shallow, gravel or cobble riffles) with a sub-meter accuracy GPS.

- Physically locate and enumerate active or inactive nests.[21]

- Physically locate actively spawning lamprey.

- Photo document, geo-reference, and physically mark (with fluorescent marker or other re-locatable marking device) active and inactive nests.

- Collect habitat data at representative nest sites including:

    - Nest dimensions (length/width), along with measurements of depth and velocity at the upstream end, top of mound, and bottom of pit.

    - Substrate classification.

    - Water temperature.

Once nests and spawning habitat are located and delineated, surveyors will return to a sub-sample of at least 30 randomly distributed individual nests (if available) throughout the investigation area during low water level conditions following a high-flow operational event to assess the effects on spawning habitat and nests. To ensure adequate spatial coverage and the evaluation of lamprey nests in multiple locations, the subsample will be divided among different large-scale location classifications (*i.e.* Turners Falls Impoundment; Bypass Reach; Downstream Corridor, *etc*.), with a goal of subsampling at least 10 nests in each determined location. At these stations, surveyors will:

- Photo document active and inactive nests during low water level conditions.

- Collect habitat data during low water level conditions to document changes resulting from Project operations, including:

    - Number of nests dewatered, partially or wholly.

    - Nest dimensions (length/width), along with measurements of depth and velocity at the upstream end, top of mound, and bottom of pit.

    - Water temperature.

- Delineate remaining wetted areas of suitable habitat (*i.e.,* spawning beds) for lamprey (shallow, gravel or cobble riffles) with a sub-meter accuracy GPS during low water level conditions for determinations of areal loss of habitat.

[21] For the reach of the mainstem Connecticut River downstream of Cabot Station and below Vernon Dam, this will include using existing habitat data collected by FirstLight in 2012 or information related to known spawning sites to identify suitable habitat in advance of field surveys.

Task 2: Data Analysis

All field data will be compiled, entered into a database, assured for quality, and archived. Tabular and graphic summaries of sea lamprey abundance and a map of the spatial distribution of suitable habitat will be developed.

Task 3: Report

A report will be prepared describing monitoring methods and results. The report will also include an assessment of impacts due to Project operations and whether changes to operational regimes could reduce potential adverse impacts to sea lamprey spawning and spawning habitat.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Turners Falls Project and Northfield Mountain Project on sea lamprey spawning in the investigation area. The estimated cost for this one-year study is approximately $30,000 to $45,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May14-15, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

FirstLight anticipates that this study will be conducted in late May or June of 2014, depending on water temperature and river flow conditions, which corresponds with sea lamprey spawning timeframes in the Connecticut River.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

Literature Cited

FirstLight Hydro Generating Company (FirstLight). (2012). *Aquatic Mesohabitat Assessment and Mapping*. Northfield, MA: Author.

Hartel, K.E., D.B. Halliwell, & A.E. Launer. 2002. Inland Fishes of Massachusetts. Massachusetts Audubon Society (Lincoln). 328 pp.

NOAA. 2013. Letter with Comments on FirstLight Power Resources Notice of Intent to File License Application dated February 27, 2013.

3.3.16 Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the CT River below Cabot Station

General Description of Proposed Study

MADFW requested a study investigating the effects of flow regime on state-listed freshwater mussels, or potential habitat, downstream from the Turners Falls Dam. Although the geographic scope of such a study was not defined in the MADFW study request, FirstLight defines the study area as the 13-mile reach between Cabot Station and the Route 116 Bridge in Sunderland. A two-phase approach is proposed for this study. In Phase 1, the study area will be surveyed for state-listed mussels using approved survey protocols; biologists will characterize populations of state-listed and co-occurring common mussel species, describe habitat conditions, and map/analyze habitat for any state-listed mussel species found in the study area. Phase 2 will focus on more detailed habitat measurements in areas where state-listed mussel species are found, and combine these data with hydraulic modeling and IFIM studies (described under separate study plans) to assess potential effects of the current flow regime on state-listed mussel populations or their habitat.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

This study has two objectives that can be accomplished in two phases:

- Phase 1: Delineate, through field surveys, populations of state-listed mussels downstream from Cabot Station and employ methods to characterize the distribution, abundance, demographics, and habitat use of these populations. Even if state-listed mussel species are not detected, surveys will identify and map potential habitat for state-listed species based on habitat preference of each species.
- Phase 2: Collect more detailed data on mussels and habitat parameters in areas where state-listed species are found, and combine these data with the independent hydraulic model and IFIM studies, to evaluate the effects of existing and potential flow regimes on state-listed mussel species.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The Massachusetts Natural Heritage & Endangered Species Program (NHESP), part of the MADFW, is charged with ensuring the conservation and protection of species listed under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) as Endangered, Threatened, or of Special Concern. The resource management goals identified by the NHESP/MADFW are to:

- Ensure that PME measures are commensurate with Project effects and meet MESA requirements.
- Conserve, protect, and enhance the habitats for state-listed species that will be affected by Project operations.

The MADFW study requests are intended to facilitate the collection of information necessary to conduct impact analyses and develop reasonable conservation, PME measures pursuant to the Fish and Wildlife Coordination Act, as amended (16 U.S.C. §661 *et seq.*), the Federal Power Act (16 U.S.C. §791a, *et seq.*), the Clean Water Act (33 U.S.C. §1251 *et seq.*), the MESA, and the WPA.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Species Composition: In 2011, a freshwater mussel survey was conducted in the Turners Falls Impoundment, bypass reach, and canal as a baseline study in anticipation of the FERC relicensing process. State-listed mussel species were not detected in any of these areas (Biodrawversity, 2012). Also in 2011, a freshwater mussel survey was conducted upstream and downstream of the Vernon Hydroelectric Project as part of the planning for TransCanada's FERC relicensing process, and no state-listed mussel species were found during that study (Biodrawversity & LBG, 2012). As part of the requirements of the FERC license for the Holyoke Dam, freshwater mussel studies have been conducted at four-year intervals in that project area, which includes the area from Dry Brook (Sunderland) to the Holyoke Dam, plus the bypass reach and power canals (this survey is scheduled to occur again in 2013). These studies, combined with surveys conducted for several riverbank stabilization or construction projects along this same reach, have resulted in a very good understanding of the distribution and habitat of common and state-listed mussel species in the Connecticut River from the Holyoke Dam to the Vernon Dam, minus a mostly unsurveyed 13-mile reach from the Route 116 Bridge in Sunderland to Cabot Station.

The yellow lampmussel (*Lampsilis cariosa*), listed as Endangered in Massachusetts, has been documented in the impoundment of the Holyoke Dam as far upstream as the Hadley Dike, with highest concentrations from Elwell Island (Northampton) downstream to Brunelle's Marina (South Hadley). The eastern pondmussel (*Ligumia nasuta*) has been found at only one location in the lower Holyoke Dam impoundment, and it occurs in several small tributaries. There is potential for either of these species to occur in the Connecticut River in the unsurveyed 13-mile reach downstream from Cabot Station. In addition, there is a historic record (~1978) of dwarf wedgemussel (*Alasmidonta heterodon*) in the Connecticut River from Sunderland, and it is possible that this species still persists in this reach. This is a federally endangered species, with the closest known populations in the Fort River (Amherst, MA), Mill River (Hatfield, MA), Ashuelot River (Swanzey, NH), and in the Connecticut River in the impoundment of the Bellows Falls Dam in New Hampshire and Vermont.

Impact of Flow Regime: The impacts of current flow regime on mussels downstream from the Turners Falls Dam are not well understood. There are significant within-day flow fluctuations downstream from the Turners Falls Dam. These changes in water elevations and flow dynamics have the potential to adversely affect state-listed mussels, their habitats, and their long-term viability in the Connecticut River. Species most vulnerable would be those that have an affinity for nearshore habitats, or other shallow areas that are most likely to become dewatered or in shallow water (where they may be vulnerable to heat stress or predators) during periods of low flow. Effects are expected to be most acute in areas of the river with channel morphometry, bank slope, and substrate conditions that are both conducive to mussel colonization and that experience the greatest degree of change from flow minima to flow maxima. The IFIM and hydraulic models studies proposed for this project, combined with the mussel surveys and habitat assessments that will be completed specifically during the mussel study, will help to identify both the species and locations where flow regime effects are more likely to occur, and will help provide an overall assessment of these effects.

Project Nexus (18 CFR § 5.11(d)(4))

The timing, rate, and magnitude of releases from the Turners Falls Project may have adverse effects on rare mussel populations although the degree of these effects is unknown. In order to evaluate the potential impacts of the Project on the abundance and distribution of state-listed mussel species and their habitat, baseline information is needed.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Finalize study plan and attain collection permit

Because the study is focusing on state-listed mussel species, FirstLight will work with NHESP to finalize the study plan and attain the necessary permit to handle/collect state-listed mussels. FirstLight will comply with the conditions and reporting requirements of the collection permit.

Task 2: Phase 1 Mussel Survey and Habitat Assessment

Surveyors will systematically search the open water riverine habitats downstream from Cabot Station, employing the following protocol:

- The survey will be conducted when appropriate water clarity and water depth conditions are present, between early June and late September.
- Surveys will be conducted using SCUBA in depths over three feet, and by snorkeling in shallower waters.
- At least one site per mile, with additional sites in complex areas (such as around islands) will be surveyed for a minimum of 1.0 person-hours of survey effort per site. Additional time will be spent surveying areas where state-listed species are found to characterize and delineate these populations.
- The Catch per Unit Effort (CPUE) method will be used to qualitatively assess mussel species abundance. Specifically, the number of individuals of each species encountered within a defined amount of time will be tallied, and the CPUE values will be calculated and compared.
- Standard morphometric data (e.g., species, size, shell injury/erosion etc.) and site data (i.e., location, extent, elevation, and age class structure) will be collected. All state-listed mussel species encountered, and the first 50 individuals of common species, will be measured (mm) to enable assessment of size distribution and recruitment.
- For each state-listed mussel that is encountered, the following data will be recorded: precise location, water depth, substrate, presence/abundance of aquatic plants, presence/abundance of woody debris, and flow velocity.
- Representative digital photographs of each state-listed species will be taken at each site to document and confirm the identity. Photos showing the lateral view and/or in situ siphoning will be included.
- Representative samples of spent shells (if encountered) will be collected for each state-listed species; these will be sent to the Division for documentation.
- All mussels removed from the substrate will be replaced to the same area and carefully re-bedded into the sediment in their original orientation; anteriorly into the substrate, posterior end up.
- At all survey sites, biologists will record key instream habitat parameters such as water depth, flow velocity, major substrate types, aquatic plant species/abundance, abundance of woody debris, bank condition, and representative photographs.
- This general habitat assessment will provide habitat descriptions and maps to adequately describe the relative amount, distribution, and quality of suitable habitat for the state-listed freshwater mussels in areas influenced by the Turners Falls Project.

Task 3: Phase 2 Habitat Assessment and Mussel Survey

The Phase 2 habitat assessment and possible additional mussel surveys (e.g., quantitative surveys) will only be conducted at sites where state-listed mussel species are found. Given the potential to find either state-endangered or federally endangered mussel species, we think it is prudent to only outline a Phase 2

approach and commit to working with MADFW or USFWS to refine this approach listed below depending on Phase 1 results.

- Additional habitat data will be collected to support the IFIM study. Specifically, depth, velocity, and substrate profile(s) will be recorded at one or more cross-channel transects; the number of transects will depend on the size of the mussel bed and habitat complexity at a site.
- Both the boundaries of mussel beds and the wetted area will be delineated using GPS.
- If state-listed mussel densities are high enough, quantitative sampling (using quadrats or transects) will be employed to provide a more accurate assessment of density and population size at that location.

Task 4: Effects of Flow Regime on State-listed Mussels

The IFIM and hydraulic model studies proposed for this project, combined with the mussel surveys and habitat assessments that will be completed specifically during the mussel study, will help to identify where Project effects are more likely to occur, which species are more susceptible, and will help provide an overall assessment of these effects.

If state-listed mussels are detected and the Phase 2 mussel survey is completed, the IFIM and hydraulic models will be supplemented with the detailed habitat data collected at the sites where state-listed mussels are found, resulting in a more comprehensive assessment of the effects of flow regime on state-listed mussels.

Task 5: Report

A report will be prepared describing the survey and modeling methods and results. A tentative table of contents follows:

- Introduction
- Study Area
- Methods
    - Mussel Surveys
    - Habitat Assessment
    - Hydraulic Model and IFIM
- Results
    - Mussel Surveys
    - Habitat Assessment
    - Effects of Flow Regime
- Discussion
- Conclusions

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The methods and analyses proposed are consistent with other studies of this nature. The estimated cost for this study will depend, in part, on whether state-listed mussel species are found and the amount of mussel/habitat data that must be collected where state-listed mussels are found. Overall costs may range $15,000 - $60,000 (not including the hydraulic model and IFIM completed as a separate study). The cost for the Phase 1 mussel survey and habitat characterization would comprise the low end of that range; higher costs would likely only result from the discovery of state-listed mussels and the necessity of a Phase 2 mussel survey.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

Field work for the Phase 1 mussel survey is planned to occur in 2013, if possible, in advance of the instream flow study proposed in Section 3.3.1. Completing the Phase 1 survey early in 2013 will help to determine if and where the Phase 2 mussel surveys are needed, and help inform the instream flow study. The remainder of any necessary work will occur in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

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Biodrawversity, (2012). *Freshwater Mussel Survey in the Connecticut River for the Turners Falls and Northfield Mountain Hydroelectric Projects*. Amherst, MA: Author.

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3.3.17 Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitat

General Description of Proposed Study

The NHFGD, Town of Gill, MADFW, CRWC, VTDEC, TU and USFWS requested a study to determine if water level fluctuations due to Project operations result in a barrier(s) to fish movement in and out of tributaries and backwaters to the impoundments and riverine reaches below the dams. Additionally, the stakeholders requested an assessment of the impacts of water level fluctuations due to Project operations on water levels, available fish habitat and water quality in the tributaries and backwaters of the impoundment and riverine reaches below the dams. It is anticipated that this study will provide data that may be used to determine the adequacy of existing downstream minimum flow requirements.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goals of this study are to determine if water level fluctuations from the Turners Falls and Northfield Mountain Projects result in reductions of available aquatic habitat due to movement barriers and/or habitat alterations. Results from this study will be useful for developing mitigation measures and to determine the adequacy of existing downstream minimum flow requirements. Specific objectives of the study are to:

1. Identify potential barriers or constrictions of fish access to tributaries and backwater areas resulting from water level fluctuations.

2. Measure changes to available habitat, and water quality in backwater areas and tributaries resulting from water level fluctuations.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals identified by the commenting agencies are:

- Protect, enhance, or restore diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.

- 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.

- Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Major tributaries to the Turners Fall Impoundment include the Ashuelot River in New Hampshire, which drains 420 mi^2 from the east and enters the Connecticut River just below Vernon Dam, and the Millers River, which drains 392 mi^2 from the east and enters downstream of the Northfield Mountain tailrace. Smaller named streams entering the Turners Falls Impoundment, from upstream to downstream, include Newton Brook, Pauchaug Brook, Bottom Brook, Mill Brook, Mallory Brook, Millers Brook, Bennett Brook, Merriam Brook, Otter Run, Ashuela Brook, Dry Brook, Pine Meadow Brook, and Fourmile Brook.

For the downstream reach from the base of the dam to the Route 116 bridge, major tributaries potentially impacted by Project operations include the Fall River, Deerfield River, Sawmill River, and Gunn Brook.

Limited information related to the potential impacts of the Turners Falls Project and Northfield Mountain Project operations on tributary/backwater access and habitats is available; therefore, the study is being completed to establish baseline conditions and assess the potential effects of existing or proposed operations. Given that the major tributaries to the Connecticut River in the project area (*i.e.,* Deerfield River, Miller River, and Ashuelot River) are large, regulated, and gauged river systems with ample catchment size, it is assumed that access to these major systems is afforded during all operational phases of the Turners Falls Project and Northfield Mountain Project. Therefore, the study will focus on smaller tributary systems that may not have enough river flow to maintain connectivity during drawdown periods.

Project Nexus (18 CFR § 5.11(d)(4))

Operation of the Turners Falls Project and Northfield Mountain Project may directly impact tributary/backwater and aquatic habitat access through the use of water for hydropower generation.

The investigation area includes the following smaller named streams entering the Turners Falls Impoundment, from upstream to downstream (Figure 3.3.17-1)[22] as well as significant backwatered areas within the Turners Falls impoundment:

- Newton Brook
- Pauchaug Brook
- Bottom Brook
- Mill Brook
- Mallory Brook
- Millers Brook
- Bennett Brook
- Merriam Brook
- Otter Run
- Ashuela Brook
- Dry Brook
- Pine Meadow Brook
- Fourmile Brook
- Backwater habitat encountered during survey work.

Investigation areas downstream of Turners Falls Dam will include the Fall River, Deerfield River, Sawmill River, and Gunn Brook (*see* Figure 3.3.17-2).

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Common tools to evaluate water level impacts may be used including: bathymetric mapping; habitat measurements (*e.g.,* substrate, depth and velocity), and water quality information (*e.g.,* dissolved oxygen, temperature, turbidity, and pH). Other methods (river bed surveys, visual inspections, GIS/GPS mapping, and hydraulic/habitat modeling) will also be utilized. The study area for tributary and backwater sampling will include 13 smaller named tributaries along with other significant backwater habitat encountered

[22] Assumes all of these tributaries are locatable.

during the surveys. All field work described below would be performed once during the spring, summer, and fall of the first study year.

Task 1: Field Data Collection

For the purpose of this study, low water level conditions will be considered as 176.0 feet msl (or as close as is practical at the time of the study) in the Turners Falls Impoundment, and at a gage height of ≤ 8 feet at Montague for river reaches below the Turners Falls Dam.

Tributaries – Surveyors will locate individual tributary confluence areas within the Turners Falls Impoundment and the downstream reach to the Route 116 Bridge by boat or vehicle/foot during full-pond conditions or high water level conditions downstream. At each tributary site, surveyors will perform the following:

7. Photo document the tributary confluence area.

8. Delineate the perimeter of the inundated tributary confluence area with a sub-meter accuracy GPS. Aerial imagery may also be used to delineate tributary confluence areas.

9. Collect spot measurements of water temperature, dissolved oxygen, turbidity, and pH at one location within the inundated tributary confluence area. For comparison, measurements will also be taken at one location in the Connecticut River near the confluence area and in a free-flowing riverine reach immediately above the elevation affected by water level fluctuations.

Surveyors will then revisit tributary confluence areas during lower water level conditions to determine if stream intermittency or constrictions occur as a result of Project operations that would restrict fish movements into free-flowing riverine reaches. At each tributary site, surveyors will perform the following:

1) Photo document the tributary confluence area and any stream channel features (*e.g.,* barriers) that may restrict fish movements. Assessment and identification of these constriction points will be based on the best professional judgment of the biological staff employed to do the work. Generally, stream features with water depths less than 4-inches in the thalweg area will be considered as potential constrictions to fish movements.[23]
2) Delineate the perimeter of the dewatered tributary confluence areas with a sub-meter accuracy GPS. Aerial imagery may also be used to delineate tributary confluence areas. Critical transects will also be GPS-located for future reference.
3) Characterize and map exposed aquatic habitats in the tributary confluence area.
4) If barriers to fish movement are observed:
    - Record and photo document their location.
    - Perform a longitudinal bathymetric/topographic thalweg[24] survey of the dewatered confluence area, with stream bed elevations relative to low water level elevation.
    - Perform a cross-sectional profile of stream channel features that may restrict fish movements.

[23] Given that these small tributaries are likely only used by resident riverine fish and perhaps sea lamprey, water depths greater than 4-inches will be considered adequate for upstream of downstream movements of fish.
[24] Point of lowest elevation.

- Collect water depth, velocity, and substrate data at longitudinal and cross-section survey points.

5) Collect spot measurements of water temperature, dissolved oxygen, turbidity, and pH within the riverine portion of the tributary. For comparison, measurements will be taken in three areas (within the Connecticut River near the mouth of the tributary confluence, within the affected portion of the tributary, and upstream of the influence of the normal water level fluctuations.
6) Photo document and delineate areas subject to fish stranding (*e.g.,* standing pools without or with little outflowing water to allow for volitional fish movements to deeper waters).

Backwater Areas – For purposes of this study we have defined backwater habitat as areas with a notable increase in water surface elevation caused by a constriction or obstruction in flow, or off-channel habitats created as a result of floodplain (or other habitat features, *e.g.,* oxbow) development. Backwater habitats are characterized by slow currents, shallow water, and silty or vegetated substrates. To assess the effects of Project operations, surveyors will locate backwater areas during relatively high water levels. Surveyors will collect/perform the following at each backwater site at these conditions:

1) Photo document and GPS the location of individual backwaters.
2) As possible, delineate the perimeter of backwatered areas with a sub-meter accuracy GPS. Aerial imagery may also be used to delineate backwater habitat.
3) Collect spot measurements of water temperature, dissolved oxygen, turbidity, and pH within the backwater. For comparison, measurements will also be taken in the impoundment near the backwater area.

Surveyors will then revisit backwatered areas during low water level conditions to assess connectivity and habitat conditions. The following information will be collected:

1) Photo documentation of backwaters at low water level conditions.
2) Photo documentation and GPS mapping of areas subject to fish stranding (*e.g.,* standing pools without or with little outflowing water to allow for volitional fish movements to deeper waters).
3) If barriers to fish movement are observed:
   - Record and photo document their location,
   - Perform longitudinal bathymetric/topographic thalweg survey of backwater area, with bed elevations relative to low water level elevation.
   - Collect water depth, velocity, and substrate data at longitudinal and cross-section survey points.
4) Collect spot measurements of water temperature, dissolved oxygen, turbidity, and pH within the backwater. For comparison, measurements will also be taken in the Connecticut River near the backwater area.

Task 2: Evaluation of Fluctuation Range

If it is determined that the existing flow fluctuation range creates barriers to fish movements in tributaries and/or backwatered areas, or adversely affects aquatic habitat, FirstLight will perform modeling/GIS studies to evaluate if changes in water level fluctuation range would mitigate for any identified impacts. Modeling software (*i.e.,* HEC-RAS or River 2D or comparable) will be used to develop a GIS to demonstrate changes in tributary or backwater access (including resultant water depth and water velocity modeling) at identified barriers and habitat conditions.

Task 3: Data Analysis and Reporting

Data will be compiled and analyzed after each sampling effort. Data will be developed in tabular and graphic format for inclusion in draft and final report preparation.

The report will be submitted as part of the Initial Study Report as per the ILP process schedule.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

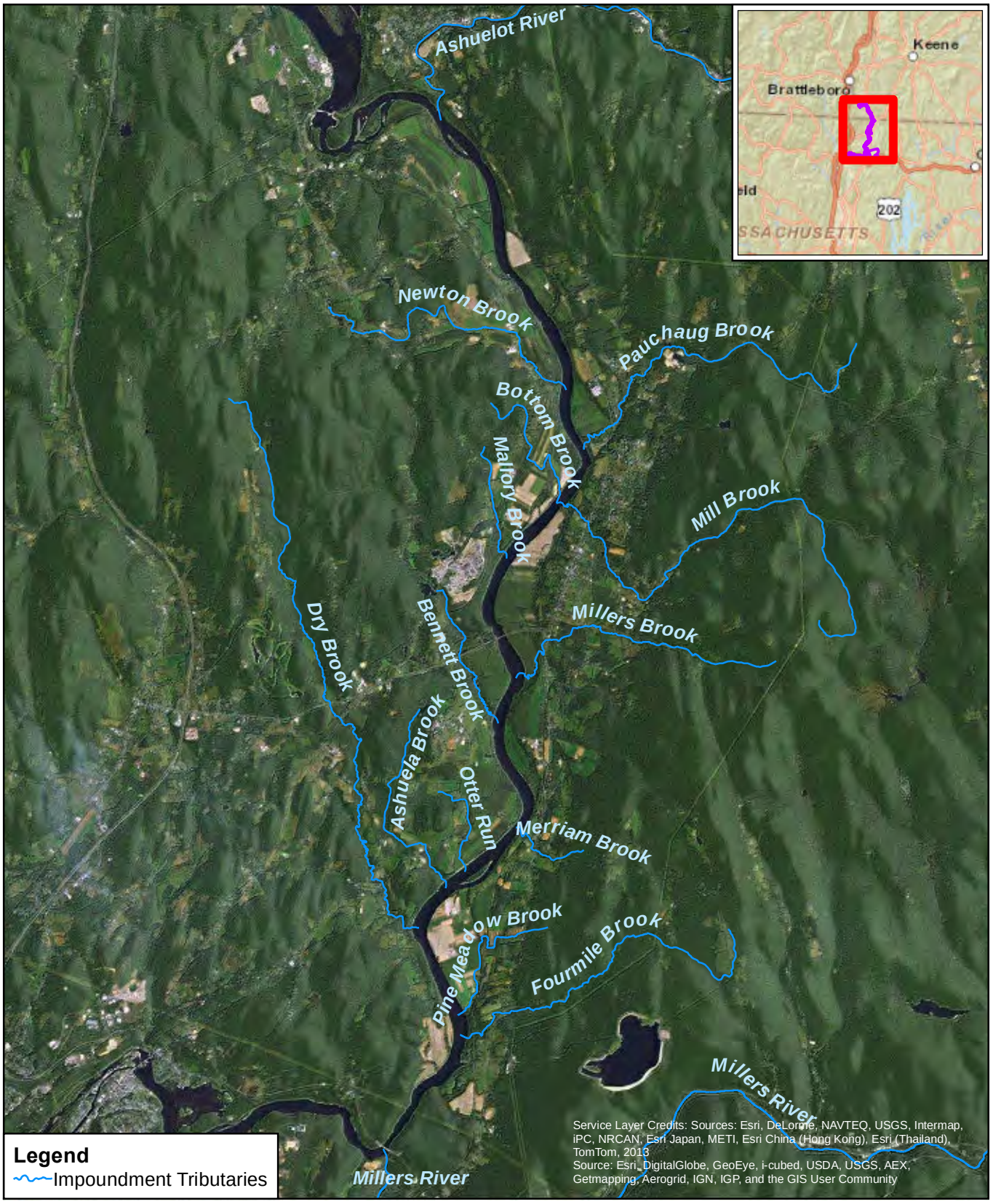
FirstLight believes the proposed level of effort is adequate to accurately assess the potential effects of the Turners Falls Project and Northfield Mountain Project on tributary and backwater access in the investigation area. The estimated cost for this one-year study is approximately $30,000 to $45,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

It is anticipated that this survey will be conducted in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.



FirstLight Power Resources
GDF SUEZ

N

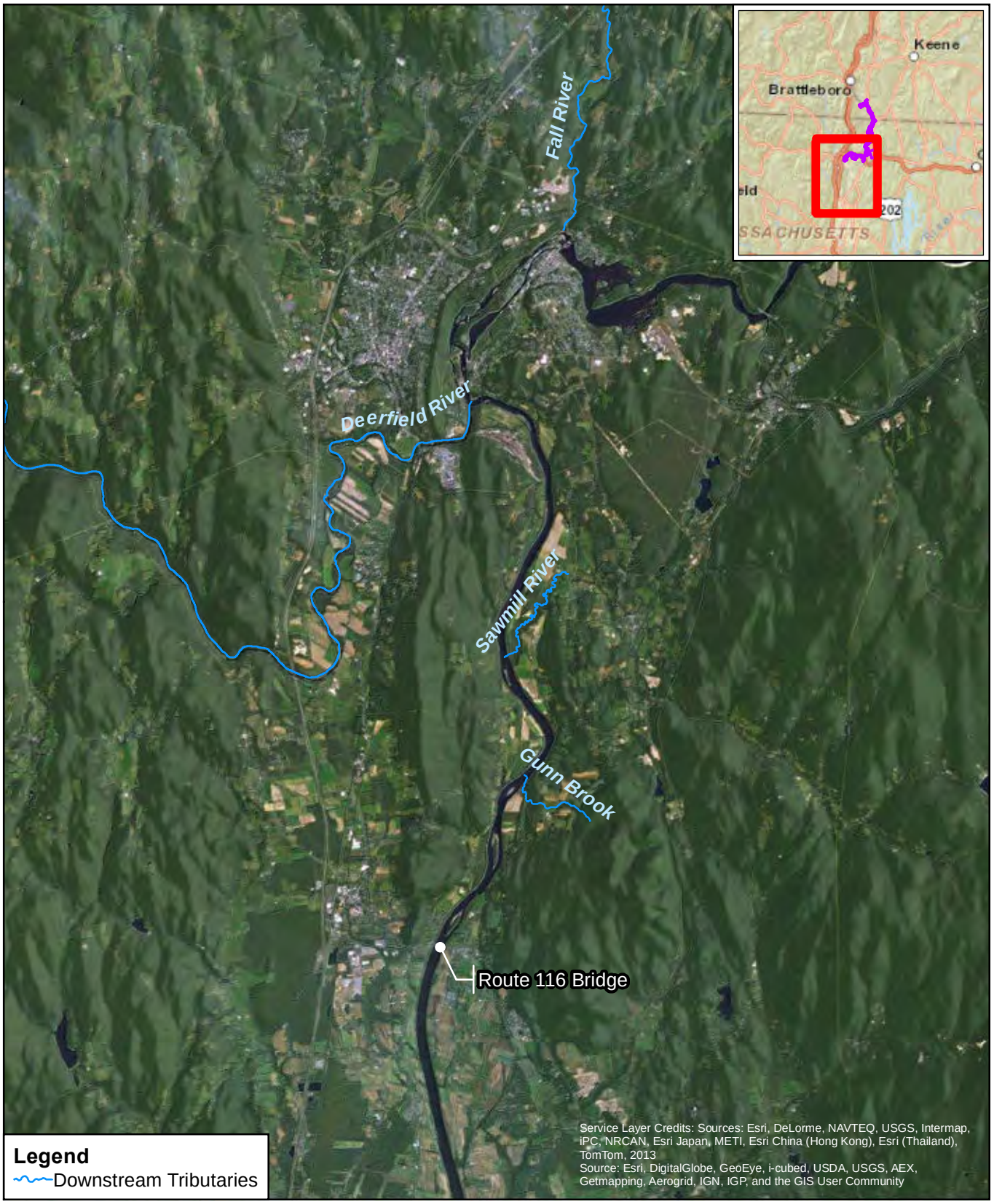
0 1 2 4 Miles

FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

Figure # 3.3.17-1
Location of Target Tributaries in the Turners Falls Impoundment for FirstLight's Tributary and Backwater Access Study

Path: W:\gis\maps\TributaryAccessStudy\TributaryList.mxd



FIRSTLIGHT POWER RESOURCES

PRE-APPLICATION DOCUMENT

N

0 1 2 4 Miles

Figure # 3.3.17-2
Location of Target Tributaries Downstream of the Turners Falls Dam for FirstLight's Tributary and Backwater Access Study

Path: W:\gis\maps\TributaryAccessStudy\TributaryList_Downstream.mxd

3.3.18 Impacts of the Turners Falls Canal Drawdown on Fish Migration and Aquatic Organisms

General Description of Proposed Study

In the study request letter from the USFWS, a study to quantify the impacts of the annual Turners Falls Project canal drawdown on emigrating and resident fishes, freshwater mussels and mudpuppies in the canal was requested. Similar requests were also received from the MADFW, NHFGD, NOAA, CRWC, and TU. The stakeholder's indicate that the study request is intended to facilitate the collection of information necessary to conduct effect analyses and to develop reasonable and prudent conservation measures, along with PME measures.

Historically, FirstLight has conducted annual surveys of the canal during drawdown events. In 2011, a more extensive survey was conducted and documented in a memo report as explained below under the Existing Information discussion. FirstLight believes existing information is sufficient to qualitatively assess effects of the drawdown on emigrating and resident fish and aquatic organisms. Rather than conduct additional surveys at a level necessary to quantify effects, FirstLight instead proposes to conduct an assessment of potential measures to reduce adverse effects due to dewatering for the annual drawdown events in 2014.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to identify and evaluate potential measures to reduce adverse effects due to dewatering for the annual canal drawdown events. The objectives are to:

- Determine which mitigation measures are to be implemented.
- Design and implement mitigation measures.
- Survey fish and aquatic organism populations during canal drawdown after implementation of mitigation measures.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The CRASC developed *A Management Plan for American Shad in the Connecticut River Basin* in 1992. Management Objectives in the plan include the following:

1. Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually.
2. Maximize outmigrant survival for juvenile and spent adult shad.

The ASMFC Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, has the stated goal of "*Protect, enhance, and restore Atlantic coast migratory stocks and critical habitat of American shad in order to achieve levels of spawning stock biomass that are sustainable, can produce a harvestable surplus, and are robust enough to withstand unforeseen threats,"* and includes the following objectives:

1. Maximize the number of juvenile recruits emigrating from freshwater stock complexes.

2. To enhance survival at dams during emigration, evaluate survival of post spawning and juvenile fish passed via each route (e.g. turbines, spillage, bypass facilities, or a combination of the three) at any given facility, and implement measures to pass fish via the route with the best survival rate.

The USFWS seeks the accomplishment of a number of resource goals and objectives through the relicensing process for the Turner Falls Project. General goals include the following:

1. Ensure that PME 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 Turners Falls Project.

Specific to diadromous fishes, the USFWS goal is to minimize current and potential negative project operation effects on diadromous fishes, including juvenile shad, adult silver eels, and sea lamprey ammocetes.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Historically, FirstLight has observed stranding of juvenile American shad during annual drawdown events. In 2011, FirstLight's consultant and staff from Conte Lab conducted a more formal survey to include delineation of the canal into seven distinct zones. Each zone was visually surveyed for juvenile shad and other species, which were counted or estimated depending on numbers present. Any pool areas were documented with photos and represented on aerial photos. A summary report was developed and is provided in Appendix G of this PSP. While no shad were observed, probably because of a flood event prior to the drawdown, a variety of species were documented, including centrarchid and cyprinid species, sea lamprey, carp, perch, mussels, chain pickerel, and American eel. Numbers observed varied by zone and by species.

The 2011 survey effort largely qualitatively addressed stakeholder objectives to evaluate presence and abundance of species stranded during a typical canal drawdown. FirstLight believes that mapping and photo documentation of pool locations and locations of fish observations, as well as canal bed conditions during a drawdown event are sufficient to identify habitat types and assess how drawdown events may affect fish present in the canal and that a more detailed quantitative evaluation is not necessary.

Project Nexus (18 CFR § 5.11(d)(4))

Previous studies at Cabot Station have documented that juvenile American shad and American eel migrate through the project area during the canal drawdown period. During normal operations (where canal water level elevations are stable), downstream migrants are able to utilize the Cabot bypass facility; however, as the canal water level is drawn down, the bypass is no longer available, and the only routes of egress are through the turbines at Cabot Station and Station No. 1, unless the Cabot Station spill gates are utilized.

Once the canal has been drawn down, isolated shallow pools remain until the canal is refilled. During this period, fish (including lamprey ammocetes), amphibians, and benthic invertebrates are prone to desiccation, predation or other sources of mortality.

The annual canal drawdown was formerly conducted in July. In response to ISO-NE's request that FirstLight conduct the drawdown outside of the June through August period, FirstLight moved the

drawdown to September, which coincides with the part of the migration period for some diadromous species.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

The 2011 survey effort identified above (see Appendix G for summary report) largely addresses stakeholder objectives to evaluate the presence and abundance of species stranded during a typical canal drawdown event in a qualitative manner. FirstLight believes that mapping and photo documentation of pool locations and locations of fish observations, as well as canal bed conditions during a drawdown event are sufficient to identify habitat types and assess how drawdown events may affect fish present in the canal and does not necessitate a quantitative evaluation. Therefore, rather than conduct an additional field study in 2014, FirstLight proposes to fulfill the objectives of this study as follows.

Task 1: Identify and Assess Potential Measures

This task will be conducted in 2014 and consist of consulting with agencies and other stakeholders to identify and evaluate potential measures that may reduce adverse effects on fish in the canal during drawdown conditions. Potential measures may include, but not be limited to, assessment of drawdown timing or placement of temporary weirs or baffles in select areas of the canal to enlarge pools that remain during drawdown events or create additional pools to keep specific habitat areas wetted for the duration of the drawdown event. The Task 1 evaluation will compare the merits and drawbacks of each measure, as well as develop an order-of-magnitude cost estimate. Should FirstLight and stakeholders reach an agreement on the most appropriate measure(s) to evaluate in the field then engineering design will proceed in Task 2 with the goal of field-testing the selected measure(s) during the 2015 drawdown event.

Task 2: Design Selected Measure(s)

Upon agreement between FirstLight and stakeholders on the most appropriate measure(s) to reduce adverse effects on aquatic organisms during drawdown events, engineering design (if applicable) of the selected measure(s) will be developed for field-testing during the 2015 drawdown event.

Task 3: Field-test Selected Measure(s)

The measure(s) designed in Task 2 will be tested during the 2015 drawdown event to assess effectiveness in reducing impacts to aquatic organisms in the canal. Methodology of the assessment will be similar to previous aquatic organism assessment during canal drawdown. The measure of 'effectiveness' will be jointly determined through consultation with agencies and stakeholders during the evaluation of alternatives in Task 1. The results of field testing will be documented and provided to agencies and stakeholders for review.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes the proposed level of effort is adequate to assess potential measures to effectively reduce the impacts of the annual drawdown events on aquatic organisms present in the canal. The total estimated cost for the proposed study is approximately $55,000 - $75,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

FirstLight anticipates conducting Task 1, as noted above, in 2014 with the remaining study efforts occurring in 2015.

3.3.19 Evaluate the Use of an Ultrasound Array to Facilitate Upstream Movement to Turners Falls Dam by Avoiding Cabot Station Tailrace

General Description of Proposed Study

An evaluation of the use of an ultrasound array to facilitate upstream movement of American shad to Turners Falls Dam by avoiding Cabot Station Tailrace was requested by USFWS, NHFG and CRWC. For this scenario to be effective, adult shad attraction to the Cabot Station discharge would need to be addressed. This study will be performed in the second study season so as to not effect the results of the work conducted under Study No. 3.3.2: *Evaluate Upstream and Downstream Passage of Adult American Shad*, and will attempt to determine if use of ultrasound technology would be an effective method to minimize attraction to the tailrace discharge while facilitating movement past the Cabot discharge and up to the spillway area.

The location of the proposed array would be in the area of the identified shortnose sturgeon spawning grounds. It would need to be operated during the sturgeon spawning season as the shad upstream migration and sturgeon spawning periods overlap.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to determine if use of ultrasound is an effective behavioral mechanism to create avoidance of the Cabot Station tailrace area by upstream migrating adult shad. If not attracted to the Cabot Station discharge, shad may proceed upstream and pass the Turners Falls Dam via the fishway at the dam.

The objective of the study would be to establish a high frequency sound (ultrasound) array across the entire Cabot Station tailrace and determine the effect of the ensonified field on upstream migrating radio-tagged shad moving past Cabot Station. This would be accomplished by monitoring the movements and passage of shad and the time shad spent in the tailrace area.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

In 1992, the Connecticut River Atlantic Salmon Commission (CRASC) developed a draft document titled: *A Management Plan for American Shad in the Connecticut River Basin*.

Management Objectives in the plan include the following:

Specific management objectives in the plan include the following: Achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually; achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem; and maximize outmigrant survival for juvenile and spent adult shad.

The Atlantic States Marine Fisheries Commission, Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management), approved in 2010, includes and objective to maximize the number of juvenile recruits emigrating from freshwater stock complexes.

Amendment 3 also includes the following recommendations for upstream passage:

- American shad must be able to locate and enter the passage facility with little effort and without stress.

- Where appropriate, improve upstream fish passage effectiveness through operational or structural modifications at impediments to migration.

- Fish that have ascended the passage facility should be guided/routed to an appropriate area so that they can continue upstream migration, and avoid being swept back downstream below the obstruction.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

In spite of the extensive studies and many successes for some species of fish at some station intakes, as yet, there is no one behavioral barrier or deterrent that is effective with all species and lifestages of fish. Behavioral barriers are generally still considered experimental.

High frequency sound was used at the James A. Fitzpatrick power plant located on Lake Ontario, and was found to reduce impingement of alewife by more than 80 percent and its use was approved by the regulatory agencies. Similar avoidance by herring species was noted where sound was tested at hydroelectric sites.

American shad and alewife belong to the same family, Clupeids, and as such may react similar to high frequency sound. Information exists about adult shad avoidance of ultrasound. In field trials in the early 1980s to develop a guidance system for downstream-migrants in the First Level Canal of the Holyoke Canal System, adult shad avoided but were not well guided by an ultrasonic array. However, upstream migrants were guided well and even stopped entirely by the ensonified field (Kynard and Taylor, 1984). Creating an ensonified field caused adult shad to leave their preferred location in the river upstream of trashracks at Holyoke Dam as long as the sound system was on.

Blueback herring also avoided the ultrasound field and behaved similar to shad in the Holyoke Canal studies (Kynard and Taylor, 1984). Acoustic barriers have been used for blueback herring on the Savannah River (Richard B. Russell Dam) and Santee River (St. Stephen fish lift) in South Carolina and on the Mohawk River in New York (Crescent Project, FERC No. 4678; Vischer Ferry, FERC No. 4679). Evidence from many studies that attempted to produce behavioral avoidance by adult shad suggests that ultrasound is an effective stimuli (Carlson and Popper, 1997). Evidence suggests that shad and blueback herring may avoid the tailrace of Cabot Station if an ultrasound field was installed.

Project Nexus (18 CFR § 5.11(d)(4))

Studies to assess potential passage solutions are frequently conducted during relicensing proceedings. This study, coupled with the adult shad radio-telemetry study, can provide the information needed to select an approach to resolve upstream shad passage at the Turners Falls Project.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Ultrasound Deployment

This study would establish a high frequency sound (ultrasound) array across the entire Cabot Station tailrace and determine the effect of the ensonified field on upstream migrating shad moving by Cabot Station by monitoring shad behavior. Telemetry methods like those proposed in Study Plan 3.3.2 will be utilized. FirstLight will consult with the agencies to determine a schedule to turn the array off and on.

Task 2: Reporting

Data collected in Task 2 will be analyzed to determine if ensonification is a successful deterrent mechanism. A report will be prepared detailing methods, results, a discussion and conclusions.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The cost for the test would be $55,000 to $70,000. Costs will be related to rental, installation, and operation of the ultrasound system, analysis of data, and production of a final report. The study could utilize the same monitoring equipment as the adult shad radio telemetry study (although a few additional tracking stations may have to be installed in the Cabot Station tailrace).

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The study proposed herein will be conducted in the second study season, after the adult shad study described in Section 3.3.2, *Evaluate Upstream and Downstream Passage of Adult American Shad.* American shad migrate up the river when water temperatures are generally between 12 and 20°C; spawning occurs from 14 to 23°C when river flow is generally declining from the spring peak with shad reaching Cabot Station in late April or early to mid- May. The ultrasonic array and shad monitoring equipment will be deployed, calibrated and tested in late March and early April, prior to the arrival of adult shad to the study area. Spent outmigrants travel downstream shortly after spawning. The exact timing of the out-migration will be dependent on many factors, most notably water temperature. The study is anticipated to conclude by mid-July.

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

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Buckley, J. & Kynard, B. 1985. Vertical distribution of juvenile American shad and blueback herring during seaward migration in the Connecticut River. Final Report to Northeast Utilities Service Company, Berlin, CT. 13pp.

Carlson, T. J. & Popper, A. N. (editors) (1997). Using sound to modify fish behavior at power-production and water-control facilities. A workshop held December 12-13, 1995, Portland, Oregon. Published by Bonneville Power Administration, Portland Oregon, 362 pp.

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3.4 Terrestrial Wildlife and Botanical Resources

3.4.1 Baseline Study of Terrestrial Wildlife and Botanical Resources at the Turners Falls Impoundment, the Bypass Reach and below Cabot Station within the Project Boundary

General Description of Proposed Study

In its PAD, FirstLight proposed to conduct a study to obtain baseline information on terrestrial wildlife and botanical resources in the Turners Falls Impoundment, the Bypass Reach, and below Cabot Station within the Project boundary. The Town of Montague, MA requested that FirstLight complete a wildlife habitat assessment of the Turners Falls Bypass.

Note that terrestrial resources around the Northfield Mountain Project are being studied, as described in Study No. 3.4.2.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to characterize and describe the terrestrial wildlife and botanical resources that use representative upland habitats within the Project boundary. Specific objectives are:

- Survey and inventory overall existing upland wildlife habitats;
- Note the occurrence of wildlife sighting during the course of the surveys;
- Survey and inventory vegetation cover classes and land use;
- Survey and evaluate the presence of targeted RTE species or associated habitats;
- Survey and inventory the nature and extent of invasive and exotic vegetation species; and
- Assess the effects of current and future operations on terrestrial wildlife and botanical communities.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

This study plan will provide baseline information to agencies with jurisdiction over wildlife and botanical resources allowing them to address potential Project effects. Resource management goals relevant to terrestrial wildlife and botanical resources studies are described below.

Terrestrial wildlife resources are administered by the USFWS. The mission of the USFWS is to "conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people." In doing so, USFWS enforces wildlife laws, protects endangered species, manages migratory birds, and helps to restore important fisheries. They administer the ESA, designed to protect imperiled species from going extinct.

The conservation and protection of species state-listed as Endangered, Threatened, or of Special Concern under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) is an important objective of the Natural Heritage & Endangered Species Program (NHESP) of the MADFW. State-listed species and their habitats are protected pursuant to the MESA and its implementing regulations (321 CMR 10.00), as well as the rare wildlife species provisions and protection of wetlands and aquatic habitats of the Massachusetts Wetlands Protection Act (WPA) (310 CMR 10.59). The MADFW's resource goals and regulatory requirements are to:

- Ensure that protection mitigation and enhancement measures are commensurate with Project effects and meet MESA and the WPA requirements for the Project.

- Conserve, protect, and enhance habitats for state-listed species that will be affected by Project operations.

Massachusetts Invasive Plant Advisory Group (MIPAG) maintains a list of invasive plant species in Massachusetts and provides criteria used in evaluating species. The NHESP management goal is to promote the conservation and protection of species that are not hunted, fished, trapped or commercially harvested in Massachusetts. The NHESP highest priority is protecting the state listed RTE species. The overall goal of the program is the protection of the state's wide range of native biological diversity.

The conservation goals of the VDFW are to:

- Maintain or increase populations of rare, threatened and endangered species in the area of interests;

- Maintain, restore, provide long-term stewardship of, or conserve habitats and natural communities that support rare, threatened and endangered species.

NHFG primary management goals relative to terrestrial and wildlife resources are to restore and maintain critical habitats and populations of the state's species of conservation and management concern.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

The PAD provides a list of plant and wildlife species, as well as dominant vegetative communities in the Project area, but does not provide any site-specific information on the known occurrences of species within the upland habitats of the Project. Additional site-specific data are needed to meet the goal of evaluating Project effects. Studies will supplement existing information regarding vegetation mapping, invasive plants, and presence of RTE species or associated habitat.

Project Nexus (18 CFR § 5.11(d)(4))

The Turners Falls Project and Northfield Mountain Project provide habitat for a variety of wildlife and botanical species. Water levels fluctuations have the potential to affect habitat for a variety of life stages of terrestrial resources. An understanding of the terrestrial resources in the project area would provide information on the type and quantity of habitat potentially affected by Project operations.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

A field survey of the shoreline will be conducted within the Turners Falls Impoundment, in the Bypass Reach, and below Cabot Station to the downstream extent of the Project boundary to document the type and distribution of wildlife habitats, including vegetation communities and plant species, present in the project area. A field survey of wildlife species will be conducted concurrently with other botanical and wetland studies (StudyNo. 3.5.1). Surveys will be conducted by biologists visually assessing habitats along and above the shoreline from boat and/or walking on FirstLight and public lands during the growing season when vegetation is most conspicuous and readily identifiable. The presence of any RTE species or habitats will also be noted. Any direct observations of RTE species documented in the Project area will be processed in accordance with applicable State and Federal procedures and all data and records will be available immediately to appropriate organizations (FirstLight, USFWS, MADFW).

Task 1: Literature Review

The initial step prior to the field reconnaissance surveys will include reviewing existing information and data to identify areas of representative communities and potentially suitable habitat for protected species of interest. Using GIS and other available sources of information, a preliminary base map will be produced to assist field surveys. To refine the vegetation and habitat mapping for the study area, the following tasks will be performed:

- Acquire and compile existing GIS vegetation cover type layers from available resources;
- Examine any visible vegetation boundaries in aerial photos or other imagery to fix or update type polygon boundaries, based on field observations;
- Produce a final vegetation type map that displays vegetation type polygon boundaries, the study area, and specific Project components; and
- Use the vegetation type map to produce a table of vegetation types and calculate the percent acres of each vegetation type present in the study area in general, in areas potentially affected by the Project, and indirectly affected key wildlife habitats.

Task 2: Field Surveys

Field surveys will be conducted to document wildlife habitat and occurrence, vegetative cover types and invasive plant species in the Project area, as described further below.

Wildlife and Habitat Type Mapping

The primary objective of wildlife surveys for the Project is to provide information on the distribution and abundance of wildlife habitats. General habitat field notes will record dominant vegetation cover classes and land use; unique or unusual habitat types; observations of avian, reptile, amphibian, and mammal species; and locations of invasive plant species. Wildlife surveys will be conducted through the use of visual encounter surveys concurrent with the habitat type verification mapping. Transect lines parallel to the shoreline will be placed randomly or at least objectively with respect to representative habitats present along the shoreline. The total number of transects will be determined after an initial site reconnaissance. The observer will walk a transect at a pace of approximately five minutes per 50 meters, for a total search time of approximately two hours. During these searches, an observer will survey the area to either side of the transect, looking for targeted species or indirect signs (i.e., tracks, scat, den areas, nests, etc.) Each transect will be surveyed only once per season, however, qualitative data from other similar surveys efforts will also be noted and included in the overall wildlife census list.

More intensive casual searches will be performed for individual species in appropriate areas where suitable habitat is observed (such as searching for amphibians under logs). Other supplemental techniques, such as broadcast or listening surveys will be used to improve the odds of detecting some more elusive avian and amphibian species. The locations of significant sightings or observations will be documented through the use of GPS and geo-referenced photographs and then entered into the GIS data base. Data collected will be compiled into a Project area species list.

Vegetation Cover Type Mapping

The overall design of the vegetative mapping is to identify all vascular botanical species within the Study Area while focusing on the targeted listed species and other RTE plant species. Botanical assessments will be completed to determine the species composition, structure, and distribution of vegetative communities. The types of data that will be collected include percent cover and dominant species within

the herbaceous, shrub, and tree stratums along with the general distribution and juxtaposition of vegetative communities. Timed-meander surveys will be conducted in representative habitat types encountered within the Study Area. The meander survey will involve walking a wandering path through each habitat and recording species present until a period of time (typically for approximately ten minutes) passes where no new species were added to the vegetation list. Surveyors will compile a list of all plants found within each respective habitat, and will maintain an overall census list of all plant species identified within the Project Area. Plants will be identified to the species level if possible, or at a minimum, if the plant is outside its phenological peak, the plant will be identified to the genus level if species identification is not possible. If positive identification cannot be completed in the field, a voucher sample can be collected, pressed, and preserved for further identification when appropriate.

Prior to the 2014 field survey, biologists will obtain the necessary collecting permit for any voucher samples that may need to be collected from the State Botanist at the Massachusetts NHESP. Biologists will also coordinate with VDFW and NHFG RTE programs if similar collection permits are required for voucher samples prior to any field studies. Other general information that will be gathered during meander surveys will include general health of communities and site quality conditions. Vegetation communities will be classified using the NHESP Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011).

Multiple sample vegetation plots will also be established to collect quantitative information to characterize the different habitats and provide species composition of habitat types. Vegetation plot locations will be selected using NHESP guidelines and protocols. A NHESP Quantitative Community Characterization Form (NHESP Form 3) will be completed for representative habitats to document the results of each plot location. Geo-referenced photographs will also be taken to document site conditions at the time of the survey.

Invasive Plant Survey

The MIPAG maintains a list of invasive plant species in Massachusetts and provides criteria used in evaluating species. The MIPAG species list of invasive plants will be utilized to identify targeted invasive species when conducting botanical meander surveys. Surveyors will use methods adapted from the USFS Invasive Species Program, Invasive Species Inventory and Mapping Data Recording Protocols. These adapted methods focus on presence, location, extent, abundance and other site characteristics to provide site infestation information.

To document an infested area, biologists will use GPS at sub-foot accuracy to delineate the boundary of the infestation as defined by the dominant canopy cover of the invasive plant. Areas containing only occasional invasive species will be characterized with a GPS center point and radius necessary to enclose the population will be used. For areas where invasive species are ubiquitous or impractical to map, surveyors will characterize the invasive species population using estimates of aerial coverage and percent of species present. All sampling areas containing invasive botanical species will be photo-documented with geo-referenced photos, and an Invasive Species Documentation Form will be completed.

Task 3: Data Analysis and Reporting

A draft and final technical report will be prepared for this study. The results of this study will provide both quantitative and qualitative information that will be important in defining existing conditions, as well as providing any information on potential project impacts. The report will contain all supporting correspondence among licensing participants. The draft report will be revised to address final comments by licensing participants.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

This study would likely take one study season to complete. The estimated budget for the study ranges from approximately $40,000 to $60,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The Inventory will be conducted as follows:

- January – March 2014: Reviewing existing information and data
- April - August 2014: Conduct field reconnaissance surveys
- September - December 2014: Prepare data and report

Literature Cited

Swain, P.C., & Kersey, J.B. (2011). Classification of the Natural Communities of Massachusetts: Draft. Retrieved from http://www.mass.gov/dfwele/dfw/nhesp/natural_communities/natural_community_classification.htm. Accessed August 23, 2011.

3.4.2 Effects of Northfield Mountain Project-related Land Management Practices and Recreation Use on Terrestrial Habitats

General Description of Proposed Study

FERC requested FirstLight to complete a study to provide baseline information on wildlife and botanical habitats occurring in the Northfield Mountain Project area, and study the effects of Northfield Mountain Project-related land management practices and recreation use on terrestrial habitats.

FirstLight is proposing a study to collect baseline information, which will inform an assessment of Project-related land management practices and recreational use impacts on terrestrial resources on Project lands at the Northfield Mountain Project.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of this study is to gather information necessary to understand the potential effects of land management practices and recreational use on wildlife and botanical resources within the Northfield Mountain Project area. The objectives of this study are to provide supporting information which will provide the basis for an assessment of the potential resource impacts of the Project that were identified during development of the PAD and FERC scoping for the License Application, as follows:

- Identify and describe FirstLight's Project-related land management practices (including the maintenance of Project-related recreation areas) occurring in the Northfield Mountain Project boundary;
- Provide information pertinent to describe existing wildlife and botanical habitats occurring in the Northfield Mountain Project area;
- Determine if Project-related land management and maintenance practices and the use of Project-related recreation areas has the potential to facilitate the growth and spread of invasive plant species; and
- Provide information to identify if Project-related land management and maintenance practices and the use of Project-related recreation areas may affect existing wildlife and botanical resources (e.g., clearing of vegetation).

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

This study plan will provide baseline information to agencies with jurisdiction over wildlife and botanical resources allowing them to address potential Project-related effects. The Connecticut River watershed support a diverse assemblage of plant and wildlife communities that provide various public opportunities, such as bird watching, hiking, and hunting. Consideration of the effects of Project operations, maintenance, land management, and recreational use on these resources is relevant to the Commission's public interest determination.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

The PAD provides baseline information pertaining to the effects of project operation, maintenance, land management, and recreation use on wildlife and botanical habitats and the location of invasive plant species within the Northfield Mountain Project area. FirstLight is proposing to conduct wildlife and botanical studies for the Turner Falls Project as outlined in Study No. 3.4.1 and Study No. 3.5.1; however, those studies only address the Turner Falls Impoundment (lower reservoir for the Northfield Mountain Project) and downstream areas with a focus on assessing Project operations primarily associated with

water level fluctuations. Additional information on the location and abundance of invasive plant species and the impacts on wildlife and botanical resources as a result of project-related maintenance and land management practices in the Northfield Mountain Project area are needed to evaluate the Project's full effects on wildlife and botanical resources.

In 2006, FirstLight, formerly operating under the NE Hydro Generating Company name, contracted Tighe & Bond, Inc. to complete a botanical survey on Project lands where land management and recreational activities occurred. The areas surveyed included Bennett Meadow Wildlife Management Area, Barton Cove Campground and a Picnic Area on the Turners Falls Impoundment. The summary report describes the survey efforts that focused on the lower impoundment, which provides insight as to which species are within those areas surveyed and what could potentially be at other sites within the Northfield Mountain Project boundary. In the MADFW review letter dated April 25, 2007 from the MADFW to Tighe & Bond (NHESP Tracking Number: 06-19884), the MADFW indicated that the Northfield Mountain Recreational Trails are not located within Priority Habitat or Estimated Habitat and concluded that existing uses of the recreational facilities described in the Operation and Maintenance Plan would not require review under the MESA; however, select activities which are regulated by FERC licenses may require review by NHESP during the FERC review process.

FirstLight conducted a recreational facilities inventory at the Turners Falls Project and Northfield Mountain Project during two field visits in October 2011 and July 2012 (see Study No. 3.6.2). The purpose of the inventory was to identify the current formal recreational facilities associated with the Projects. This information was needed to prepare the recreation sections of the PAD. TRC developed a report (2012) of these facilities providing a summary of each formal recreational facility that was inventoried. This report will be used as baseline information as to what types of recreational use could potentially affect wildlife and botanical habitats at the Northfield Mountain Project.

Project Nexus (18 CFR § 5.11(d)(4))

The Northfield Mountain Project provides habitat for a variety of wildlife and botanical species. An understanding of the terrestrial resources in the Project area would provide information on the type and quantity and quality of habitat potentially affected by Project-related land management and maintenance practices and the use of recreational areas.

The Northfield Mountain Project has many recreational features (e.g., a trail system with over 26 miles of trails, observation area, picnic areas) that are inherently attractive. Public recreation sites can affect wildlife behavior (both attracting and displacing) and impact botanical resources (e.g., trampling and spreading invasive species). An analysis of the effects of the maintenance, land management practices, and use of these recreational features on wildlife and botanical resources would help form the basis for determining the Project's effect on these resources.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

For the purposes of this study, the Northfield Mountain Project area includes the lands around Project facilities (e.g., lands around the upper reservoir, parking areas, access roads) and recreational areas (e.g., picnic areas, trails, and hiking areas) on Northfield Mountain.

A field survey of wildlife and botanical species will be conducted concurrently with other field surveys where applicable. Wildlife and botanical resource assessments will be conducted on the terrestrial, wetland, riparian, and littoral areas of the Turners Falls Impoundment, bypass and downstream areas as described in Study No. 3.4.1 and Study No. 3.5.1. Surveys will be conducted by biologists during the 2014 growing season.

Task 1: Literature Review

A pre-survey review of existing information and data will be completed to identify areas of representative communities, land use classes, recreational areas and trails, invasive species and potentially suitable habitat for protected species of interest as identified in Section 4.7 of the PAD. Using GIS and other available sources of information, a preliminary field map will be produced to assist field surveys.

Prior to field investigations, researchers and biologists will review and screen the practices and locations of FirstLight Project-related land use management activities (e.g., areas routinely mowed, vegetation management areas, access roads) and recreational uses (e.g., trails, climbing areas, camping, skiing) at the Northfield Mountain Project.

Task 2: Wildlife and Habitat Type Mapping

The primary objective of wildlife surveys for the Northfield Mountain Project is to provide a general census and information on the distribution and abundance of wildlife habitats. General habitat field notes will record dominate vegetation cover classes; unique or unusual habitat types; and observations of avian, reptile, amphibian, and mammal species. Wildlife surveys will be conducted through the use of visual encounter surveys along transects. Transect lines will be placed randomly or at least objectively with respect to representative habitats, including representative Project-affected habitats (i.e., areas of vegetation management, recreational use areas). The total number of transects will be determined after an initial site reconnaissance in early spring. The observer will walk a transect at a pace of approximately five minutes per 50 meters, for a total search time of approximately two hours. During these searches, an observer will survey the area to either side of the transect, looking for targeted species or indirect signs (i.e., tracks, scat, den areas, nests, etc.). Each transect will be surveyed only once per season, however, qualitative data from other similar surveys efforts will also be noted and included in a overall wildlife census list. More intensive casual searches will be performed for individual species in appropriate areas where suitable habitat is observed (such as searching for amphibians under logs). Other supplemental techniques, such as broadcast or listening surveys will be used to improve the odds of detecting some more elusive avian and amphibian species. Field studies will be conducted on a seasonal basis in order to record species when they are most conspicuous. The locations of significant sightings or observations will be documented through the use of GPS and geo-referenced photographs and then entered into a GIS data base. Data collected will be compiled into a Project area species list.

Task 3: Vegetation Cover Type Mapping

Botanical assessments will be completed to determine the species composition, structure, and distribution of vegetative communities. The types of data that will be collected include percent cover and dominate species within the herbaceous, shrub, and tree stratums along with the general distribution and juxtaposition of vegetative communities. Timed-meander surveys will involve walking a wandering path through each representative habitat type and recording species present until a period of time (usually 10 minutes) passes where no new species were added to the vegetation list. Surveyors will compile a list of all plants found within each respective habitat, and will maintain a list of all plant species identified within the Project Area.

Plants will be identified to the species level if possible, or at a minimum, if the plant is outside its phenological peak, the plant will be identified to the genus level if species identification is not possible. If positive identification cannot be completed in the field, voucher samples can be collected, pressed, and preserved for further identification when appropriate. Prior to the 2014 field survey, biologists will obtain the necessary collecting permit for any voucher samples that may need to be collected from the State Botanist at the Massachusetts NHESP. Other general information that will be gathered during meander

surveys will include general health of communities, evidence of erosion, and site quality conditions. Vegetation communities will be classified using NHESP Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011). Palustrine habitats will be field-verified using the NWI as a base map. These areas will not be formally delineated, but will be further defined from the NWI using methods outlined in the ACOE Wetland Delineation Manual and the Regional Supplement to the *Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region* (USACE, 1987; USACE, 2012).

Sample vegetation plots within representative habitat types will also be established to collect quantitative information to characterize the different habitats and provide species composition of habitat types. Vegetation plot locations will be selected using NHESP guidelines and protocols. Sample vegetation plots will be completed for representative areas of Project-related vegetation management and recreational areas. These plots will be used to compare natural undisturbed habitats at the Projects to Project-affected habitats. A NHESP Quantitative Community Characterization Form (NHESP Form 3) will be completed for representative habitats to document the results of each plot location. Geo-referenced photographs will also be taken to document site conditions at the time of the survey.

To refine the vegetation type map for the study area, the following tasks will be performed:

- Acquire and compile existing GIS vegetation cover type, land use, and recreational layers from available resources;
- Examine any visible vegetation boundaries in aerial photos or other imagery to fix or update type polygon boundaries, based on field observations;
- Produce a final vegetation type map that displays vegetation type polygon boundaries, the study area, and specific Project components; and
- Use the vegetation type map to produce a table of vegetation types and calculate the percent acres of each vegetation type present in the study area in general, in areas potentially affected by the Project, and indirectly affected key wildlife habitats.

Task 4: Invasive Plant Survey

The MIPAG maintains a list of invasive plant species in Massachusetts and provides criteria used in evaluating species. The MIPAG species list of invasive plants will be utilized to identify targeted invasive species when conducting botanical meander surveys. Surveyors will use methods adapted from the NHESP and the United States Forest Service (USFS) Invasive Species Program, Invasive Species Inventory and Mapping Data Recording Protocols (USFWS, 2010). These adapted methods focus on presence, location, extent, abundance and other site characteristics to provide site infestation information.

To document an infested area, biologists will use a GPS at sub-foot accuracy to delineate the boundary of the infestation as defined by the dominant canopy cover of the invasive plant. Areas containing only occasional invasive species will be characterized with a GPS center point and radius necessary to enclose the population. For areas where invasive species are ubiquitous or impractical to map, surveyors will characterize the invasive species population using estimates of aerial coverage and percent of species present within a defined polygon. As land disturbances following Project maintenance activities may favor establishment of invasive plants over native plant communities, survey efforts for invasive species will be focused on disturbed lands, areas of vegetation management, access roads and recreational trails which can be vectors for invasive species propagation. Sampling areas containing invasive botanical species will be photo-documented with geo-referenced photos, and an Invasive Species Documentation Form will be completed.

Task 5: Land Management Practices and Recreation Uses

FirstLight will provide information to identify Project-related land management and maintenance practices and the usage of Project-related recreation areas. Annual maintenance activities are typically conducted during the growing season every year and may include vegetation management, erosion control, road maintenance, and other general project maintenance. This information will be analyzed with results from the wildlife and botanical field surveys at the Northfield Mountain Project to identify the relationship between Project facilities, recreational uses and wildlife and botanical resources and identify practices to avoid or minimize impacts.

Task 6: Data Analysis and Reporting

A draft and final technical report will be prepared for this study. The results of this study will provide both quantitative and qualitative information that will be important in defining existing conditions, as well as providing any information on potential project impacts as they relate to preparation of the License Application. The report will contain all supporting correspondence among licensing participants. The draft report will be revised to address final comments by licensing participants.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

This study would likely take one study season to complete. The estimated budget for the study ranges from approximately $30,000 to $40,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The Inventory will be conducted as follows:

- January – March 2014: Reviewing existing information and data
- April - August 2014: Conduct field reconnaissance surveys
- September - December 2014: Prepare data and report

Literature Cited

Swain, P.C., & Kersey, J.B. (2011). Classification of the Natural Communities of Massachusetts: Draft. Retrieved from http://www.mass.gov/dfwele/dfw/nhesp/natural_communities/natural_community_classification.htm. Accessed August 23, 2011.

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U.S. Fish and Wildlife Service (USFWS). (2010). Northeast Region Inventory and Monitoring Procedure. Retrieved from http://www.fws.gov/invasives/staffTrainingModule/pdfs/assessing/NEregionInventoryProcedure.pdf Accessed on November 2, 2012.

3.5 Wetlands, Riparian, and Littoral Habitat

3.5.1 Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

General Description of Proposed Study

This study contains multiple elements. In addition to conducting an inventory of wetlands, riparian and littoral zone resources in the Turners Falls Impoundment, the methods in this study contain provisions for assessing Project impacts on state-listed plant species in the Turners Falls Impoundment as well as downstream of Cabot Station, and assessing Project impacts on state-listed invertebrate species that utilize riparian areas downstream of Cabot Station.

Several stakeholder groups submitted a request to FirstLight to study impacts of water level fluctuations due to operations at the Turners Falls and Northfield Mountain Pump Storage Project on riparian, wetland and littoral zone resources in the Turners Falls Impoundment. The USFWS, Town of Gill, LCCLC, FRCOG, CRWC, VANR, NHFG, NHDES, and TNC study requests were similar and requested that the applicant complete studies to obtain baseline information on riparian, wetland, littoral zone, and 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, submerged aquatic vegetation (SAV) and emergent aquatic vegetation (EAV), littoral, and shallow water (e.g., mid river bars and shoals) habitats are impacted by current water level fluctuations permitted under the license for the Turners Falls Project and Northfield Mountain Project. A baseline inventory will be conducted to map these resources and to determine if there is any unique or important shoreline or aquatic habitats in the Project area.

The MDFW also requested two additional studies related to the above requests. The first request (study request number 23) is to conduct a study to quantify the impacts of water level fluctuations and the current and proposed flow regimes on state-listed rare plant species in the Turners Falls Impoundment, and in the 13+ miles of riverine habitat below the Turners Falls Dam (to the Rt. 116 Bridge in Sunderland).

The second MDFW request (number 19) is to integrate modeled river flows and water levels with a habitat assessment for state-listed riparian invertebrate species. MDFW requested that the model should specifically assess the influence of existing and proposed Project operations on water levels at both known populations and potential habitats for the Cobblestone Tiger Beetle (*Cicindela marginipennis*), state-listed as "Endangered," and the Puritan Tiger Beetle (*Cicindela puritana*), state-listed as "Endangered" and federally-listed as "Threatened", and assess how Project operations may be modified to conserve and enhance existing populations and potential habitats.

As requested by the MDFW, this study will utilize the results of the Hydraulic Study as described in Section 3.2.2 to quantify and assess potential impacts of Project-related water level fluctuations on existing wetlands, riparian and littoral habitat resources including state-listed plant and invertebrate species.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goals of this study are to characterize and describe the wildlife and botanical resources within the Project Area and assess the potential impacts of Project-related reservoir water level fluctuations on identified resources. The specific objectives of this study are to:

- Quantitatively describe and field verify National Wetland Inventory (NWI) mapped wetland types, describe and map shallow water aquatic habitat, including submerged aquatic vegetation (SAV) and emergent aquatic vegetation (EAV), substrate type , invasive species and associated wildlife in the Turners Falls Impoundment and up to 200 feet from the Turners Falls Impoundment shoreline within the Project boundary.
- Obtain baseline information, through field surveys, on the locations and population parameters of Massachusetts state-listed rare plant species in the Turner Falls Impoundment and the 13+ miles of riverine habitat below Cabot Station to the Rte. 116 Bridge in Sunderland.
- Analyze how the Project operations affect botanical and wildlife resources with an emphasis on how Project operations influence known or potential habitat of state-listed plant species and state-listed invertebrate species including the Cobblestone Tiger Beetle and the Puritan Tiger Beetle.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

This study will provide baseline information to agencies with jurisdiction over wetlands, riparian and littoral resources allowing them to address potential Project effects. The resource management goals identified are listed below.

Wildlife and freshwater fish resources are administered by USFWS, whose mission is to "conserve, protect and enhance and if needed mitigate fish, wildlife and plants and their habitats for the continuing benefit of the American people." In doing so, USFWS enforces wildlife laws, protects endangered species, manages migratory birds, and helps to restore important fisheries. They administer the ESA, designed to protect imperiled species from going extinct. Specific to the Turners Falls Project the Service goals are to:

- 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.
- Minimize current and potential negative Project operation effects on water quality and aquatic habitat.

The conservation and protection of species state-listed as Endangered, Threatened, or of Special Concern under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) is an important objective of the Natural Heritage & Endangered Species Program of the MADFW. State-listed species and their habitats are protected pursuant to the MESA and its implementing regulations (321 CMR 10.00), as well as the rare wildlife species provisions and protection of wetlands and aquatic habitats of the Massachusetts Wetlands Protection Act (WPA) (310 CMR 10.59). The MADFW resource goals and regulatory requirements are to:

- Ensure that protection mitigation and enhancement measures are commensurate with Project effects and meet MESA and the WPA requirements for the Project.
- Conserve, protect, and enhance habitats for state-listed species that will be affected by Project operations.

Massachusetts Invasive Plant Advisory Group (MIPAG), a committee where the Massachusetts Natural Heritage Endangered Species Program (NHESP) is represented, maintains a list of invasive plant species in Massachusetts and provides criteria used in evaluating species. The NHESP management goal is to promote the conservation and protection of species that are not hunted, fished, trapped or commercially harvested in Massachusetts. The NHESP highest priority is protecting the state-listed RTE species. The overall goal of the program is the protection of the state's wide range of native biological diversity.

The VANR's resource management goals applicable to this study plan are:

- Protect, enhance, or restore, diverse high quality habitat necessary to sustain healthy aquatic and riparian plant and animal communities.
- 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.
- Minimize the potential negative effects of project operation on water quality and aquatic habitat, and mitigate for loss or degradation.
- Conserve, enhance, and restore Vermont's natural communities, habitats, and species and the ecological processes that sustain them.
- Provide a diversity of fish- and wildlife-based activities and opportunities that allow the safe and ethical viewing, regulated harvesting, and utilization of fish, plant and wildlife resources consistent with the North American model of fish and wildlife conservation.

The New Hampshire Department of Environmental Services is primarily interested in the portion of the Turners Falls Impoundment that is in New Hampshire. NHDES is responsible for ensuring that all state surface waters meet the water quality criteria for their designated classification, including existing and designated uses, and that the chemical, physical, and biological integrity of New Hampshire's surface waters is maintained [Env- Wq 1703.01 (b)].

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

The PAD provides lists of plant and wildlife species whose native ranges overlap with the Project area, but it does not provide any site-specific information on known occurrences of these species in the wetlands, riparian, littoral and shallow water habitats, within or adjacent to, the Project area. In addition, existing information in the PAD does not quantify EAV and SAV in the Project 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.

Small areas of known invasive SAV beds are present in the Turners Falls Impoundment in the vicinity of Barton's Cove. FirstLight is currently cooperating with the USFWS on hand pulling water chestnut plants in this area. A very small colony exists on the Gill and Montague sides, located between the upstream side of the Dam and the boat barrier.

Additional site-specific data are needed to meet the goal of evaluating Project effects. Studies will supplement existing information regarding vegetation mapping, sensitive plants, invasive plants, and presence of RTE species or associated habitat.

Section 4.6 of the PAD contains information about wetland vegetation mapped in area of the Project, including NWI maps. Other available information including FEMA floodplain maps, USGS 7.5 minute quadrangles, NRCS soil surveys, and aerial photography. While this information provides baseline data for analysis, there are no known site-specific assessments or ground-mapping data of wetland habitats within the Project boundary. Additional site-specific data are needed to evaluate specific Project effects. Field studies will supplement existing information in the following areas:

10. Refine existing mapping, which will include field verifying the NWI mapping; and

11. Identify and classify existing wetlands and other "waters of the U.S." in accordance with USACE practices to define areas subject to federal regulation and policies.

In preparation of the PAD, Federal and state agencies were contacted regarding the potential presence of RTE species and critical habitats within the Turners Falls Project and Northfield Mountain Project boundaries and included the USFWS, NMFS, Massachusetts NHESP, VTFWD, and NHFGD. The consultation resulted in the identification of three federally-listed threatened and/or endangered species (Section 4.7.1 of the PAD), 39 state-listed threatened and/or endangered species (Section 4.7.2 of the PAD), 21 state-listed species of special concern (Section 4.7.3 of the PAD) and designated critical habitat (Sections 4.7.4) that are likely or known to occur within the Project boundary and are detailed in Section 4.7 of the PAD.

Agency consultation revealed no federally designated critical habitat areas within the Turners Falls Project and Northfield Mountain Project areas; however, the Project areas are located within or on a portion of State designated Natural Areas classified as priority habitats and/or estimated habitats. Detailed information regarding habitat preferences and life histories of these species can be found in Section 4.7 of the PAD.

The MADFW commented that several surveys along this stretch of the River have shown that many state-listed plant species are dynamic local populations and often display meta-population dynamics, changing in size and location from year to year. The MADFW commented that this is particularly true for plant species inhabiting sand bars and high energy shore and cobble islands, including (but not limited to) the state-listed Wright's Spike-rush, Intermediate Spike-sedge, Ovate Spike-sedge, Frank's Lovegrass and Tufted Hairgrass. Large and/or rapid changes in water elevation and/or flow dynamics may cause adverse effects to existing and potential habitat for state-listed plant species. FirstLight is not aware of any studies that evaluate the effects of these changes in water level elevations on the life cycle of state-listed species and in particular, the germination, growth, and dispersal of species inhabiting mudflats, sand bars, and cobble islands. A list of NHESP state-listed species for the Project is provided in Table 4.7.2.5-1 in Section 4.7.2.5 of the PAD.

Additional information is needed to analyze how Project operations have or will alter hydrology in the Connecticut River from below the Vernon Hydroelectric Project downstream to the Holyoke Dam, or how operations have or may affect known wildlife and botanical resources. Of particular concern is how operations have or may affect known populations and potential habitats for state-listed invertebrate species, including the Puritan and Cobblestone Tiger Beetles.

Puritan tiger beetle and the cobblestone tiger beetle populations are limited in Massachusetts. The only known population of each species is found along the Connecticut River, with Puritan tiger beetle known from a single site at Rainbow Beach in Northampton, MA, and cobblestone tiger beetle known from a single site in Montague, MA (first observed in 2000). Detailed surveys of Puritan tiger beetle have been conducted at Rainbow Beach for adults and larvae from 1997 to the present (Davis, 2011[25]).

Project Nexus (18 CFR § 5.11(d)(4))

The Turners Falls Project and Northfield Mountain Project provide a variety of wetland, riparian, and littoral habitat for a range of wildlife and botanical species. Water levels fluctuations have the potential to affect these water sensitive resources. An understanding of the locations and extent of resources in the Project area would provide information on the type and quantity of wildlife, plants, and habitat potentially affected by project operations. 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

[25] Unpublished report submitted to U.S. Fish & Wildlife Service, Turners Falls, MA.

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 (18 CFR § 5.11(b)(1), (d)(5)-(6))

A field survey will be conducted within the Turners Falls Impoundment and below Cabot Station to document the type and distribution of wildlife habitats and vegetation communities present in the Project Area. The Study Area includes the following:

12. Turners Falls Impoundment and land up to 200 ft from the shoreline of the impoundment within the Project boundary extending from the base of Vernon Dam to the Turners Falls Dam.

13. The approximate 13+ miles of riverine habitat below the Dam to the Rte. 116 Bridge in Sunderland.

Field surveys will be conducted to observe conditions at the lowest water level operational range permitted on a daily operation schedule, under low flow conditions. In addition, the rate and height of water level changes resulting from Project operations during the field season will be cataloged to better understand the correlation of field observations and how they relate to field conditions during survey dates.

Task 1: Literature Review

Prior to the field reconnaissance surveys, existing information and data will be reviewed to identify areas of representative communities and potentially suitable habitat for protected species of interest. Using GIS and other available sources of information, a preliminary field map will be produced to assist field surveys. Pre-survey, biologists will review life histories of wildlife and phenology of listed plants for known listed species at the Project to select field survey windows to optimize observations.

Task 2: Riparian and Littoral Zone Botanical Survey

Botanical assessments will be completed to determine the species composition, structure, and distribution of vegetative communities. The types of data that will be collected include percent cover and dominate species within the herbaceous, shrub, and tree stratums along with the general distribution and juxtaposition of vegetative communities. All botanical field inventories listed in this study will employ the concepts of timed-meander surveys, which will involve walking a wandering path through each representative habitat type and recording species present until a period of time (typically 10 minutes) passes where no new species were added to the vegetation list. Surveyors will compile a census list of all plants found within each respective habitat, and will maintain an overall list of all plant species identified within the Project Area. Plants will be identified to the species level if possible, at a minimum if the plant is outside its phenological peak, the plant will be identified to the genus level if species identification is not possible. If positive identification cannot be completed in the field, a voucher sample will be collected, pressed, and preserved for further identification when appropriate. Prior to the 2014 field survey, biologists will obtain the necessary collecting permit for any voucher samples that may need to be collected from the State Botanist at the Massachusetts NHESP. Other general information that will be gathered during meander surveys will include general health of communities and site quality conditions. Vegetation communities will be classified using NHESP Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011).

Sample vegetation plots will also be established to collect quantitative information to characterize the different habitats and provide species composition of habitat types. Vegetation plot locations will be selected using Massachusetts NHESP guidelines and protocols. Massachusetts NHESP Quantitative Community Characterization Forms (Massachusetts NHESP Form 3) will be completed for representative habitats to document the results of each plot location. Geo-referenced photographs will also be taken to document site conditions at the time of the survey.

To refine botanical information for the study area, the following tasks will be performed:

14. Acquire and compile existing GIS vegetation cover type layers from available resources;

15. Examine any visible vegetation boundaries in aerial photos or other imagery to fix or update type polygon boundaries, based on field observations;

16. Produce a final vegetation type map that displays vegetation type polygon boundaries, the study area, and specific Project components;

17. Use the vegetation type map to produce a table of vegetation types and calculate the percent acres of each vegetation type present in the study area in general, in areas potentially affected by the Project, and indirectly affected key wildlife habitats.

During botanical surveys, incidental wildlife observations will be noted and reported consistent with Study No. 3.4.1.

Task 3: Sensitive Plant Survey

A sensitive plant survey and completion of a biological evaluation on the locations and population parameters of Massachusetts state-listed rare plant species as identified in Section 4.7 of the PAD will be completed in the Turner Falls Impoundment and the 13+ miles of riverine habitat below the Dam to the Rte. 116 Bridge in Sunderland. This sensitive plant survey will utilize guidelines and modified protocols established by the Massachusetts NHESP, VDFW Wildlife Diversity Program, and the NHFG Nongame and Endangered Wildlife Program. The sensitive plant survey will document state-listed plant species exhibiting meta-population dynamics and will focus more intensive field surveys on plant communities inhabiting mud flats, sand bars, and high energy shore and cobble island habitat types which are directly affected by water level fluctuations. The shoreline of the study area will be surveyed to locate all high probability areas that have suitable habitat and a high likelihood for sensitive plant associations. In identified areas having high likelihood of sensitive plants a timed-meander survey will be conducted for approximately 10 minutes to provide a census of the area. Species identified will be recorded for each site investigated and will also be added to the overall plant species census list for the Project.

The exact areas of focus will be determined after more extensive review of available information and based on professional judgment in the field. Areas having a known record of special status plants as determined in the pre-survey review and that may be affected by Project operations will be surveyed to cover 100 percent of the area. Positive identification of state-listed plant species will be photo-documented and GPS-located.

Task 4: Invasive Plant Survey

The Massachusetts Invasive Plant Advisory Group (MIPAG) maintains a list of invasive plant species in Massachusetts and provides criteria used in evaluating species. The MIPAG species list of invasive plants will be utilized to identify targeted invasive species when conducting botanical meander surveys.

Surveyors will use methods adapted from the USFS Invasive Species Inventory and Mapping Data Recording Protocols (USFWS, 2010). These adapted methods focus on presence, location, extent, abundance and other site characteristics to provide site infestation information.

To document an infested area, biologists will use a GPS at sub-foot accuracy to delineate the boundary of the infestation as defined by the dominant canopy cover of the invasive plant. Areas containing only occasional invasive species will be characterized with a GPS center point and radius necessary to enclose the population. For areas where invasive species are ubiquitous or impractical to map, surveyors will characterize the invasive species population using estimates of aerial coverage and percent of species present within a delineated polygon. As land disturbances following Project maintenance activities may favor establishment of invasive plants over native plant communities, survey efforts for invasive species will be focused on disturbed lands, areas of vegetation management, access roads and recreational trails, which can be vectors for invasive species propagation. All sampling areas containing invasive species will be photo-documented with geo-referenced photos, and an Invasive Species Documentation Form will be completed.

Task 5: Mapping Wetlands and Waters of the United States

Initial determination of wetland areas will be conducted through the use of existing information such as existing FirstLight site knowledge, NWI maps, FEMA floodplain maps, USGS 7.5 minute quadrangles, soil surveys, and aerial photography. This information will be transferred and digitized into GIS and preliminary wetland base maps will be prepared. This GIS wetland overlay will also be incorporated into an overall habitat or cover type map detailing all the habitat areas found in the project area or influenced by the Project.

Using the preliminary base wetland maps, field assessments will be completed to verify, classify and characterize the wetland communities. A team of qualified wetland biologists will complete the field assessments during the 2014 growing season when vegetation is most readily identifiable. Wetland habitats will not be formally delineated, but will be further defined from the existing NWI maps. Wetlands will be identified using standard federal criteria and methods outlined in the USACE Wetland Delineation Manual and the Regional Supplement to the USACE Wetland Delineation Manual: North Central and Northeast Region (USACE, 1987; USACE, 2012). Wetland types mapped will be classified using the USFWS Cowardin wetland classification system (e.g., palustrine, unconsolidated bottom, riverine aquatic bed) (Cowardin et al., 1979). General wetland verification and mapping will be completed using a GPS at sub-foot accuracy. Points collected in the GPS will be transferred to the GIS data base to assist in the creation of the final wetland presentation including location, type, and extent.

Evaluations and analysis of wetland functions and values will use the standard USACE descriptive approach (also known as the ACE Highway Methodology) (USACE, 1999). The ACE method is a descriptive (qualitative) approach for evaluating the functions and values of wetlands, which directs the user to identify the functions and values associated with a particular wetland based on the presence or absence of certain characteristics. For each wetland type, standard data will be recorded for the most important biotic and abiotic characteristics as the basis for identifying important wetland functions and values. This assessment will be completed holistically for each wetland type. A functional analysis of each wetland is not necessary because wetland "types" are functionally similar. Investigators will identify the "principal" or important functions and values associated with each wetland or wetland type.

Task 6: Project Water Level Fluctuation Assessment

A HEC-RAS model in an unsteady state will provide data to determine the contribution of water level fluctuations associated with Project operations. This hydraulic model will be developed as part of Study

No. 3.2.2. Specifically, this information will be used to address how hydraulically connected habitats and vegetation is affected.

A cross-section will be established in known areas of cobblestone tiger beetle and Puritan tiger beetle habitat for use in conjunction with the model results. The cross-section information will include depth and substrate measurements. The model output will provide information on water level elevation changes in relation to Connecticut River flows under a variety of test conditions

Task 7: Data Analysis

Following field surveys, GIS-based maps will be developed depicting wetland habitats, SAVs, EVAs, invasive species, RTEs, and other related information collected during the study. The field data collected will be geo-referenced as polygons or point data and overlain on orthophotos at a suitable scale. Field data will then be subject to QA/QC procedures, including spot-checks of transcription and comparison of GIS maps with field notes to verify locations of wetland sites and wetlands found. The results of this study will provide both quantitative and qualitative information that will be important in defining existing conditions, as well as providing any information on potential Project impacts as they relate to preparation of the License Application. This study is consistent with methodologies of generally accepted scientific practices and uses standard federal wetland assessment methods developed and used by Federal land management agency personnel.

Task 8: Reporting

A draft report will be prepared for study team review and comment, documenting methods and results. The report will provide the baseline information to defining existing conditions as well as analytical discussions and conclusions of potential Project impacts. The report will contain appendices of survey data and supporting correspondence among licensing participants. The report will be finalized following receipt of input from the study team and revisions to address any final comments by licensing participants.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

This study will likely take one study season to complete and will be conducted during the 2014 field season. The estimated cost for the study could range from approximately $60,000 to $80,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

The Wildlife and Botanical Inventory will be conducted as follows:

- January – March 2014: Reviewing existing information and data
- April - August 2014: Conduct field reconnaissance surveys
- September - December 2014: Prepare data and report

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3.6 Recreation and Land Use

3.6.1 Recreation Use/User Contact Survey

General Description of Proposed Study

This study was originally proposed as part of the PAD. FERC has requested a Recreation Facility Inventory and Use and Needs Assessment. In particular, FERC requested that FirstLight conduct a study to determine the existing use and demand at the projects and an assessment of the need to enhance recreation opportunities and access at the Projects. FERC proposed that the data be collected using on-site visitor intercept surveys at formal and informal public recreation areas at the Project reservoirs, tailraces, and riverine areas, including the Turners Falls bypassed reach; and mail and/or internet surveys targeting unique stakeholder groups that may not be practically accessed through on-site surveys (e.g. adjacent residential landowners, residents of the counties in which the projects are located, rock climbers, whitewater boaters).

FirstLight proposes to conduct a user count at the Turners Falls Project and Northfield Mountain Project recreation sites using both pressure tube counters and visual counts, including calibration counts to support the tube counters. FirstLight also proposes to develop and conduct contact surveys to determine the views of the recreating public with regard to the available recreation sites and activities within the Turners Falls Project and the Northfield Mountain Project boundary and to also request zip code information to assist with determining user distribution. It is anticipated that conducting the contact surveys at formal recreation sites will capture use by the majority of Project recreation users, including use at informal sites. This is because the majority of individuals utilizing informal sites within the Projects will access the sites via formal recreation facilities.

In addition, FirstLight proposes to conduct a mail survey targeted at adjacent residential landowners. The targeted mail survey should capture the majority of recreational use that may not originate at formal and informal sites. FirstLight is not proposing to conduct a mail survey of residents of the counties in which the Projects are located because the high cost of a general mail survey outweighs the uncertain benefit of a mail survey. The results of county-wide surveys tend not to be representative of the general recreational user population and produce unreliable results. There are an estimated 97,844 households in the three counties in which the Projects are located. Depending on the survey return rate, the estimated cost of conducting a mail survey, using a modified Dillman method, for 97,844 households could range from $700,000 to more than $1,605,000.00. FirstLight is not proposing to conduct internet surveys as part of this study. Internet surveys are generally not appropriate for quantitative analysis because the results tend not to be representative of the general recreational user population and are not reliable.

FirstLight proposes to use the information from the *Recreation Use/User Contact Survey* in conjunction with the *Recreation Facilities Inventory and Assessment* (Study No. 3.6.2), the *Whitewater Boating Evaluation* (Study No. 3.6.3), the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4), and the *Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use* (Study No. 3.6.7) to determine the sufficiency of existing recreation facilities in meeting recreation demand at the Projects and to assess the need to enhance recreation opportunities and access at the Projects.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

The objectives of the study are:

- Determine the amount of recreation use and demand at the Turners Falls and Northfield Mountain recreation sites; and
- Interview the recreating public to determine user opinions and goals with regard to the recreation sites, including the perceived adequacy of recreation facilities and access at the Project.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals are to enhance the recreational opportunities associated with the operation of the Turners Falls and Northfield Mountains Projects.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information:

Section 4.8 of the PAD provided information regarding recreation resources within the Projects and surrounding area. Recreation use at the Turners Falls Project and Northfield Mountain Project occurs in all seasons and includes motorized and non-motorized boating, fishing, camping, canoeing, climbing, sightseeing, hunting, skiing, hiking, walking, biking, horseback riding, and picnicking. There are multiple recreation facilities within the Projects' boundaries that offer a variety of recreation opportunities. In general, areas associated with the Turners Falls Project and the Northfield Mountain Project are open to the public for recreation use. There is no public access to the upper reservoir, and the reservoir is surrounded by a security fence. It can be viewed, however, from a platform on a nearby trail.

There are 20 formal recreation facilities located within the Turners Falls and Northfield Mountain Projects' boundary. These facilities provide a variety of amenities, including but not limited to boat ramps, camp sites, picnic tables, benches, trails, and interpretive displays. Lands within the Northfield Mountain Project contain Rose Ledge and Farley Ledges, which are routinely used by climbers.

The 2009 Form 80 for the Turners Falls Project reported that the total annual daytime use was 36,694 recreation days, and the total annual nighttime use was 4,584 recreation days. The peak weekend daytime average use was 339 recreation days, and the nighttime average was 27 recreation days. The interpretive displays were used at 80% of facility capacity, while the trails were used at 5% of their capacity. Parks and picnic areas in the Project were used at 35% of the facility capacities. The canoe portage and tailwater fishing facilities were used at 10% of their capacities.

The 2009 Form 80 for the Northfield Mountain Project reported that the total annual daytime use was 71,672 recreation days, and the total annual nighttime use was 4,564 recreation days. The peak weekend daytime average was 2,360 recreation days, and the nighttime average was 207 recreation days. The tent/trailer/RV sites and group camps were used at 80% of the facilities' capacities, while the interpretive displays were used at 20% of their capacity. The parks were used at 28% capacity, trails were used at 25% capacity, picnic areas were used at 24% capacity, and the Tour and Trail Center was used at 50% capacity.

Need for Additional Information:

Information on current use and whether existing access facilities in the area are meeting recreation demand would inform a decision on whether additional, designated public access at the Projects is necessary to meet existing and future recreation demand at the Projects.

Project Nexus (18 CFR § 5.11(d)(4))

FERC regulations require that the license application include a statement of the existing recreation measures or facilities to be continued or maintained and the new measures or facilities proposed by the applicant for the purpose of creating, preserving, or enhancing recreational opportunities at the Projects and in their vicinities, and for the purpose of ensuring the safety of the public in its use of Project lands and waters. In addition, recreation is a recognized project purpose at FERC-licensed projects under section 10(a) of the FPA.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

To determine the amount of recreation use at the Projects, the Licensee proposes to conduct a recreation use study in combination with a user contact survey and mail survey.

Task 1: Study Preparation

FirstLight will develop a user contact survey, determine the survey dates and times. All sampling days will be randomly selected and survey routes will be completed on a rotating basis and at different times of day to account for time-of-day use patterns. FirstLight also will develop a mail questionnaire/survey, based on Dillman approaches for developing mail surveys, which will be designed to ascertain recreational use by residential abutters.

Task 2: Field Work

The recreation use study will occur over four seasons in order to capture recreational use occurring in spring, summer, winter, and fall. It will be conducted using a combination of tube counters, calibration counts, spot counts, and actual use numbers. Tube counters will be placed at high use facilities within the Projects. These will be used to obtain an estimate of the number of vehicles using the site. The counters will be checked on Friday afternoon and Monday mornings to differentiate between weekday and weekend use. Calibration counts will be conducted at each formal Project recreation facility and will be documented on a survey form. These counts will last for at least two hours per site on each calibration day. This information will be used to verify that the traffic counters are functioning properly, determine the average number of individuals per vehicle, and determine the type of recreation use individuals are participating in. The spot counts will be conducted at all formal recreation areas within the Project. This information will be documented on a survey form. The spot counts will record the number of vehicles parked at a facility to determine the time-of-day use patterns at the sites. FirstLight currently charges a fee for winter recreation use at the Northfield Mountain Project and for their interpretive riverboat cruises. This information will be combined with the collected field data, when developing the user figures for the Projects. Final recreation use for the formal recreation facilities within the Projects will be summarized by season and activity type for each site. FirstLight will work with State agencies and private groups (e.g., Franklin County Boat Club, Turners Falls Rod and Gun Club, and Northfield Mount Hermon School) that manage existing public and private recreation facilities within the Project boundaries to determine use at their facilities.

A user contact survey will be developed to determine user opinions and goals with regard to the existing Project recreation facilities and opportunities such as whitewater and other boating opportunities, overnight camping, trail use, and rock climbing. The user contact survey will take place over the course of four seasons. The survey will also ask for the individuals' zip code to determine how far existing users travel to visit the Projects for recreational purposes. This information will also be used to determine length of stay, number of people in a party, and the opinion of the user with regard to the amount and

types of recreation opportunities offered within the Projects' boundaries. The survey will be administered during the calibration and spot count site visits.

A mail survey, using a modified Dillman method, will be mailed in the spring to residential abutters and a follow-up reminder card will be mailed out approximately two weeks later to those residences who have not returned a survey. It is assumed that approximately 25-40% of the targeted mail surveys will be completed and returned.

Task 3: Data Entry and Statistical Analysis

Information collected during Task 2 will be entered into spreadsheets for statistical analysis. Information such as the number of recreation days spent at the Projects' recreation sites, length of stay, average number of persons per party, and the percent of the facilities' capacity that is currently being utilized will be determined.

Task 4: Report Writing

The information that is gathered during this effort will be used to complete both the recreation and land management portions of the license application, as well as the FERC Form 80. Information from this study will be incorporated into a Recreation Management Plan along with information from several other studies.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the proposed level of effort is sufficient to obtain baseline information on recreational usage and demand within the Projects' area. The estimated cost for the recreation inventory and user contact survey outlined in this plan is approximately $85,000-$95,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. Field data collection will take place in 2014. Statistical analysis of the data will occur in 2015.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.6.2 Recreation Facilities Inventory and Assessment

General Description of Proposed Study

The majority of this study was conducted in 2011 and 2012 in order to collect baseline information on recreation facilities associated with the Projects and a summary of the results were originally presented in the PAD. Due to low snow years in 2011 and 2012, the winter field work of this baseline survey was not conducted until March 2013. This study was designed to confirm the number of existing recreation facilities, the number and types of amenities available at each facility and the overall condition of the facilities. In its study requests, FERC requested information on the condition of existing recreation facilities and access sites at the Projects. The intent of the proposed study is to prepare a summary report that identifies the number of existing recreation facilities and access sites, and the amenities and the overall condition of the facilities and access sites.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The objective of this study is to complete the baseline investigation of the existing recreation facilities within the Turners Falls Project and Northfield Mountain Project boundary with the preparation of a summary report of the results.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals are to enhance the recreation opportunities associated with the presence and operation of the Turners Falls and Northfield Mountain Projects.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information:

There are 20 formal recreation facilities located within the Turners Falls and Northfield Mountain Projects' boundary. These facilities provide a variety of amenities, including but not limited to boat ramps, camp sites, picnic tables, benches, trails, and interpretive displays. Below is a brief description of each of the recreation facilities located within the Turners Falls and Northfield Mountain Projects' boundary.

Cabot Woods Fishing Access: This site is located within the Turners Falls Project on Migratory Way in Montague, MA. This site is owned and managed by the Licensee and is open to the public for day use activities such as fishing, hiking, and picnicking. There are picnic tables, three ADA parking spaces, and 17 parking spaces available at the site.

Turners Falls Branch Canal Area: This site is located within the Turners Falls Project, off of Power Street in Montague, MA. This site is owned and managed by the Licensee and is open for fishing. Parking and benches are available at this site.

Turners Falls No. 1 Station Fishing Access: This site is located within the Turners Falls Project, off of Power Street in Montague, MA. This site is owned and managed by the Licensee and is open for fishing. Parking is available.

Unity Park: This park is located within the Turners Falls and Northfield Mountain Projects, on either side of First Street in Montague, MA. This site is owned by the town of Montague, with a portion on the east side that is owned by the Licensee. The park facilities located on the south side of the road are managed

by the town of Montague, while the portion of the park located between the river and the road is managed by the Licensee. The park offers day use activities including walking, fishing, sightseeing, picnicking, and biking. Amenities at the park include restrooms, a playground, parking, ballfields, a basketball court, a paved trail, benches, and picnic tables.

Canalside Trail Bike Path: This bike trail is located within the Turners Falls Project along the Turners Falls Power Canal in Montague, MA. The trail property is leased to and managed by the MA Department of Environmental Management (now MA Department of Conservation and Recreation) and is open for non-motorized public use.

Turners Falls Fishway Viewing Area: This site is located within the Turners Falls and Northfield Mountain Projects, off of First Street in Montague, MA. The fishway is managed by the Licensee and is located at the southern end of Unity Park. The facility is open to the public in the spring to watch migrating fish.

Barton Cove Nature Area and Campground: This Nature Area is located within the Turners Falls and Northfield Mountain Projects, on Barton Cove Road in Gill, MA. The Nature Area is owned and managed by the Licensee and is open to the public for camping, picnicking, and bank fishing. Campsites have a picnic table, fire ring and garbage can. There are two vault toilets and additional portable restrooms located within the campground. There is water access from some of the sites and bank fishing is permitted.

MA State Boat Launch: This launch is located within the Turners Falls and Northfield Mountain Projects, off of Route 2 in Gill, MA. This site is owned and managed by the state of Massachusetts, and is open to the public. The site offers boat launching and bank fishing opportunities. There is a parking lot, boat ramp, dock, and portable sanitation facility.

Barton Cove Canoe and Kayak Rental Area: This site is located within the Turners Falls and Northfield Mountain Projects, off of Route 2 in Gill, MA. This site is owned and managed by the Licensee and offers day use opportunities. There is a canoe/kayak launch, a rental office, picnic tables, parking, and a portable sanitation facility.

Cabot Camp: This camp is located within the Turners Falls and Northfield Mountain Projects, at the end of Mineral Road in Montague, MA. The site is owned and managed by the Licensee and is open to the public as an informal bank fishing area. There is a large parking area and access to a local bike trail from the site.

Northfield Mountain Boat Tour and Riverview Picnic Area: This picnic area is located within the Northfield Mountain Project, off Pine Meadow Road in Northfield, MA. This site is owned and managed by the Licensee, and is available for day use activities including interpretive riverboat cruises, picnicking, and bank fishing. The site is accessible from the water and via a paved road. There is a formal parking lot available for those using the site and those who are boarding the riverboat. There are picnic tables, grills, sanitation facilities, and a boat dock at the site.

Northfield Mountain Tour and Trail Center: This site, which is also known as the Visitor Center, is located within the Northfield Mountain Project, off Millers Falls Road (Rt. 63) in Northfield, MA. The Center is owned and managed by the Licensee and is available for day use activities. Available opportunities include viewing interpretive displays, picnicking, and educational programs. The Center has restrooms, cross-country ski rental equipment, and parking. It is open for year-round recreational and educational use.

Northfield Mountain Trail System: The trail system is located at the Northfield Mountain Project, off Millers Falls Road (Rt. 63) in Northfield, MA. Over twenty-six miles of trail are available for hiking, biking, horseback riding, snowshoeing, and cross-country skiing.

Northfield Mountain Mountaintop Observation Area: This site is located adjacent to the Northfield Mountain Project upper reservoir. The Observation Deck is owned and managed by the Licensee and is accessible by hiking the trail system.

Munn's Ferry Boat Camping Recreation Area: This site is a water access site located on the east side of the river in Northfield, MA. The camping area is located within the Turners Falls and Northfield Mountain Projects. This area is owned and managed by the Licensee and is available for overnight use. There are tent campsites each with a trash can, tent platform, picnic table, fire ring and grill. There is also a lean-to site with a trash can, tent platform, picnic table, fire ring and grill. There are pit toilets available at the site. Bank fishing opportunities are also available at this site.

Bennett Meadow Wildlife Management Area (WMA): The Bennett Meadow WMA is managed by the state of Massachusetts, Division of Fisheries and Wildlife. The site is located within the Turners Falls and Northfield Mountain Projects. This site offers day use opportunities; it is open for hunting, and is also used for walking and hiking.

Pauchaug Boat Launch: This site is owned and managed by the state of Massachusetts. The site is located within the Turners Falls Project and Northfield Mountain Project. There is a boat launch, parking and portable sanitation available at this site.

Pauchaug WMA: This WMA is owned and managed by the state of Massachusetts, Division of Fisheries and Wildlife. This site is similar to the Bennett Meadow WMA and is located within the Turners Falls Project and Northfield Mountain Project. The site is open for hunting and is used for walking/hiking and bank fishing.

Governor Hunt Boat Launch/Picnic Area: This site is owned and managed by TransCanada, which owns the Vernon Project. While this area is within the Vernon Project boundary, the area is also located in the area where the Turners Falls Project and Northfield Mountain Project boundaries and the Vernon Project boundary overlap. The area is open for day use opportunities and has a picnic area and boat launch. Recreation opportunities at the site include bank fishing, picnicking, boat launching, and sightseeing.

Turners Falls Canoe Portage: Portages around the Turners Falls Dam are available seven days per week for canoes and kayaks. The portage take-out is at the Barton Cove Canoe & Kayak Rental Area. Boaters wishing to proceed downriver of Barton Cove are picked up by the Licensee and driven to just downstream of the Project on Poplar Street in Montague City, where they can continue their trip.

Project Nexus (18 CFR § 5.11(d)(4))

FERC regulations require that the license application include a statement of the existing recreation measures or facilities to be continued or maintained and the new measures or facilities proposed by the applicant for the purpose of creating, preserving, or enhancing recreational opportunities at the Projects and in their vicinities, and for the purpose of ensuring the safety of the public in its use of project lands and waters. In addition, recreation is a recognized project purpose at FERC-licensed projects under section 10(a) of the FPA.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

As stated in the PAD, the bulk of this study was conducted in 2012 and a summary of the results was included in Section 4.8.1. The winter portion was completed in 2013 and a summary of the results for all four seasons of investigation will be prepared.

Task 1: Study Preparation and Field Work

FirstLight developed a standardized survey form to evaluate each existing recreation facility to determine its current condition and available amenities. Photos and GPS data was recorded while in the field for each facility. Once the work was completed this information was then entered into a GIS format.

Task 2: Summary Development

A summary of the results of the two studies will be prepared, along with maps of the recreation facility locations. FirstLight proposes to use this information in conjunction with Study No. 3.6.1 the *Recreation Use/User Contact Survey*, the *Whitewater Boating Evaluation* (Study No. 3.6.3), the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4), and the *Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use* (Study No. 3.6.7) to assess the sufficiency of existing recreational facilities. This information will also be included in the Recreation Management Plan.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The cost to complete the remaining portion of this study is estimated at $15,000-20,000. FirstLight believes that this is sufficient to fully meet the goals of this study.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.6.3 Whitewater Boating Evaluation

General Description of Proposed Study

FERC, NEF, AMC, AWWA, NPS, VRC and FCRP submitted requests for a controlled flow whitewater boating analysis of the Turner Falls bypass reach. All the requests were similar and requested FirstLight to use accepted whitewater boating evaluation practices to assess the presence, quality, and preferred flow ranges for river based boating resources in the Turner Falls bypass reach. FERC also requested that competing recreational uses and resource needs that may be adversely impacted by any scheduled releases be identified. NEF, AMC, AWWA, NPS, VRC and FCRP also request that access needs for put-in and take-out along the bypass reach be identified and a flow information and distribution system be assessed. FirstLight is proposing to develop and conduct a controlled whitewater boating analysis of the Turner Falls bypass using accepted comparative evaluation practices. FirstLight will consult with stakeholders to develop a comparison flow study methodology, determine the number of flows and volumes to be evaluated, schedule the timing of the evaluation, and to enlist a group of experienced boaters to participate in the evaluation.

NEF, AMC and AWWA request that the flow assessment occur on various dates in the spring (for moderate and high flows) and in the summer (for potential scheduled lower flow releases). FirstLight is not proposing to conduct whitewater boating evaluations in the spring because the only known spawning and rearing areas for ESA-listed shortnose sturgeon in the Connecticut River are located in the bypass reach and whitewater flow releases have a potential to interrupt spawning or flush eggs and larvae from the rearing area.. In addition, FirstLight does not propose to conduct a spring evaluation because of the possibility of unreliable results due to the lag time between spring and summer evaluations. Because a component of the boating evaluation will be a comparative rating and analysis of several flows, FirstLight is proposing that the on-water boating evaluation be conducted on consecutive days in one season to ensure consistency in assessing and comparing the various flows and in the make-up of the flow evaluation team.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The objectives of the study are:

- Assess the effects of a range of bypassed reach flows on whitewater recreation opportunities;
- Determine what whitewater boat-types would be appropriate to utilize any potential whitewater flows in the bypassed reach;
- Determine the range of flows (minimum through optimal) needed to support various whitewater boating opportunities by watercraft;
- Determine whether current or future demand exists for whitewater boating in the bypassed reach;
- Determine the number of days per month the acceptable and optimum flows for whitewater boating would be available under the Turners Falls Project's current and any proposed mode of operation;
- Determine any competing recreational uses or other resource needs that may be adversely affected by whitewater boating;
- Identify the need for and define adequate access points, if needed, that provide trails and car-top parking at Great Falls Discovery Center, Station #1 and Cabot Station, and egress at the end of the 2.7 mile bypass run at the confluence of the Deerfield River;

- Conduct an assessment of existing regional whitewater boating opportunities; and
- Prepare a study report that describes the: whitewater boating attributes of the range of flows examined, including level of difficulty, portage requirements; identifies the acceptable and optimal flows for the reach and the frequency of availability of the identified flows under current and any proposed project operation; incorporates relevant results from the *Recreation Use/User Contact Survey* (Study No. 3.6.1), the *Recreation Facilities Inventory and Assessment* (Study No. 3.6.2), and the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4) including characterization of the suitability of the bypassed reach for whitewater boating, annual recreation use by activity and season of the bypassed reach; whether or not there is a demand for whitewater boating in the bypassed reach; and any competing recreation uses or other resources in the bypassed reach that could be adversely affected by providing flows for whitewater boating.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals are to enhance the recreational opportunities associated with the presence and operation of the Turners Falls and Northfield Mountains Projects.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information:

There is limited information on whitewater boating flows associated with the Turner Falls bypass. The Appalachian Mountain Club *AMC River Guide, Massachusetts, Connecticut, Rhode Island*, Fourth Edition (2006) states there is very little water in the bypass reach except during flood conditions when canoeing is not advised, and that the 3.5 miles of river below the Turner Falls Dam cannot be run even by experienced canoeists.

Anecdotal information indicates that whitewater features exist during high flow conditions in the bypass near the river bend just downstream of Turner Falls Dam and at the so-called "rock dam" located approximately 1.8 miles downstream of the dam, and that the remainder of the bypass is fast current.

Need for Additional Information:

To determine if flows in the bypass area can provide whitewater boating opportunities, a variable flow evaluation will need to be conducted.

Project Nexus (18 CFR § 5.11(d)(4))

FERC policy requires licensees to provide reasonable public recreation opportunities consistent with the safe and effective operation of the Project.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1 – Develop Boating Evaluation Protocol, Logistics and Schedule

Working with NEF, AWWA and AMC, and other interested stakeholders, FirstLight will coordinate selecting bypass flows (approximately four), scheduling of the evaluation (estimate two consecutive days), assembling a team of volunteer expert boaters, field logistics, and developing a methodology and comparative evaluation process to rate the bypass flows to meet the study objectives. FirstLight will

inspect the bypass reach for the presence of rebar in areas subject to flows, and if found, remove the rebar prior to the boating evaluation.

Task 2 – On-Water Boating Evaluation

The boating evaluation will be conducted as designed in Task 1. Though flows to be evaluated will be established prior to the field evaluations, flows may be adjusted based on participant boater recommendations during the evaluation provided any adjusted flow(s) can be calibrated at Turner Falls Dam. Participating boaters will complete an evaluation form after each flow and a comparative summary evaluation for all flows upon completion of the file evaluation. FirstLight will lead a post evaluation discussion to discuss the study and to gather additional feedback from the participants.

Task 3 – Identify and Evaluate Access to the Turner Falls Bypass Reach

FirstLight will identify, investigate, and assess access points that provide trails and car-top parking along the bypass reach including the Great Falls Discovery Center, Station #1, Cabot Station, and at the end of the 2.7 mile bypass run at the confluence of the Deerfield River. This work may be conducted as part of the *Recreation Use/User Contact Survey* (Study No. 3.6.1).

Task 4 – Data Review and Analysis

Historic flow data will be analyzed to determine the number of days per month the acceptable and optimum flows for whitewater boating, as determined by the results of the controlled flow analysis, would be available under the Turner's Falls Project's current mode of operation. An analysis will also be conducted to determine the number and timing of boatable flows for any proposed mode of operation at Turner Falls.

FirstLight will assess whether current or future demand exists for whitewater boating in the bypassed reach using data from the controlled flow analysis, the *Recreation Use/User Contact Survey* (Study No. 3.6.1), an assessment of existing regional whitewater boating opportunities, and regional projections for changes for paddle boating.

Based on existing data and data collected from other relicensing studies related to the Turner Falls bypass, FirstLight will identify any competing recreational uses or other resource needs that may be adversely affected by any scheduled releases for boating.

Task 5 – Report Development

The information gathered during these efforts will be included in a study report addressing the study goals and objectives identified above.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the proposed level of effort is sufficient to obtain data to determine the level of whitewater boating opportunities, which may be available with releases in the Turner Falls bypass. The estimated cost for the whitewater boating evaluation outlined in this plan is approximately $45,000 to $50,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. The Whitewater Boating Evaluation will be conducted in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.6.4 Assessment of Day Use and Overnight Facilities Associated with Non-motorized Boats

General Description of Proposed Study

A number of stakeholders requested this study including NPS, AMC, VRC, FCRP, NEF, AWWA, and CRWC. As part of its request for a study of project facilities to support multiple-day self-powered boating trips, NPS/AMC et al request a survey of people who do not use the river or are displaced. FirstLight has proposed to conduct a study of recreation use at the Northfield Mountain Project but does not propose to conduct a survey of non-users or displaced users. It is difficult to identify with any degree of precision the scope of non-users and displaced users and target these groups for a survey. A regional blanket mail survey (to some portion of the populations) to reach these users requires a significant level of effort that is not justified by the typical low rate of return when considering the ratio of non-users and displaced users in relation to the population sampled. In sum, the survey may not provide a statistically valid sample size. FERC regulations require the Licensee to provide an estimate of existing and potential recreational use of the project area as well as measures for creating, preserving and enhancing recreational opportunities at the project. The proposed study plans use standard, FERC- accepted methodologies including a review of the existing day use and overnight facilities associated with carry-in boat launching and water-access camping within the Turners Falls and Northfield Mountain Projects.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

The objectives of the study are:

- Determine the number of overnight recreation facilities located within the Projects including the number, capacity, and types of amenities available;
- Determine the need for and if alternate canoe portage trails are feasible;
- Determine the need for and possible locations for future carry-in boat facilities (particularly at Turners Falls Dam, Station #1, Cabot Station, and the Deerfield River Confluence) and overnight facilities;
- Determine if current facilities are adequately spaced for non-motorized boating day use trips;
- Determine if improvements are necessary at existing facilities to meet current and near future use particularly at put-in and take-out facilities; and
- Determine if the seasons of operation are consistent with actual river use.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals are to enhance the recreational opportunities associated with the presence and operation of the Turners Falls Project.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information:

Boating, camping, and canoeing use currently occurs within the Projects. The Connecticut River National Blueway, which encompasses the river and its 7.2 million-acre watershed includes Project lands and waters. The AMC River Guide and the Connecticut River Boating Guide: Source to Sea (3rd ed.) describe the Connecticut River between the Vernon Falls Dam and the Turners Falls Dam as a flat water to quick water paddle with overnight camping available at Munn's Ferry and Barton Cove Campground.

There are multiple recreation facilities within the Projects' boundaries that offer a variety of recreation opportunities to the boating community, including the following existing facilities.

Barton Cove Nature Area and Campground: This Nature Area is located within the Turners Falls and Northfield Mountain Projects, on Barton Cove Road in Gill, MA. The Nature Area is owned and managed by the Licensee and is open to the public for camping, picnicking, and bank fishing. Campsites have a picnic table, fire ring and garbage can. There are two vault toilets and additional portable restrooms located within the campground. There is water access from some of the sites and bank fishing is permitted.

MA State Boat Launch: This launch is located within the Turners Falls and Northfield Mountain Projects, off of Route 2 in Gill, MA. This site is owned and managed by the state of Massachusetts, and is open to the public. The site offers boat launching and bank fishing opportunities. There is a parking lot, boat ramp, dock, and portable sanitation facility.

Barton Cove Canoe and Kayak Rental Area: This site is located within the Turners Falls and Northfield Mountain Projects, off of Route 2 in Gill, MA. This site is owned and managed by the Licensee and offers day use opportunities. There is a canoe/kayak launch, a rental office, picnic tables, parking, and a portable sanitation facility.

Munn's Ferry Boat Camping Recreation Area: This site is a water access site located on the east side of the river in Northfield, MA. The camping area is located within the Turners Falls and Northfield Mountain Projects. This area is owned and managed by the Licensee and is available for overnight use. There are tent campsites each with a trash can, tent platform, picnic table, fire ring and grill. There is also a lean-to site with a trash can, tent platform, picnic table, fire ring and grill. There are pit toilets available at the site. Bank fishing opportunities are also available at this site.

Pauchaug Boat Launch: This site is owned and managed by the state of Massachusetts. The site is located within the Turners Falls Project and Northfield Mountain Project. There is a boat launch, parking and portable sanitation available at this site.

Governor Hunt Boat Launch/Picnic Area: This site is owned and managed by TransCanada, which owns the Vernon Project. While this area is within the Vernon Project boundary, the area is also located in the area where the Turners Falls Project and Northfield Mountain Project boundaries and the Vernon Project boundary overlap. The area is open for day use opportunities and has a picnic area and boat launch. Recreation opportunities at the site include bank fishing, picnicking, boat launching, and sightseeing.

Turners Falls Canoe Portage: Portages around the Turners Falls Dam are available seven days per week for canoes and kayaks. The portage take-out is at the Barton Cove Canoe & Kayak Rental Area. Boaters wishing to proceed downriver of Barton Cove are picked up by the Licensee and driven downstream to Poplar Street in Montague, where they can continue their trip.

Project Nexus (18 CFR § 5.11(d)(4))

FERC regulations require that the license application include a statement of the existing recreation measures or facilities to be continued or maintained and the new measures or facilities proposed by the applicant for the purpose of creating, preserving, or enhancing recreational opportunities at the Projects and in their vicinities, and for the purpose of ensuring the safety of the public in its use of Project lands and waters. In addition, recreation is a recognized project purpose at FERC-licensed projects under section 10(a) of the FPA.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Literature Review:

FirstLight proposes to conduct a desk top review of the existing recreation data including recreation facility inventory data collected in 2012-2013 and camping records. This information will be used to determine the locations and spacing between facilities associated with non-motorized boating trips, as well as hours and seasons of operations. Data regarding existing capacity and existing campsite use will be compared to determine if the current facilities are meeting current use needs. The Licensee will review and take into consideration appropriate federal, state, county and local programs and plans related to recreational use of the waterway within the Projects' boundaries. Data from the *Recreation Use/User Contact Survey* will be reviewed to assess the need for new or improved facilities to accommodate non-motorized boating use at the Projects. FirstLight will also review land ownership information, existing improvement plans, and aerial photography to determine potential locations for future use sites, if needed and potential improvements for existing sites, if needed.

Task 2: Field Work

A field survey will be used to ground verify the location for potential future use sites and determine the feasibility of developing these sites. A review of potential canoe portage trails will also be conducted in the field along with flows at potential put-in locations. FirstLight will observe water flows and depths in the by-pass to determine navigability by non-motorized boats.

Task 3: Report Preparation

Upon completion of field surveys, FirstLight will use the data reviewed and gathered to develop a written report discussing the findings including the sufficiency of current recreation facilities and need, if any, for new or improved facilities and potential improvements with respect to multiple day non-motorized boat trips. A map depicting the current locations of facilities and potential future locations will also be included as part of the report.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the proposed level of effort is sufficient to obtain information regarding carry-in boating opportunities within the Turners Falls Project area. The estimated cost for the assessment outlined in this plan is approximately $20,000-25,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering

and study requests. The *Assessment of Day Use and Overnight Facilities Associated with Non-motorized Boats* will be in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.6.5 Land Use Inventory

General Description of Proposed Study

This study was proposed by FirstLight as part of the PAD and includes a review of existing land uses occurring on Project and adjacent lands, applicable land use controls such as local zoning, results of other resource studies, and a determination of the appropriate land use designations for lands within the Turners Falls Project and Northfield Mountain Project. Once the existing land uses and land use controls are identified, FirstLight will review available aerial photography and apply an appropriate designation to the Turners Falls Project and Northfield Mountain Project lands. This will aid in future land management decisions for lands within the Turners Falls Project and Northfield Mountain Project boundaries.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

The objectives of this inventory are as follows:

- Identify the current land uses within the Turners Falls Project boundary and the Northfield Mountain Project boundary.
- Identify the current land uses on lands abutting the Turners Falls and Northfield Mountain Project boundaries up to 200 feet.
- Identify current land use controls on lands within the Projects' boundaries and on lands abutting the Project boundaries up to 200 feet.
- Determine the appropriate land use designations for lands within the Turners Falls Project and Northfield Mountain Project boundaries. Designations will be based on the review of existing uses on lands within the Projects' boundaries and adjacent lands, the results of other resource studies, and land use controls such as local zoning.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

Resource management agencies are interested in the appropriate land designations in order to protect the natural resources within the Northfield and Turner Falls Projects.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information

Section 4.8 of the PAD provided information regarding recreation resources within the Projects and surrounding areas. Lands within the Projects' boundaries are used for operation of the Projects and recreation. There are also areas of agricultural and forested lands, as well as wetland areas located within the Projects. Other land types located within the Projects include open land, medium, low, and very low density residential development, forest, wetlands, open land, powerline/utility, urban, public/institutional, and industrial uses. Associated land use activities also include land maintenance, road and trail maintenance, tree removal, and vegetation clearing. The area surrounding the Turners Falls and Northfield Mountain Projects, from the Northfield Mountain Project north to the Vernon Project, is

largely rural with a mix of agriculture lands and some forested areas. The lands south of the Northfield Mountain Project, near the Turners Falls Dam, are largely developed with a mix of residential and industrial uses. There are no Vermont, Massachusetts, or New Hampshire designated natural areas within the Turners Falls and Northfield Mountain Projects' boundaries.

The Licensee has granted permission to others for non-Project uses of Project lands in accordance with the provisions of the Turners Falls and Northfield Projects' licenses. These non-Project uses include uses of Project lands and waters for a parking area, the Conte Fish Lab, a fire pond, a privately owned boat club, private camps, landscaping activities, agricultural uses, communications antennas, docks, a NPDES discharge, and water withdrawals.

Need for Additional Information:

FirstLight will continue to make land management decisions regarding the use of lands within the Projects. In order to guide in decision making for future use of lands within the Projects' boundaries, FirstLight requires updated land use information regarding the current uses of Project lands and of lands within 200 feet of the Projects' boundaries. This information can then be used to determine appropriate land use designations for lands within the Projects' boundaries. The information would be readily available via GIS mapping and can be continually updated as information changes.

Project Nexus (18 CFR § 5.11(d)(4))

Operation of the Turners Falls Project and the Northfield Mountain Project may have the potential to affect land use within the Projects' boundaries.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Literature and Aerial Photography Review

FirstLight proposes to review existing land use controls, because land use controls may impact how land is currently being used. Information reviewed will include local plans, ordinances, statutes, policies, and guidelines that may affect use and/or management of Project lands, and the results of resource studies conducted as part of the relicensing process. Using aerial photography, FirstLight will also identify land uses and land use controls on lands abutting the Projects up to 200 feet beyond the Projects' boundaries. Identification of uses of lands within 200 feet of the Projects' boundaries will allow for appropriate designation of lands within the Projects taking into consideration abutting property use.

Task 2: Development and Application of Land Use Designations

FirstLight will use the results of the literature review and the results of the identification of land uses currently occurring within the Projects' boundaries and on adjacent lands to develop appropriate land use designations for lands within the Projects' boundaries. Once land use designations are defined, FirstLight will propose the application of the appropriate designation to lands within the Turners Falls Project and Northfield Mountain Project boundaries.

Task 3: Map and Summary Development

FirstLight will prepare maps and a summary of the results of the inventory. The summary will include the proposed land use designations and definitions, along with the percentage of Project lands in each designation.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the proposed level of effort is adequate to obtain baseline information on the existing land uses and land use controls within the Project boundaries and on abutting lands up to 200 feet from the Project boundaries. The estimated cost for this inventory is approximately $15,000-20,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. The *Land Use Inventory* will be initiated in 2014 but because the *Inventory* depends in part on the results of other resources studies proposed herein, the *Inventory* will be completed in 2015

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.6.6 Assessment of Effects of Project Operation on Recreation and Land Use

General Description of Proposed Study

FirstLight originally proposed this study in the PAD. The study plans to use the information derived from the studies set forth in the Recreation Use/User Contact Survey and the Recreation Facilities Inventory and Assessment to assess the potential impact of continuing operation and maintenance of the Projects on recreation and land use.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

The objective of this assessment is to determine if the operation of the Turners Falls Project and the Northfield Mountain Project has an effect on the recreation facilities or land use within either Project.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals are to enhance the recreational opportunities associated with the operation of the Turners Falls and Northfield Mountains Projects.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information:

There are 20 formal recreation facilities located within the Turners Falls and Northfield Mountain Projects' boundary. Section 4.8 of the PAD provided information regarding recreation resources within the Projects and surrounding areas. These facilities provide a variety of amenities, including but not limited to boat ramps, camp sites, picnic tables, benches, trails, and interpretive displays.

Need for Additional Information:

FirstLight will need to review the proposed studies, once completed, to determine if there are effects on the existing public recreation sites or on land use within either Project from Project operations.

Project Nexus (18 CFR § 5.11(d)(4))

The objective of this assessment is to determine if the operation of the Turners Falls Project and the Northfield Mountain Project has an effect on the recreation facilities or land use within either Project.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Data Compilation

FirstLight will review the information derived from the studies set forth in the *Recreation Use/User Contact Survey* (Study No. 3.6.1), the *Recreation Facilities Inventory and Assessment* (Study No. 3.6.2), the *Whitewater Boating Evaluation* (Study No. 3.6.3), the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boats* (Study No. 3.6.4), and the *Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use* (Study No. 3.6.7) to assess the

potential impact of continuing operation and maintenance of the Projects' on recreation. FirstLight will also review historic and existing water level fluctuation information.

Task 2: Data Analysis

FirstLight will compare the information reviewed in Task 1 to determine if there are access issues resulting from water level fluctuations. This will include analyzing inventory data and comparing it to water elevation data on the dates of the surveys. In addition, FirstLight has proposed to develop a hydraulic model of the Turners Falls Impoundment, bypass reach and of the Connecticut River below Cabot Station down to Holyoke Dam (Study 3.2.2 *Hydraulic Study of Turners Falls Impoundment, Bypass Reach and below Cabot Station*), which will also be used in the assessment of impacts to recreational access from water level fluctuations.

Task 3: Report Development

FirstLight will prepare a report with the results of the study, including a determination if there are access issues due to fluctuating water levels and where they may be occurring.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the assessment as proposed above is sufficient to determine if the operation of the Projects has an effect on the recreation facilities or land use within the Project. It is estimated that this assessment will cost approximately $10,000-12,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. The *Assessment of Effects of Project Operations on Recreation and Land Use* will be initiated in 2014 but because the *Assessment* depends in part upon the results of other studies, it will be completed in 2015.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.6.7 Recreation Study at Northfield Mountain, including Assessment of Sufficiency of Trails for Shared Use

General Description of Proposed Study

A number of stakeholders requested this study including: NPS, AMC, VRC, FCRP, and Ms. Krug. This study is designed to determine the number of existing recreation facilities, the number and types of amenities available at each facility and the overall condition of the facilities associated with the Northfield Mountain Project. This will include a review of the trail system and climbing ledges located within the Northfield Mountain Project boundary.

NPS/AMC et al request that the study of the Northfield Project recreation facilities include a survey that seeks to determine what discourages the public from using the facilities. FirstLight proposes to use the contact and mail surveys conducted as part of the *Recreation Use/User Contact Survey* (Study No. 3.6.1) to seek out what improvements may be needed. As set forth, however, in the *Assessment of Day Use and Overnight Facilities Associated with Non-Motorized Boating* (StudyNo. 3.6.4), FirstLight does not propose to conduct a survey of non-users or displaced users because such a survey will not yield reliable or meaningful information in consideration of the level of effort required.

Ms. Krug requests that FirstLight evaluate trail networks in Franklin County to determine the need for additional trails and to conduct a site visit to some of these trails. This was not adopted because these trails are located outside of the Project area. FirstLight is proposing to gather information regarding the trail needs for mountain biking as part of the user contact survey proposed in *Recreation Use/User Contact Survey* (Study No. 3.6.1).

NPS requests that FirstLight evaluate its expenditures over the term of the current license in support of the facility, its promotion, and usage and extrapolate in current dollars, what would be necessary to bring the facility up to the quality and level of use that applicable FERC regulation prescribe. Past expenditure information is available on the FERC Form 80 and has not been included as part of this study. As part of its license application, FirstLight will provide estimates for any proposed recreational improvements.

Ms. Krug asks for online user surveys to talk to mountain bike groups regarding the needs of mountain bicyclists and assess interest in opportunities at Northfield Mountain. Internet surveys are not appropriate for quantitative analysis because they are not representative of the general recreational user population and do not provide reliable results. FirstLight proposes to use the results of the surveys proposed in the *Recreation Use/User Contact Survey (*Study No. 3.6.1) to seek out what improvements may be needed.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to compile existing data and develop additional information to support a new FERC license application for continued future operation of the Project.

The objectives of this study are as follows:

- Determine whether the Northfield Mountain Tour and Trail Center has met recreation needs and if improvements or additions are necessary at the Center with a consideration of potential needs over the course of the 30 to 50 year new license; and

- Identify uses taking place on the current trail system and whether the current trail system is suitable and adequate for sustaining those uses, including evaluating the condition of existing trails e.g., erosion, drainage, width, slope, or obstacles.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The resource management goals are to enhance the recreation opportunities associated with the operation of the Northfield Mountain Project.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Existing Information:

The Northfield Mountain Tour and Trail Center, Northfield Mountain Trail System and Northfield Mountain Mountaintop Observation Area provide numerous recreation opportunities within the Northfield Mountain Project boundary. Although they are not formal recreation facilities, Rose Ledge and Farley Ledge provide climbing opportunities to the public. The three formal recreation facilities are described in detail below.

Northfield Mountain Tour and Trail Center: This site, which is also known as the Visitor Center, is located within the Northfield Mountain Project, off Millers Falls Road (Rt. 63) in Northfield, MA. The Center is owned and managed by the Licensee and is available for day use activities. Available opportunities include viewing interpretive displays, picnicking, and educational programs. The Center has restrooms, cross-country ski rental equipment, and parking. It is open for year-round recreational and educational use.

Northfield Mountain Trail System: The trail system is located at the Northfield Mountain Project, off Millers Falls Road (Rt. 63) in Northfield, MA. Over twenty-six miles of trail are available for hiking, biking, trail running, horseback riding, snowshoeing, and cross-country skiing. Climbers currently utilize a portion of the trail system to access Rose Ledge.

Northfield Mountain Mountaintop Observation Area: This site is located adjacent to the Northfield Mountain Project upper reservoir. The Observation Deck is owned and managed by the Licensee and is accessible by using the trail system.

Project Nexus (18 CFR § 5.11(d)(4))

FERC regulations require that the license application include a statement of the existing recreation measures or facilities to be continued or maintained and the new measures or facilities proposed by the applicant for the purpose of creating, preserving, or enhancing recreational opportunities at the Projects and in their vicinities, and for the purpose of ensuring the safety of the public in its use of Project lands and waters. In addition, recreation is a recognized project purpose at FERC-licensed projects under section 10(a) of the FPA.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1: Review of Existing Information

The Licensee proposes to use data collected as part of the *Recreation Use and User Contact Survey* (Study No. 3.6.1) to identify opinions of current recreation users of the Northfield Mountain recreation facilities. Prior to conducting field work associated with this study, a review of proposed trails, existing aerials and property ownership will be conducted.

Existing hiking and biking trail information for the Northfield Mountain area will be reviewed, as well as best management practices set forth by the International Mountain Bicycling Association, the USFS Trail Classifications, and the MA Department of Conservation & Recreation's Trail Guidelines and Best Practices standards.

Task 2: Field Work

The Licensee will conduct a field review of the current trail system, climbing sites, and the existing portion of the New England National Scenic Trail. This will include locating the sites with a GPS, if the information does not currently exist; photographing and recording the current amenities and conditions of the sites; and determining if there is a need for improvement.

Task 3: Desktop Analysis

A desktop analysis will be conducted to compare field data, survey data, and existing information. The analysis will determine if the current facilities are meeting the existing recreation needs at Northfield Mountain and provide a list of potential improvements that could be completed if the need arises over the course of the license.

Task 4: Report Development

The information collected will be compiled within a written report.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

FirstLight believes that the proposed level of effort is sufficient to obtain information on recreational facilities and amenities at Northfield Mountain, within the Northfield Mountain Project boundary. The estimated cost for the study outlined in this plan is approximately $20,000-$25,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. The *Recreation Study at Northfield Mountain, including Assessment of Need for Shared-Use Trails* will be conducted in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

3.7 Cultural Resources

3.7.1 Phase 1A Archaeological Survey

General Description of Proposed Study

In its PAD, FirstLight proposed to conduct a Phase 1A archaeological survey. FERC and the Town of Montague have requested assessments of archaeological resources. The purpose of the Phase IA archaeological survey is to identify known archaeological sites within the Turners Falls and Northfield Mountain Projects' APE that potentially may be eligible for inclusion in the National Register of Historic Places (NRHP) and to assess possible effects from the Projects' operations on those resources.

The area of investigation will include the FERC-defined APE as identified in the PAD, which includes the Projects' boundaries and any construction, recreational, or known locations effected by project operation outside of the Projects' boundaries. The Project APE is further defined by FERC as: "the lands enclosed by the Projects' boundary and lands or properties outside of the Project's boundaries where project construction and operation or project-related recreational development or other enhancements may cause changes in the character or use of historic properties, if any historic properties exist." The Massachusetts, Vermont, and New Hampshire SHPOs will be consulted for concurrence with or refinement of this definition. A detailed map of the APE will be prepared and included in the Study Report.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to assist FERC in meeting its compliance requirements under Section 106 of the NHPA, as amended, by determining if licensing of the Project will have an adverse effect on historic properties.

The objective of the study is to identify known cultural resources listed in or eligible for listing in the NRHP and to identify and assess any potential adverse effects to historic properties from the continuing operation and maintenance of the Projects.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

Section 106 of the National Historic Preservation Act (1966) requires that federal agencies, licensees, and those receiving federal assistance take into account the effects of proposed undertakings on any resource that is listed on or is eligible for the NRHP. As the lead agency, FERC is responsible for fulfilling the requirements of Section 106 in its decision to issue a new license to the Projects.

As stipulated by the regulations that implement Section 106 (36 CFR 800), the Massachusetts, Vermont, and New Hampshire SHPOs represent the interests of their respective States and their citizens, and advise and assist FERC in determining the significance of cultural resources within the APE. FirstLight proposes consulting closely with the SHPOs in the development of the survey methodology, identification of existing cultural resources and effects, establishment of its APE, and development of a Programmatic Agreement (PA) and HPMP, if needed.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Information contained in the PAD indicates that Native Americans have occupied the Connecticut River Valley as early as 14,000 years before the present day. Archaeological sites dating from the *Paleoindian*

(before 8000 BC), *Archaic* (8000 BC – 1000 BC), and *Woodland* (1000 BC – AD 1600) periods, as well as the early Euro-American exploration, settlement, and industrial periods, may exist on lands bordering the Connecticut River. The Riverside Archaeological District in the Towns of Gill and Greenfield was listed in the NRHP in 1975 in recognition of significant archaeological remains known to exist in the Turners Falls vicinity. European settlement in the Connecticut River basin in what was to later become Northfield Township and the Town of Gill occurred as early as 1672. During King Phillip's War in 1676, Peskeopscut (Turners Falls) was the site of a military encounter between colonial forces under Captain William Turner and Native Americans. Following the American Revolution, transportation improvements included construction of the Upper Locks and Canal (1792-98) from Turners Falls to Montague. After the Civil War, Turners Falls developed as an important center of manufacturing with the establishment of the Turners Falls Company in the early 1870s. In the 1890s, Turners Falls continued to expand with construction of a new paper mill, shoe factory, and leather manufacturers.

To date, there have been no comprehensive, professional archaeological surveys of the Project APE to identify such resources. FirstLight therefore proposes to conduct the Phase IA archaeological survey to identify potential NRHP-eligible archaeological resources in the Projects' APE and provide information to assess potential adverse effects to such resources.

Project Nexus (18 CFR § 5.11(d)(4))

The proposed cultural resources study will provide information on known archaeological sites located within the Projects' APE. The resulting technical reports will provide information on which resources are potentially eligible for inclusion in the NRHP and what potential adverse effects to these historic properties would be created by the continued operation of the Project. Once the potential adverse effects are determined, the information that is developed during the course of the study may be used as the basis for preparing an HPMP. Guiding the Licensee's actions relating to Section 106 during the term of the new license, an HPMP would discuss how to avoid potential adverse effects or how they would be mitigated. A final HPMP would be filed with the license application.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1 – Meeting with the Massachusetts, Vermont, and New Hampshire SHPOs

FirstLight will consult with the Massachusetts, Vermont, and New Hampshire SHPOs to reach concurrence with respect to the precise APE for the Projects, the development of a sensitivity model, and archaeological field reconnaissance methodology.

Task 2 – Background Research

FirstLight proposes to examine archaeological site files, cultural resources reports, and archives located at the Massachusetts, Vermont, and New Hampshire SHPOs and other local and regional repositories, such as the Great Falls Discovery Center in Turners Falls and the Pocumtuck Valley Memorial Association in Deerfield. The purpose of this work is to examine relevant sources that may contain historical and archaeological information on the two Project areas in order to develop prehistoric and historic contexts and an archaeological sensitivity model. As part of this study, FirstLight will endeavor to obtain background information from local historians, researchers, and other persons knowledgeable of the cultural history of the two Project areas.

Task 3 – Development of a Sensitivity Model

FirstLight will develop a sensitivity model, based on its consultation with the SHPOs and background research to identify areas within the APE that are likely to contain archaeological resources. FirstLight will obtain the SHPOs concurrence with the sensitivity model.

Task 4 – Field Reconnaissance

FirstLight also proposes to conduct archaeological field reconnaissance of the Turners Falls Project and Northfield Mountain Project areas to confirm the sensitivity models and eliminate areas from further study as warranted. The field reconnaissance will consist of visual examination of selected portions of the Project areas, focusing primarily on landforms that have the greatest potential to contain archaeological resources, and as well as confirming areas of disturbance, steep slope, and wetlands, which would have little potential to contain archaeological resources. A limited number of soil cores may be taken to confirm soil characteristics and/or ground disturbances; it is anticipated that no other ground disturbance will be required for this study. The methods to achieve the goals of this study will be conducted in consultation with the SHPOs following their professional standards and guidelines. FirstLight will employ a professionally qualified archaeologist who meets the *Secretary of the Interior's Standards* to conduct the cultural resources study.

Task 5 – Report Development

FirstLight will develop a report that contains a record of its consultation with the SHPOs, a summary of background research, a description of the sensitivity model, results of Phase 1A reconnaissance, maps of the APE, and recommendations to conduct, if necessary, a Phase IB archaeological survey depending on the results of the study and in consultation with the SHPOs.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The estimated cost for the Phase IA cultural resources survey is between $55,000 and $65,000. FirstLight believes that the proposed level of effort is adequate to obtain needed information on historic and prehistoric cultural resources within the Projects' APE and to determine the need for more intensive surveys.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. The *Phase IA Archaeological Survey* will be conducted in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1

3.7.2 Reconnaissance-Level Historic Structures Survey

General Description of Proposed Study

In its PAD, FirstLight proposed to conduct a Historic Structures Survey. FERC also noted that FirstLight had proposed such a survey. The purpose of the reconnaissance-level historic structures survey is to identify historic resources within the Turners Falls and Northfield Mountain Projects' APE that are listed in or may be eligible for listing in the NRHP and to assess possible effects from the Projects' operations on those resources. This will be accomplished through SHPO consultation, site file research and literature review, and field studies. A reconnaissance-level historic structures survey will be conducted to gather information on known historic architectural resources in the Projects' APE and to identify buildings, structures, objects, sites and districts for possible further intensive-level survey. Existing information will be collected from records maintained at the Massachusetts, Vermont, and New Hampshire SHPOs, state and local libraries and historical societies, the Library of Congress, and the National Register in Washington, DC.

The area of investigation will include the FERC-defined APE as identified in the PAD, which includes the Projects' boundaries and any construction, recreational, or known locations affected by project operation outside of the Projects' boundaries. The Project APE is further defined by FERC as: "the lands enclosed by the Projects' boundary and lands or properties outside of the Project's boundaries where project construction and operation or project-related recreational development or other enhancements may cause changes in the character or use of historic properties, if any historic properties exist." The Massachusetts, Vermont, and New Hampshire SHPOs will be consulted for concurrence with or refinement of this definition. A detailed map of the APE will be prepared and included in the Study Report.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goal of the study is to assist FERC in meeting its compliance requirements under Section 106 of the NHPA, as amended, by determining if licensing of the Project will have an adverse effect on historic properties.

The objective of the study is to identify cultural resources listed in or eligible for listing in the NRHP. If it is confirmed that historic properties are present, FirstLight with then move forward to identify and assess any potential adverse effects to historic properties from the continuing operation and maintenance of the Project.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

Section 106 of the National Historic Preservation Act (1966) requires that federal agencies, licensees, and those receiving federal assistance take into account the effects of proposed undertakings on any resource that is listed on or is eligible for the NRHP. As the lead agency, FERC is responsible for fulfilling the requirements of Section 106 in its decision to issue a new license to the Projects.

As stipulated by the regulations that implement Section 106 (36 CFR 800), the Massachusetts, Vermont, and New Hampshire SHPOs represent the interests of their respective States and their citizens, and advise and assist FERC in determining the significance of cultural resources within the APE. FirstLight proposes consulting closely with the SHPOs in the development of the survey methodology, identification of existing cultural resources and effects, establishment of its APE, and development of a PA and HPMP, if needed.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

European settlement in the Connecticut River basin in what was to later become Northfield Township and the Town of Gill occurred as early as 1672. During King Phillip's War in 1676, Peskeopscut (Turners Falls) was the site of a military encounter between colonial forces under Captain William Turner and Native Americans. Following the American Revolution, transportation improvements included construction of the Upper Locks and Canal (1792-98) from Turners Falls to Montague. After the Civil War, Turners Falls developed as an important center of manufacturing with the establishment of the Turners Falls Company in the early 1870s. In the 1890s, Turners Falls continued to expand with construction of a new paper mill, shoe factory, and leather manufacturers.

The Turners Falls Historic District, containing residential, commercial, and industrial buildings and structures associated with the nineteenth-century industrial history of Turners Falls, and including historic resources located within the Project boundaries, was listed in the National Register in 1982. Because there have been no comprehensive architectural surveys conducted within the Projects' APE, there is the potential for other NRHP-eligible resources located within the Projects' boundaries in Massachusetts, Vermont, and New Hampshire. These resources will be identified during reconnaissance- and intensive – level architectural surveys proposed by FirstLight.

Project Nexus (18 CFR § 5.11(d)(4))

The proposed reconnaissance-level historic structures survey will provide information on known (previously identified) historic resources within the Projects' APE and the location of resources that may be recommended for further intensive survey. Following further consultation with the appropriate SHPOs, the intensive-level survey, if any, will seek to provide information on resources potentially eligible for NRHP listing. Once NRHP eligibility determinations have been obtained for the intensively surveyed resources, potential effects to these historic properties by continued Project operations will be assessed. Information developed during the course of the intensive survey will be used as the basis for preparing an HPMP. Guiding the Licensee's actions relating to Section 106 during the term of the new license, the HPMP will discuss how to avoid potential adverse effects or how they will be mitigated. The final HPMP will be filed with the license application.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Task 1 – Meeting with the Massachusetts, Vermont, and New Hampshire SHPOs

FirstLight will consult with the Massachusetts, Vermont, and New Hampshire SHPOs to reach concurrence with respect to the precise APE for the Projects, the development of historic contexts, and field reconnaissance methodology.

Task 2 – Background Research

FirstLight proposes to examine architectural site files (not available on-line), cultural resources reports, National Register nominations, historic maps and atlases, and building records located at the Massachusetts, Vermont, and New Hampshire SHPOs and other research repositories, such as the Great Falls Discovery Center in Turners Falls, the Pocumtuck Valley Memorial Association in Deerfield, local libraries and historical societies, and at FirstLight's offices.

Task 3 – Development of Historic Contexts

FirstLight will use the results of the background research to develop historic contexts to guide the field reconnaissance and will consult with the SHPOs regarding the historic contexts.

Task 4 – Field Reconnaissance

FirstLight also proposes to conduct field reconnaissance ("windshield survey") of the Turners Falls Project and Northfield Mountain Project APE to identify architectural resources (buildings, structures, objects, and districts) 50 years or older. Survey methods will follow the relevant SHPO professional standards and guidelines. FirstLight will employ professionally qualified architectural historians, who meet the *Secretary of the Interior's Standards*.

Task 5 – Report Development

FirstLight will develop a report that contains a record of its consultation with the SHPOs, a summary of the background research, a description of the historic contexts, results of the windshield survey, maps of the APE, and recommendations to conduct an intensive-level architectural survey, depending on the results of the reconnaissance-level survey and after consultation with the SHPOs.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The estimated costs for the background research and windshield survey to identify 50-year-and-older resources within the Projects' APE are approximately $30,000 to $40,000. Costs associated with the intensive-level survey and assessment of effects will be developed following consultation with the SHPOs on the results of the reconnaissance-level survey. FirstLight believes that the proposed level of effort is adequate to obtain initial information on historic resources within the Projects' APE.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

In accordance with 18 CFR § 5.15(c), a Study Plan Meeting will be held on May 14, 2013. The purpose of the Study Plan Meeting will be to informally resolve any outstanding issues with respect to FirstLight's PSP and the study requests filed by stakeholders, and to clarify the PSP and any information gathering and study requests. The *Reconnaissance-Level Historic Structures Survey* will be conducted in 2014.

Study reporting will be conducted in accordance with FirstLight's Process Plan and Schedule (18 CFR § 5.6(d)(1)), as provided in the PAD, and the FERC's SD1.

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3.8 Developmental Resources

3.8.1 Evaluate the Impact of Current and Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation

General Description of Proposed Study

A simulation model of the Connecticut River Basin will be used to evaluate the impacts of current and potential alternative modes of operation in the Project area on the timing and magnitude of river flows. Output from the model--- specifically flow data—will be used in other studies to evaluate the impact of current and potential alternative modes of operation on water surface elevations (hydraulic model) and aquatic habitat.

The Connecticut River Joint Commission (CRJC) requested a Connecticut River basin-wide stormwater model. The goals and objectives of the CRJC's study request refer to stormwater; however, the proposed methodology refers to a simulation model as described further below. FirstLight contacted the CRJC to clarify whether they are seeking a basinwide stormwater runoff model or a simulation; it appears they are seeking the latter (simulation model).

Study Goals and Objectives (18 CFR § 5.11(d)(1))

The goals and objective of this study are to:

- To develop a baseline model of the Connecticut River Basin—specifically the reach from TransCanada's Wilder Project to the Holyoke Project-- which includes the following hydropower facilities: TransCanada's Wilder, Bellows Falls, and Vernon Hydroelectric Projects, FirstLight's, Turners Falls Hydroelectric Project and Northfield Mountain Project and Holyoke Gas and Electric's Holyoke Hydroelectric Project.

- The model will be used to determine the impact on hydropower generation and economics due to potential alternative modes of operation. Potential alternative modes of operation could include minimum flows in the bypass reach, changes in the Turners Falls Impoundment fluctuations, changes in operation of the Turners Falls Project relative to peaking operations, etc.

- Flow data generated from the model will be used to inform other studies, notably the hydraulic model and instream flow study.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

FirstLight proposed to develop an operations model of the Wilder, Bellows Falls, Vernon, Northfield Mountain, Turners Falls and the Holyoke hydropower facilities in the PAD.

The FRCOG Study Request No. 6 is entitled "*.Model River Flow and Water Levels Upstream and Downstream from the Turners Falls Project Dam Generating Stations and Integration of Project Modeling with Upstream and Downstream Facilities"*. FRCOG is requesting the development of a river model to evaluate the impact of Project operations on flows and water levels in the Project area.

The FRCOG Study Request No. 7 is entitled "*Develop a Comprehensive and Predictive Model of the Electric Generation System Consisting of Five Generation Projects along the Connecticut River to study the Impact and Feasibility of Various changes in Operations on Environmental Resources.* The FRCOG

notes that the study objective is to determine whether operating the system (Wilder, Bellows Falls, Vernon, Northfield Mountain, and Turners Falls) as a whole under a single set of operation parameters could serve to mitigate the environmental impacts of current operations.

FirstLight believes that both of FRCOG's study requests can be addressed in the proposed simulation model of the Connecticut River Basin.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

The Nature Conservancy (TNC), USGS, USACE, and University of Massachusetts (UMass) at Amherst ("Project Partners") have developed a simulation and optimization model of the Connecticut River Basin. Software used for the simulation model is the USACE Hydrologic Engineering Center Reservoir Simulation model or HEC-ResSim. The optimization model was developed using software called LINGO. FirstLight has been working with Project Partners and provided them with engineering and operations data on the FirstLight facilities to enter into the HEC-ResSim model. Project Partners have provided FirstLight with the HEC-ResSim model of the Connecticut River Basin. HEC-ResSim is a simulation model and operates based on a set rules and constraints set by the modeler. The Connecticut River simulation model was developed on a daily time step for the period 1960 to 2003.

Daily inflow for the model was developed by the USGS using its Connecticut River Unimpacted Streamflow Estimation (CRUISE) model. FirstLight is using the same daily inflow data, but will convert it to an hourly time step using straight line interpolation.

Project Nexus (18 CFR § 5.11(d)(4))

Potential changes in project operations at the three TransCanada Projects and FirstLight Projects will have a direct impact on the generation and economic viability at the Turners Falls Hydropower Project and the Northfield Mountain Project. Output from the model, most notably time varying flows, will be used in other studies (hydraulic model, instream flows study).

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

FirstLight proposes to conduct the following tasks using the HEC-ResSim simulation model.

Task 1. Modify Model

The Project Partner model provided to FirstLight is on a daily time step. FirstLight will modify the model such that daily unregulated flow data is converted to an hourly time using straight line interpolation. In the end, an hourly time step model will be developed for the period 1960 to 2003. The model provided by Project Partners will be refined further to better simulate the timing of pumping and generating cycles at Northfield Mountain and the use of reservoir storage in the upper and lower reservoirs. Other modifications to the model will include: a) properly simulating the timing and magnitude of fish ladder flows, attraction flows, bypass flows, and b) properly simulating the use of upper and lower reservoir storage.

Task 2: Calibration

The model will be calibrated to flow and generation using observed data for a recent year such as 2002 or 2003[26]. Relative to flow, the model predicted daily (and hourly) hydrograph will be compared against the daily (and hourly) hourly hydrograph at the USGS Gage in Montague City, MA, located below Cabot Station. Comparing model predicted flow and observed flow at the gage will indicate if the model is reasonably matching the timing and magnitude of streamflow. In addition to flow, total monthly generation predicted by the model will be compared to the observed monthly generation at the three TransCanada Projects, Northfield Mountain Project and Turners Falls Project. It will be important to review the FirstLight log sheets to determine if there were any station or individual unit outages as the model will not account for outages. The model would over-predict generation if there is a prolonged outage. Based on flow and generation findings, some fine tuning of the HEC-ResSim model may be needed to match observed conditions.

Note that the year selected for calibration (2002 or 2003) may not represent the current project equipment. For example, say in 2007 the turbines at Cabot Station were upgraded meaning that the turbine efficiency would be improved over the turbines in place in 2002 or 2003. For calibration purposes, FirstLight will rely on the equipment installed during the years selected for calibration.

Task 3. Establish Baseline Model

Once the model is calibrated, it will be updated to reflect today's equipment and operating conditions and is termed the baseline model. Output from the baseline model including generation, flows and water levels will be used as a basis of comparison to any other model runs.

Task 4. Production Runs

A production run is considered any change made to the baseline model. The HEC-ResSim model allows for simulating alternative modes of operation based on a set of constraints and rules. Alternative modes of operation that can be simulated in the HEC-ResSim model include:

- Changes in the allowable water level fluctuation in a given reservoir;
- Changes in the magnitude and timing of bypass flows;
- Changing the magnitude and timing of fishway flows and attraction flows;
- Changes in the timing and magnitude of hydropower releases;
- Placing maximum discharge constraints on hydropower releases
- Changing the hydraulic capacity at a given facility.

If a stakeholder seeks an alternative mode of operation, such as maintaining bypass flows, the impact on generation, reservoir water levels and flows can be compared between this "Production Run" and the baseline model.

[26] The inflow data for the model provided to us by TNC terminated in 2003.

Task 5. Use of Model Output for other Uses

Output from the HEC-ResSim model will be used to inform other studies. For example, Study No. 3.3.1 *Conduct Instream Flow Habitat Assessments in the Bypass Reach and below Cabot Station* will include a habitat time series analysis. The hourly discharge hydrograph from the model at Montague City will be matched with the habitat versus flow relationship developed as part of the Study No. 3.3.1 to generate hourly varying habitat.

Task 6. Report

A report will be developed documenting the model inputs (engineering data, physical data, and flow data), and results from the calibration model, baseline model and Production Runs

Level of Effort and Cost (18 CFR § 5.11(d)(6))

Because FirstLight is using the HEC-ResSim model initially developed by the Project Partners, the level of effort is less than if developing the model from scratch. However, the model provided to FirstLight will still require significant updates to reflecting the intra-day operation and dispatch of the project, which cannot be simulated in a daily time-step model. Model calibration, establishment of a baseline model, development and simulation of Production Runs and a report are needed. The estimated cost of the modeling effort is on the order of $100,000 to $125,000.

Study Schedule (18 CFR § 5.11(b)(2) and (c))

Development of the simulation model does not require the collection of any field data. As such, FirstLight plans on completing model calibration and establishing a baseline model in 2013. Additional modeling of will be conducted in 2014 and 2015 as field studies are completed that will better inform potential Production Runs. For example after the instream flow study is complete, it will be used to inform potential bypass flows, which will be simulated in the model to evaluate impacts on generation.

4.0 STUDIES NOT INCLUDED IN THE PSP

The following section describes the studies not included in FirstLight's PSP.

4.1 Geology and Soils

4.1.1 Study of Shoreline Erosion Caused by Northfield Mountain Pumped Storage Operations

The following groups requested the same study: FRCOG, CRWC, FCD, Town of Gill, and LCCLC. In addition, NHDES and VANR requested a similar study titled *Vernon and Turners Falls Hydroelectric Projects: Shoreline and downstream erosion from water level fluctuation in the impoundment and downstream from peaking operations in New Hampshire.*

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

Proponents state that the study objectives would be to: (1) calculate the total volume of eroded material, calculate resulting nutrient loading of eroded material, and document and describe the three dimensional changes to 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 Project came on-line; (2) document and describe the changes to banks upstream and downstream of riverbank restoration projects, including bank recession; and (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 (18 CFR § 5.9(b)(2))

FRCOG, CRWC, FCD, Town of Gill, and LCCLC are not resource agencies.

Public Interest Considerations (18 CFR § 5.9(b)(3))

Proponents state that fish and wildlife are important public resources and as such it is in the public interest to maintain high quality habitat for migratory diadromous fish. Further, the proponents indicate that 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 Turners Falls Dam reduced the quality of habitat for these species.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

Proponents note several existing studies, including those contained in the PAD relative to Turners Falls Impoundment erosion, including past FRR's, Field Geology Services' 2007 fluvial geomorphic assessment of the Turners Falls Impoundment, and the 2012 investigations conducted by Simons and Associates. The proponents note that historic aerial photography of the Turners Falls Impoundment from 1929 aerials should be gathered and analyzed.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

Proponents state that the construction of the Northfield Mountain Project was contingent upon the raising the Turners Falls Dam crest elevation by 5.9 feet which in turn has lead to water level fluctuations and increased boat activity. As a result, the proponents' state that erosion caused or contributed to the Northfield Mountain Project operation can negatively affect spawning, rearing and migratory habitat for trust species and the endangered shortnose sturgeon.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

Proponents' methodology includes:

1. 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. 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. 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 underlying the surfaces;

6. An analysis on the degree to which boat wakes increase that fluctuation range;

7. Determine erosion and riverbank failure process at identified sites;

8. Determine the effects of erosion on other resources; and

9. Develop a Shoreline Management Plan

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

Proponents' state: "*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 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 some of the data collection could be done while other field studies are occurring*."

FirstLight's Rationale for Not Adopting the Proposed Studies

FirstLight does not see the need to conduct historical analysis of soil loss, erosion, nutrient loading, topography, or other geomorphic principles as requested for numerous reasons. First, as FirstLight has explained in many past FERC filings, rivers naturally migrate causing natural bank erosion, especially in the alluvial soils such as those flanking the Turners Falls Impoundment. Erosion could be caused by natural high flows, Project operations, boat wakes, upland management practices and other reasons. Thus, it is unclear why understanding the cubic yards of bank erosion in the impoundment is necessary. Second, in its *Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,* FERC reiterates that FERC uses current conditions as its baseline for evaluating project effects and alternatives and that this consists of the environment as it exists at the time of licensing.[27] FirstLight believes that the request is seeking a comparison to pre-raising-of-the-dam conditions. Finally, it is unclear how the requested data would inform potential PME measures. Additionally, FirstLight is not proposing to conduct topographic mapping or LiDAR along the 20-mile long Turners Falls Impoundment as existing topography is available from other sources and it is expensive. FirstLight will rely on the existing upland mapping obtained from USGS National Map Viewer- more specifically, the USGS 10 meter digital elevation model (DEM).

Relative to the long term monitoring transects as noted in a footnote in Field, 2007: *FirstLight has independently reviewed the 21 cross sections and checked the over 400 individual data sets and determined that a small percentage of them are suspect and should not be used for analysis. Therefore, it appears the problem is not extensive and it is unlikely the results of the analysis will change. FirstLight is working to resolve the matter.* For future monitoring, the cross sections will be monumented to allow for repeated measurements and they will extend into the floodplain.

FirstLight is proposing in Study No. 3.1.2 *Northfield Mountain/Turners Falls Project Operations Impact on Sediment Transport* to: (1) develop soils maps as a GIS overlay for use in field investigations, reducing the soil groupings to common types- likely ten, to more easily identify easily erodible soils as requested; (2) evaluate surficial mapping in locations where active or recent streambank erosion is occurring. Fixed recoverable cross-sections will be taken only in the areas of erosion; (3) analyze soils (classification, structure, parent material, etc.) at each transect; (4) conduct an analysis of water level fluctuations; and (5) analyze field collected data on boat (July 12-13, 1997 and July 26-27, 2008). In addition, some information on the number of boats will be obtained as part of the recreation studies; however, FirstLight is not proposing to collect the level of detail sought in the study request.

In regard to the NHDES and VANR request, components of the objectives described in Task 7 and 8 are captured in Study No. 3.1.1 *2013 Full River Reconnaissance Study* and Study No. 3.1.2 *Northfield Mountain/Turners Falls Project Operations Impact on Sediment Transport* therefore FirstLight is not proposing to collect the level of detail sought in the study request. FirstLight is not proposing to develop a Shoreline Management Plan as requested in Task 9.

[27] *Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,* at p. 14 (Federal Energy Regulatory Commission, Office of Energy Projects, March, 2012)

4.1.2 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.

The following groups requested the same study: FRCOG, CRWC, FCD, Town of Gill, LCCLC, and NHFGD.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

Proponents state that the study objectives would be to: (1) 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; (2) identify management measures to minimize erosion and sedimentation; (3) 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; and (4) 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 (18 CFR § 5.9(b)(2))

FRCOG, CRWC, FCD, Town of Gill, and LCCLC are not resource agencies.

NHFGD state that in order to meet the objectives of the federal Clean Water Act, MADEP adopted the Massachusetts Surface Water Quality Standards, 314 CMR 4.00. Additionally NHFGD notes, MADEP has designated the Connecticut River as a Class B river for its entire length in Massachusetts, 314 CMR 4.06(5). Class B rivers are assigned the designated uses of habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation, 314 CMR 4.05(3)(b). 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 anti-degradation provisions of 314 CMR 4.04 require protection of all existing and designated uses of water bodies, and maintenance of the level of water quality needed to protect those uses.

Public Interest Considerations (18 CFR § 5.9(b)(3))

Proponents state that Connecticut River is a valued public resource and that the public has a strong interest in protecting the water quality of the river to maintain its status as a Class B river, as designated by MADEP, 314 CMR 4.06(5).

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

Proponents note that 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. The entities also note the implementation of the *Sediment Management Plan* (revised February 15, 2012) and the *Erosion Control Plan for the Turners Falls Pool of the Connecticut River* (Simons & Associates, Inc. dated June 15, 1999).

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

Proponents state that current water level fluctuations in the Turners Falls Impoundment, combined with proposed increased flow at the Northfield Mountain Project, have resulted/will result in the discharge of large quantities of sediment. Additionally, the proponents assert that 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.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

Proponents' methodology includes:

1. Implementing the Northfield Mountain Pumped Storage Project *Sedimentation Management Plan* over the full range of river flows and pumping/generating cycles. 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;

2. Add one suspended sediment monitoring site downstream of the tailrace. If equipment continues to be problematic, explore other options. Provide data representative of tailrace discharge conditions and river conditions for two years;

3. 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;

4. Identify the most appropriate techniques for bank stabilization given the existing and proposed hydraulic conditions;

5. 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;

6. Identify recreational uses and impacts in areas known to be impacted by accumulated sediment, such as Barton Cove;

7. 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;

8. 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;

9. 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;

10. Evaluate management strategies to minimize flow fluctuations within Turners Pool including coordination with upstream users;

11. 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;

12. Identify a prioritized list of locations for bank stabilization projects in the Project Area;

13. 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;

14. 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;

15. Identify measures that could be taken to mitigate impacts to recreational use, habitat, or invasive species from sedimentation; and

16. Identify measures that could be taken to change or mitigate sediment starved reaches below the Turners Falls dam.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

Proponents' state: "*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 should accomplish many of the objectives listed above*."

FirstLight's Rationale for Not Adopting the Proposed Studies

The majority of the tasks outlined in the Proponents' methodology are included in other studies found in the PSP, including:

- Study No. 3.1.1 *2013 Full River Reconnaissance Study* (Tasks 4, 12, 13);
- Study No. 3.1.2 *Northfield Mountain/Turners Falls Operations Impacts on Sediment Transport* (Tasks 3, 4, 8);
- Study No. 3.2.2 *Hydraulic Study of Turners Falls Impoundment, Bypass Reach, and below Cabot Station* (Tasks 3, 10, 16);
- Study No. 3.3.13 *Impacts of the Turners Falls Project and Northfield Mountain Project on Littoral Zone Fish Habitat and Spawning Habitat* (Tasks 7, 15);
- Study No. 3.3.14 *Aquatic Habitat Mapping of Turners Falls Impoundment* (Tasks 7, 15);
- Study No. 3.3.17 *Assess the Impacts of Project Operations of the Turners Falls Project and Northfield Mountain Project on Tributary and Backwater Area Access and Habitat* (Tasks 7, 15);

- Study No. 3.4.1 *Baseline Study of Wildlife and Botanical Resources at Northfield Mountain Project Area, Turners Falls Impoundment, the Bypass Reach, and below Cabot Station* (Tasks 7, 15);
- Study No. 3.5.1 *Baseline Inventory of Wetland, Wildlife, and Botanical Resources in the Turners Falls Impoundment, Bypass Reach, and Below Cabot Station and Assessment of Operational Impacts* (Tasks 7, 15); and
- Study No. 3.6.6 *Assessment of Effects of Project Operations on Recreation and Land Use* (Task 6, 15)

Tasks 1, 2, and 9 of the Proponents' methodology are included in FirstLight's *Sediment Management Plan* (filed with FERC February 15, 2012). 2013 field activities are currently underway including continuous suspended sediment monitoring at the Route 10 Bridge, continuous suspended sediment monitoring of the intake and discharge lines at the Northfield Mountain Project, and suspended sediment data collection of the entire cross section of the river at the Route 10 Bridge over a range of flows during a one month period. At the end of the monitoring period (2015) FirstLight will propose measures to address the entrainment of sediment into the Project works during upper reservoir drawdown or dewatering activities.

FirstLight does not believe that it is necessary to install an additional suspended sediment monitoring device as requested in Task 2. Suspended sediment monitoring activities outlined in the *Sediment Management Plan* are more than adequate to provide the data requested above and have been approved by FERC, EPA and MADEP. Data collected at the Route 10 Bridge using the LISST-StreamSide, combined with the LISST-SL, will provide a detailed picture of suspended sediment in the mainstem Connecticut River. LISST-HYDRO devices located in the Northfield Mountain Plant are installed in-line to capture water withdrawn from the Northfield Mountain tailrace during pumping and transferred from the upper reservoir to the tailrace during generation. The combination of data collected at these locations will allow for a correlation to be made to determine what, if any, effects Northfield Mountain Project operations have on suspended sediment in the Connecticut River. In the *Sediment Management Plan* FirstLight proposes to continue sampling in 2013 and 2014, but may propose modifications to the sampling program based on sampling results.

FirstLight does not see the need to conduct historical comparisons of bathymetric data, or any geomorphic historical comparisons, for numerous reasons. First, as FirstLight has explained in many past FERC filings, rivers naturally migrate causing natural bank erosion, especially in the alluvial soils such as those flanking the Turners Falls Impoundment. Erosion could be caused by natural high flows, Project operations, boat wakes, upland management practices and other reasons. Therefore, sediment accumulation found throughout the Project area could be caused by several factors. Thus, it is unclear why understanding the historical changes in bathymetry, or other geomorphic processes, is required. Second, in its *Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,* FERC reiterates that FERC uses current conditions as its baseline for evaluating project effects and alternatives and that this consists of the environment as it exists at the time of licensing.[28] FirstLight believes that the request is seeking a comparison to pre-raising-of-the-dam conditions. Finally, it is unclear how the requested data would inform potential PME measures. Additionally, FirstLight is not proposing to conduct topographic mapping or LiDAR along the 20-mile long Turners Falls Impoundment as existing topography is available from other sources and it is expensive. FirstLight will rely on the

[28] *Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,* at p. 14 (Federal Energy Regulatory Commission, Office of Energy Projects, March, 2012)

existing upland mapping obtained from USGS National Map Viewer- more specifically, the USGS 10 meter digital elevation model (DEM).

FirstLight does not use the spillway gates or log sluice located near the bottom of the forebay adjacent to the Cabot Powerhouse during canal dewatering activities as suggested in Task 10, therefore management strategies to minimize sediment release will not be evaluated.

In regard to Task 16, it is FirstLight's belief that due to a combination of factors including the bed substrate of the Bypass channel, flood flows, and other hydrologic/hydraulic considerations discussed in Study No. 3.2.2 that mitigation of sediment starved reaches below the Turners Falls Dam is not feasible. Stream power through the upper portion of the bypass reach where bedrock outcroppings are located during high flows is high enough to scour any sediment deposition that may occur.

4.2 Water Resources

4.2.1 Watershed Wide Stormwater Model

The CRJC requested a watershed-wide stormwater model of the entire Connecticut River Basin.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

CRJC lists the study's goals as (1) take a cumulative watershed approach to the management of surface water, a public trust resource; (2) determine the effect on public interests from projected future stormwater flows and the operation of the dams; and (3) recommend measures to manage stormwater flows through the operation of the dams to protect public interests. CRJC lists the study's objectives as (1) identify public interests in the watershed that have a nexus to dam operations; (2) develop an integrated, sharable, and scientifically-rigorous stormwater model for the entire watershed; (3) assess the cumulate effect of the dams on public interests, and (4) recommend license conditions to protect, preserve and enhance public interests.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

CRJC is not a resource agency.

Public Interest Considerations (18 CFR § 5.9(b)(3))

CRJC states that the public needs to know the effects the dams and their operations have on the natural and human environment, particularly in the future when CRJC believes precipitation is expected to be more extreme. CRJC also states that the public needs to know if and how the dams can be operated to benefit public interests in addition to hydropower. CRJC further states that the dams are the most significant factor in regulating stormwater flows in the Connecticut River.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

CRJC states that existing data on the location of resources of concern, while well intentioned, are too often incomplete or inaccurate. They state that since instream and riparian uses are closely tied to the frequency, depth and duration of the inundation by the river, stormwater information needs to be modeled and modernized, as precisely as possible, for accurate application.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

CRJC states that stormwater flows in the river effect nearly every resource under study, from providing whitewater recreational activities to sustaining floodplain biological communities. They state that the dams, in which they impound and then release the water, relies entirely on available stormwater.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

CRJC states that the proposed approach to analyzing water flows is the preferred methodology for forecasting, and evaluating environmental and economic outcomes based on various dam management scenarios. They state that this approach is being utilized in the Connecticut River Watershed Restoration Project that is being undertaken by TNC, USACE, UMass, and the USGS. CRJC states that this study is being performed to help determine how management of large mainstem and tributary dams and water

systems can be modified for environmental benefits while maintaining beneficial human uses such as water supply, flood control and hydropower generation.

CRJC notes that use of LiDAR is the preferred methodology for preparing digital elevation models. They noted the use of LiDAR at various locations; however, further detail on the method(s) to evaluate stormwater flows is not provided.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

CRJC states that development of the proposed stormwater model using LiDAR data could cost $2,000,000 or more.

FirstLight's Rationale for Not Adopting the Proposed Studies

It is unclear from CRJC's study request if they are truly seeking a basin-wide stormwater runoff model as the proposed methodology does not provide enough detail. FirstLight believes that two other studies proposed herein will address the CRJC's study objectives and goals. Those studies, and how they would aid in addressing the CRJC's concerns, are listed below.

3.2.2 *Hydraulic Model of Turners Falls Impoundment, Bypass Reach and below Cabot Station*

FirstLight is proposing to develop two hydraulic models. A HEC-RAS hydraulic model of the Turners Falls Impoundment has already been developed. This model will predict the water surface profile of the Turners Falls Impoundment under a range of flows and starting downstream boundary conditions (in short, the water level at the Turners Falls Dam). This model was developed using bathymetric data collected in 2006. The second model will extend from Turners Falls Dam to the Holyoke Dam and will require use of the existing flood insurance study data for the communities along this reach of the river. The model will provide information on water surface elevations at different locations based for a range of flow conditions and project operations..

3.8.1 *Evaluate the Impact of Current and Potential Future Modes of Operation on Flow, Water Elevation and Hydropower Generation*

FirstLight is proposing to use an existing HEC-ResSim model of the Connecticut River basin that was originally developed by TNC, USACE, UMass and the USGS—the same model as cited by CRJC in their proposed methodology. This model will evaluate how current and alternative modes of operation can impact streamflow, water elevations and hydropower generation.

FERC's Study Request criteria require that the requester explain any nexus between project operations and effects on the resource to be studied, and how the study results would inform the development of license requirements 18 CFR § 5.9(b)(5). FERC's handbook "*A Guide To Understanding And Applying The Integrated Licensing Process Study Criteria*," issued March 2012, provides explanation on how FERC applies the study plan criteria in evaluating study requests. Per the guideline, relative to project nexus, it states the study request should clearly explain the connection between the project and its potential effect on the applicable resource. FirstLight does not see a nexus between the project and stormwater runoff, especially in the entire Connecticut River Basin. The only nexus between the project and the timing and magnitude of stormwater runoff the limited area of impervious surfaces associated with the project. CRJC's study request – a stormwater model of the entire Connecticut River Basin- has no nexus to the FirstLight hydropower facilities.

Also, per the guideline 18 CFR § 5.9(b)(6), under proposed methodology the requester is required to explain how any proposed study methodology is consistent with generally accepted practices in the scientific community. The guidance document further notes that the study methodology should be as detailed as possible. It was difficult for FirstLight to understand CRJC's proposed methods as it was detailed and intertwined operations modeling and stormwater modeling.

FirstLight believes that CRJC's request fails to meet FERC's nexus and methodology criteria. However, FirstLight believes that the combination of the hydraulic and operations models will address CRJC's concerns.

4.2.2 Climate Change and Continued Project Operations

The Town of Gill, LCCLC, MADFW, CRWC, NHDES, and the USFWS requested studies on climate change as it relates to continued operation of the projects.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

The Proponents share the same study objectives: (1) quantify thermal loading contributed by each impoundment at each of the hydroelectric projects on the mainstem Connecticut River upstream through Wilder; (2) predict increases in temperature of the impoundments in the next 30-50 years due to climate change; (3) model the effect of various project modifications on river temperature under current conditions and climate change predictions; (4) use climate change prediction models to determine if the projects mitigate for generally warmer air and water temperatures by producing low greenhouse gas-emitting energy; and (5) determine how climate change will impact management of high flow events and whether changes to the dam structures would mitigate any adverse impacts of the existing project flood management protocols.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

USFWS states that the proposed study would help it accomplish its general goals of: (1) ensuring that PME measures are commensurate with project effects in order to meet regional fish and wildlife objectives; and (2) conserve, protect, and enhance fish and wildlife habitat affected by the projects. With specific reference to climate change, USFWS states that its goals are to minimize: (1) current and potential negative effects of project operations; (2) deep headpond drawdowns associated with the loss of stanchion logs, which it anticipates will increase due to more frequent climate change induced high flow events; and (3) project-related thermal increases to Connecticut River water temperatures. USFWS and others have developed a National Fish, Wildlife and Plants Climate Adaptation Strategy (Adaptation Strategy) which includes, among other actions, reducing non-climate stressors in order to help fish and wildlife adapt to climate change.

MADFW's statement of resource management goals is identical to USFWS's statement. MADFW further states that the study will facilitate collection of information needed to conduct effects analyses and develop PME measures. The Massachusetts Executive Office of Energy and Environmental Affairs has published the Massachusetts Climate Change Adaptation Report which identifies various strategies to preserve, protect, and restore natural habitats and the hydrology of watersheds.

NHDES states that it is responsible for issuing water quality certifications in New Hampshire under the Clean Water Act and for establishing and administering surface water quality standards. Surface water quality standards include designated uses, which include aquatic life, fish consumption, drinking water, recreation, and wildlife. NHDES also establishes criteria to protect the designated uses and meet the anti-degradation requirement. NHDES states that its surface water criteria for Biological and Aquatic Community Integrity provide for surface waters to maintain a balanced, integrated, and adaptive community of organisms with species composition, diversity and functional organization comparable to similar natural habitats, and that climate change effects on flow and temperature may impact aquatic life and other uses.

Public Interest Considerations (18 CFR § 5.9(b)(3))

CRWC states that the public has a strong interest in protecting and enhancing the fish, wildlife, and plants that depend on the Connecticut River and associated wetlands, banks, and floodplain habitats, and that the

study will enable the potential climate change induced effects on these resources and consider potential measures to minimize ecosystem degradation and enhance adaption to climate change.

LCCLC and Gill state that they support the USFWS's resource management goals.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

Proponents all include identical discussions of existing information. They state that the PADs for FirstLight's and TransCanada's projects contain no information relative to climate change and how climate change predictions may impact future operation of the projects, or how the projects either mitigate for or exacerbate predicted climate change impacts to freshwater ecosystems.

The proponents state that TransCanada's PAD includes data showing that water temperatures increase from the upstream end of the Wilder Project headpond to the Vernon Project tailrace, but do not link the data to climate change. They also state that TransCanada's project uses stanchion bays to relieve high water levels, but there is no information on how frequently the stanchions are removed or how climate change might affect the frequency and seasonality of removal, with potential impacts to resources in the project reservoirs.

The proponents provide data collected by the National Marine Fisheries Service that shows increasing air temperatures in the Northeast since 1900. They also provide analyses showing that mean water temperatures for the Vernon Dam impoundment increased between 1974 and 2010.

The proponents also reference the summary in the PAD of water quality data for the Turners Falls and Northfield Mountain Pumped Storage (NMPS) projects, and a 1991 study that showed a maximum temperature difference in the Turners Falls reach attributable to the NMPS project operation of 0.21 degrees Celsius.

Proponents' Explanation of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

The proponents state that the projects which dam the Connecticut River have created a series of long impoundments with slow water velocities that cause increased thermal loading and higher water surface temperatures than in free flowing sections of the river. They add that warmer surface waters may be discharged downstream and with a cumulative impact of elevated downstream temperatures. They add that climate change models of the Northeast forecast warmer air temperatures, more frequent high precipitation events, more heat waves, and increased incidence of short-term droughts. They indicate that effects include potential impacts to populations or loss of species not tolerant of warmer temperatures, citing potential impacts to American shad migration as an example. With regard to TransCanada's projects, the proponents state that deep drawdowns from removal of stanchions during high flow events could adversely affect reservoir resources, and that such drawdowns could occur more frequently in the future.

Proponents' Explanation of how Methodology is Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

The proponents state that the study would quantify the thermal loading contributed by each impoundment using data for bathymetry, storage capacity, hydrology, and project operations. The individual impoundment and cumulative surface water temperature predictions would be used to predict future warming based on climate change models.

The study would then consider different potential measures to mitigate the effects of project and climate-change based warming, such as converting projects to run-of-river, making deep-water releases, removing dams, conducting large-scale riparian revegetation, and possibly others.

The proposed study would also "input to climate change models the amount of [greenhouse gas 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."

Climate change models would be used to predict whether the frequency and timing of high flow events is likely to change in the future. If the models predict that the frequency or timing of high-flow events necessitating the removal of stanchion bays will increase, then the proponents would have the Commission require the licensee to evaluate structural or operational alternatives to mitigate adverse impacts of existing flood management protocols.

Proponents' Description of Level of Effort and Cost, and Why Alternative Studies are Insufficient to Meet the Stated Information Needs (18 CFR § 5.9(b)(7))

USFWS does not include any information regarding level of effort and cost, or why alternative studies are insufficient to meet its stated information needs.

NHDES states that the cost of a thermal loading analysis would be low to moderate because bathymetry data for the Turners Falls Impoundment and Northfield Mountain upper reservoir already exist, and that the remaining work consists of loading data into an appropriate model and computing the estimated load, then comparing it to surface water data from climate change prediction models. It also states that the high flood protocol study should have a low to moderate cost because climate change models already exist. The comments of MDFW, CRWC, LCCLC and Town of Gill are identical to NHDES' comments.

FirstLight's Rationale for Not Adopting the Proposed Study

Although it is reasonable to conclude that the Connecticut River project impoundments affect water temperatures, and that regional air and water temperatures may be elevated in the future because of climate change, the proponents have failed to explain how their proposed study is consistent with accepted practice. While it is possible to estimate future water temperature conditions in the project impoundments with conventional hydrologic studies, monitoring techniques, and predictive models, the proponents have made no effort to explain how such water temperature data and predictions would be married with climate change models to accurately predict the combined effects of the projects and climate change on Connecticut River water temperatures over time. Indeed, they have not identified any climate change models that are sufficiently sensitive to accurately predict changes in the temperatures of individual rivers or the frequency or seasonal distribution of high flow events in the short-term, let alone for the 30-50 year period of a new license. In fact, they identify no specific models at all. The literature citations to the USFWS comments merely cite generally a 2009 report on global climate change impacts in the United States which includes a three page summary of potential impacts to the Northeast and the (now final) Adaptation Strategy. The proponents have also made no effort to show why conventional hydrologic studies, monitoring requirements, and reopener provisions that have been employed in hundreds of other hydroelectric license proceedings are not adequate to address potential impacts of climate change that, to the extent they occur, are likely to develop in an incremental manner over many years. In sum, the study proponents have asserted, but in no way shown, that their requested study is consistent with accepted practice.

The proponents' failure to articulate a detailed, credible study proposal for linking regional climate change to water temperature effects from the Connecticut River hydroelectric projects, individually or

cumulatively, is not surprising. A July 2012 report by the Columbia Law School Center for Climate Change Law, *Consideration of Climate Change in Federal EISs, 1009-2011*, reviewed a database of 227 federal agency EISs that substantively address climate change related impacts. The report finds:

> While greenhouse gas emissions from projects are frequently addressed in EISs, the effects of climate change on the proposed projects are considered far less often. *Preparing agencies face considerable scientific uncertainty about the severity and exact nature of climate change impacts at the regional level, and projections are even more difficult at the local level.* EISs of briefly analyze the impacts of climate change on the region or locality in which the project is located without addressing the direct impacts of climate change on the project itself. (p. 8) (emphasis added)

With specific regard to USFWS EISs, the study found:

> USFWS EISs address the impacts of climate change on a project primarily as they relate to specific plant and animal species. EISs address the effects of climate change on the habitat, food resources and behavior of individual species, especially those federally listed as endangered or threatened. *Analysis of the impact of climate change on a project is often limited to a brief discussion of climate impacts on wildlife species or vegetation as a secondary or compounding impact*. These species are discussed primarily in terms of their vulnerability to non-climate related impacts from the project (such as habitat loss or noise), and climate change is mentioned as an additional factor that might increase the cumulative impact on the species. (footnote omitted) (p. 11) (emphasis added)

The Commission has recognized the inadequacy of current day computer modeling to develop information useful for development of specific license requirements in several recent cases. *See*, ***e.g.***, Study Plan Determinations for the Susitna-Watana Project No. 14241 (Feb. 1, 2013) at B-8 (rejecting agency requests for comprehensive study of climate change impacts on all resources in the river basin potentially affected by the proposed projects because the results would be too uncertain to rely upon for development of license conditions, the study would be very costly, and existing hydrologic studies and monitoring techniques are sufficient to develop license conditions); Lake Powell Pipeline Project No. 12966 (Jan. 21, 2009) Appendix A at 1 at 14-16) (for proposed water supply project with hydroelectric component, accepting applicant's proposal to use literature review and existing US Bureau of Reclamation regional climate change model to estimate potential effects of climate change on Colorado River flows, but finding an absence of climate change models sufficiently finely tuned to make reservoir operation decisions); and Toledo Bend Project No. 2305 (August 6, 2009) Appendix A at 16-17 (finding no evidence of climate change assessment with the accuracy to predict specific resource impacts that could serve as the basis for developing license conditions; and determining that conventional hydrologic studies and monitoring techniques are adequate for the purpose).

In sum, the proponents have not provided any reason for the Commission to require FirstLight to develop a highly problematic study that it is unlikely to produce any information that would be useful for the development of license conditions, particularly when existing methods and approaches are sufficient to develop information that will enable the Commission, licensee, and resource agencies to develop timely, appropriate responses to climate change impacts.

4.3 Fish and Aquatic Resources

4.3.1 Shad Population Model for the Connecticut River

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

In their study request letters, USFWS, NHFG, MDFW, NHDES, CRWC, and TU request that FirstLight develop an American shad population model utilizing existing data to quantify how project operations and potential restoration/mitigation measures impact the Connecticut River shad population.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

Requesting agencies and TU identified Resource Management Goals for this study as defined by the *Management Plan for American Shad in the Connecticut River Basin* (1992). Specific management objectives in the plan include the following: achieve and sustain an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually; achieve annual passage of 40 to 60% of the spawning run (based on a 5-year running average) at each successive upstream barrier on the Connecticut River mainstem; and maximize outmigrant survival for juvenile and spent adult shad.

In addition, requests identify a number of broader resource PME goals under the overall relicensing process.

Public Interest Considerations (18 CFR § 5.9(b)(3))

USFWS is a federal resource agency. NHFG, MDFW and NHDES are state resource agencies. CRWC and TU are not public agencies.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

As described in the PAD, the annual number of adult shad passing into the impoundment below Turners Falls rose, with substantial year-to-year variation, until 1992 when numbers began to decline. This decline was not predicted by the predictive abundance model developed by Connecticut Department of Energy and Environmental Protection (CTDEEP). The decline has been noted in other Atlantic coast shad populations as well. Several factors may contribute to the recent decline in the Connecticut River American shad population. Factors include: 1) increased predation mortality, especially by striped bass (Savoy & Crecco, 2004); 2) competition by gizzard shad (Gephard & McMenemy, 2004); and/or 3) reduction of repeat spawners (Leggett et al., 2004). In 2012 the largest number of American shad were lifted at Holyoke Dam since 1992. While reports indicate that the American shad run on the St. John's River in 2012 was also higher than recent years, not all Atlantic coast river experienced similar increases.

Appendix G of the PAD identifies over 30 upstream and downstream fish passage studies that have been conducted at the Turners Falls Project going as far back as 1969 to as recently as 2010. FirstLight has worked diligently with agencies to evaluate effectiveness of fish passage facilities at the Turners Falls Project, including identification of potential improvements that FirstLight anticipates will be evaluated under the relicensing process, such as designs developed for a fish lift to replace the existing Cabot Fishway that were developed in consultation with representatives of CRASC.

Starting in 2008, biologists from the CAFRC have evaluated shad passage through the new Gatehouse Fishway entrance that was constructed in 2007. Results of these evaluations and review of shad counts conducted by FirstLight have demonstrated that shad successfully pass through the new entrance flume, and have also led to iterative modifications since operation of the new entrance was initiated. These

improvements have included the installation of flow controls within the fishway entrance gallery, modification of canal operating protocols, relocation of water level sensors, and installation of a temporary rock ramp from the bottom of the canal to the original entrance (the ramp is no longer in place).

Currently, shad appear to pass readily through the new entrance, but not through the original entrance. Flow control changes intended to ensure adequate flow through the new entrance and to the Spillway Fishway have resulted in excessive velocity and turbulence at the original entrance that may be inhibiting shad passage. FirstLight continues to work with CAFRC and agencies to assess alternative to improve passage at the original entrance.

Historic upstream passage telemetry studies have shown that the Northfield tailrace had no clear effect on shad movement through the impoundment. Some shad turned back upon reaching the Northfield tailrace both during operational and non-operational periods. More recently, the USFWS Connecticut River Coordinator and CAFRC have released radiotagged shad at various points in the river and tracked their movements from the release point to Vernon Dam. Results from that study will be available once data analysis has been completed.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

Existing project operations and fish ladder efficiencies have a direct effect on shad populations in the Connecticut River. Low upstream passage efficiencies and delays restrict river access to returning shad and can affect the ability of American shad to reach upstream spawning grounds while the ability to effectively pass downstream may affect outmigration and potential for repeat spawning.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

Population models are commonly used to assess anthropomorphic and natural impacts and are consistent with accepted practice. A model similar to this request was constructed for the Susquehanna River by Exelon (FERC #405, RSP 3.4). The model is constructed in Microsoft Access, and should be adaptable to allow the input of new data and other inputs. Proponents' listed a variety of model inputs.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

The Proponents' state: *"Neither First Light nor TransCanada have proposed any study to meet this need. Estimated cost for the study is expected to be low to moderate. As the model describes the impacts of multiple projects and two owners, both project owners would share the cost of model development."*

FirstLight's Rationale for Not Adopting the Proposed Studies

FirstLight is proposing a suite of upstream and downstream fish passage studies, an instream flow study in the Turners Falls bypass reach and downstream of the Turners Falls and Northfield Mountain Projects, and a desktop entrainment analysis for the Projects. Results of these studies, coupled with the vast number of previous American shad passage studies at the project facilities should be more than sufficient to assess fish passage needs and potential modifications to existing facilities necessary to achieve improved fish passage efficiency. Further, a predictive abundance model already exists which, while historically generating relatively accurate results, did not predict the downturn in returning shad numbers that likely result from difficult to predict variables such as competition and predation of other species. The study requests also include the ability for the model to analyze sensitivity of fish passage efficiencies at all Connecticut River Projects. While there may be a cumulative effect on the overall American shad

population in the river, efficiency at a given upstream or downstream hydroelectric facility is independent of FirstLight's fish passage facility efficiencies.

It is unclear to FirstLight how output from the requested population model will contribute to FERC's analysis of project effects and potential PME measures as compared to results of existing and proposed fish passage effectiveness testing.

Literature Cited

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Leggett, W.C., Savoy, T.F., & Tomichek, C.A. (2004). The Impact of Enhancement Initiatives on the Structure and Dynamics of the Connecticut River Population of American Shad. American Fisheries Society. 16 pp.

Savoy, T.F. & V.A. Crecco. (2004). Factors Affecting the Recent Decline of Blueback Herring and American shad in the Connecticut River. In P.M. Jacobson, D.A. Dixon, W.C. Leggett, B.C. Marcy, Jr. and R.R. Massengill (Eds.) The Connecticut River Ecological Study (1965-1973) revisited: ecology of the lower Connecticut River 1973-2003 (pp. 361-378). Bethesda, Maryland: American Fisheries Society, Monograph 9.

4.4 Aesthetic Study

4.4.1 Noise Level Determination for Northfield Mountain Project Operations

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

The Proponent states that the goal of the study is to evaluate the current level of noise produced by the Northfield Mountain Project as heard by neighbors to the project, to determine if the proposed changes to the project increase the noise level, and to mitigate any present and future noise.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

This request was made by a private citizen, not a resource agency.

Public Interest Considerations (18 CFR § 5.9(b)(3))

The Proponent states that it is in the public's interest that this project and its expansion not negatively impact the quality of life for Northfield Mountain Project's neighbors. Noise negatively impacts quality of life.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

The Proponent does not identify any existing information pertaining to noise levels at the Northfield Mountain Project.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

The Proponent states that: *"Northfield Pump Storage Project runs pumps to move water to a holding reservoir, and turbines to harvest energy from the water. Both these operations involve large equipment that makes a lot of noise. This noise may be broadband, low frequency, or infrasonic pressure or vibration. Increasing the pump and/or turbine operation in frequency, size, or number could impact the amount of noise this equipment makes, so that it is more audible to neighbors. Noise might need to be mitigated e.g. via insulation, or prescribed combinations of equipment running, etc. to reduce noise impact on neighbors."*

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

Additionally the Proponent proposes a 2-part process:

- Part A (1 year): neighbors to the project record unexplained noises including what type of noise and when, compare these lists with operating records of the Northfield Mountain Project to see if correlation exists
- Part B (1 year): If correlation exists, further study would be needed using MADEP protocols. This could be done simultaneously with Part A to increase turn-around time, or left until afterwards on the change it would not be needed. It could also be the first step in the process if Part A was not considered necessary.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

The Proponent states that the cost of determining a baseline noise level and comparing any old/new noises with operating records is relatively low. The Proponent also states, if it is determined that the Northfield Mountain Project is making noise then the cost of measuring the noise level would possibly be in the tens of thousands of dollars. Finally, the Proponent states that mitigating the noise would likely cost several hundred thousand dollars.

FirstLight's Rationale for Not Adopting the Proposed Studies

Due to the location of plant infrastructure deep inside of a mountain, FirstLight does not believe noise levels related to Project operations are at a level outside of the plant that could negatively impact the quality of life of Project neighbors. FirstLight believes the mountain, which the plant is located inside of, acts as a natural insulator of noise. This belief has been confirmed by FirstLight personnel who work outside of the mountain and have not heard excessive noise levels during Project operations. In addition, due to the unique configuration of the plant inside of a mountain, even in the event noise levels were found to be at a level effecting Project neighbors, PME measures would a) not be possible, or b) be far too expensive to be feasible.

4.5 Recreation and Land Use

4.5.1 Contingent Valuation Study

New England Flow, American Whitewater, and The Appalachian Mountain Club (collectively referred to as FLOW) have requested that FirstLight conduct a contingent valuation study of providing paddling flows (e.g., for kayaking, canoeing, whitewater rafting, instructional paddling, and paddle-boarding) in the Turners Falls Project bypass reach.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

FLOW states that the goal of the requested study is to examine the regional economic benefits of various flow release alternatives in the Turners Falls Project bypass reach.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

FLOW is not a resource agency.

Public Interest Considerations (18 CFR § 5.9(b)(3))

FLOW states that the public interest is economic stimulus.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

FLOW states that it is unaware of any existing information regarding the economic potential of the Turners Falls Project bypass reach for paddling flows. It does, however, cite to a study of the economic impacts of whitewater boating on a river in Vermont.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

FLOW states that understanding the economic values that could be provided by flow releases in the Turners Falls bypass for paddling recreation will assist FERC and other stakeholders in balancing the trade-offs associated with lost generation.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

FLOW states that the only methodology that will assess the economic value of paddling flows in the Turners Falls bypass reach is through a contingent valuation study that measures an individual's willingness to pay. FLOW also states that contingent valuation studies provide reliable, comparable information that can be used to frame license requirements.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

FLOW states that data should be collected through surveys and interviews of known paddling clubs, customers of commercial whitewater outfitters, outfitters of tubing equipment and kayakers, canoeists, and rafters of varying abilities. FLOW fails to describe the level of effort or cost that such data collection would entail or the level of effort and cost that other elements of a contingent valuation study would entail.

FirstLight's Rationale for Not Adopting the Proposed Studies

FirstLight disagrees that there is a nexus to Project operation and effects. Contingent valuation studies do not produce a reliable assessment of the potential economic impact of adding recreational opportunity to an area. Further, FERC has consistently found that monetization of non-power resources is inadequate in the context of assessing non-power values under Sections 4(e) and 10(a)(1). The Commission has stated that "for non-power resources such as aquatic habitat, fish and wildlife, recreation, and cultural and aesthetic values, to name a few, the public interest cannot be evaluated adequately only by dollars and cents."[29] In a recent Study Plan Determination, FERC did not adopt a request for a proposed economic study of non-power resources. FERC stated that "[n]othing in the [Federal Power Act] requires the Commission to place a dollar value on non-power resources. Nor does the fact that because the Commission assigns dollar figures to the licensee's economic costs require that the Commission do the same for non-power resources."[30]

FirstLight is proposing to conduct several studies related to recreational use and demand at the Turners Falls Project, including a controlled whitewater flow evaluation in the Turners Falls Project bypass reach, an assessment of access needs for paddling in the Project vicinity, and assessments of use and demand. These studies along with studies regarding other assessments of power and non-power resources at the Turners Falls Project bypass reach will provide FERC with the information it needs to craft a new license for the Project that gives equal consideration to power and non-power values and is in the public interest.

FirstLight also disagrees with FLOW's assertion that the only methodology that will assess the economic value of paddling flows in the bypass reach is through a contingent valuation study. Contingent valuation studies are not generally accepted within the scientific community. It is well settled that contingent value surveys are expensive, subject to bias,[31] and even "[s]tudies conducted in controlled experimental settings suggest that . . . contingent valuation . . . methods may overestimate values[32] producing "implausible" results[33] that fail by trying to reduce FERC's public interest test to a mere mathematical exercise."

Finally, FERC's Study Request criteria require that the requester describe considerations of level of effort and cost. 18 CFR § 5.9(b)(7). FERC's handbook "*A Guide To Understanding And Applying The Integrated Licensing Process Study Criteria*," issued March 2012, provides explanation on how FERC applies the study plan criteria in evaluating study requests. With respect to the level of effort and cost

[29] *See e.g., Great Northern Paper, Inc.,* 85 FERC ¶ 61,316 (1998), *reconsideration denied*, 86 FERC ¶ 61,184 (1999*), aff'd*, *Conservation Law Foundation v. FERC*, 216 F.3d 41 (D.C. Cir. 2000) (nothing in the FPA requires the Commission to place a dollar value on nonpower benefits; nor does the fact that the Commission assigned dollar figures to the licensee's economic costs require it to do the same for nonpower benefits.); *City of Tacoma,* 84 FERC ¶ 61,107 (1998), *order on reh'g*, 86 FERC ¶ 61,311 (1999), *City of Tacoma v. FERC*, 460 F.3d 53 (D.C. Cir. 2006).. *See also*, *Namekegon Hydro Co.*, 12 FPC 203, 206 (1953), *aff'd*, *Namekegon Hydro Co. v. FPC*, 216 F.2d 509 (7th Cir. 1954) (when unique recreational or other environmental values are present such as here, the public interest cannot be evaluated adequately only by dollars and cents); and *Eugene Water & Electric Board*, 81 FERC ¶ 61,270 (1997), *aff'd*, *American Rivers v. FERC*, 187 F.3d 1007 (9th Cir. 1999) (rejecting request for economic valuation of environmental resources that were the subject of 10(j) recommendations).

[30] Office of Energy Projects, Federal Energy Regulatory Commission, *Study Plan Determination for the Susitna-Watana Hydroelectric Project (Project No. 14241)*, February 1, 2013.

[31] Peter A. Diamond, and Jerry A. Hausman, *Contingent Valuation: Is Some Number Better Than No Number?,* Journal of Economic Perspectives, Volume 8, Number 4, Fall 1994, pp 45-64 at 45,46.

[32] National Research Council, Committee on Assessing and Valuing Aquatic and Related Terrestrial Ecosystems, *Valuing Ecosystem Services, Toward Better Environmental Decision-Making,* 2004, at 122.

[33] Kenneth Arrow et alia, *Report of the NOAA Panel on Contingent Valuation,* 1993, at 12, 13.

criteria, FERC explains that to estimate the level of effort and cost, a study proponent should, at a minimum, estimate the number of hours or person-days that would be required to conduct the requested study and identifiable tasks (e.g., report preparation). FERC states that the information gained under this criterion is also useful in weighing the costs and benefits of different methods for obtaining the needed information. While FERC may not reject a study based on cost alone, information on cost and level of effort is necessary for FERC to determine whether the requested information is in line with the magnitude of the potential effect of the Project on particular resources.

The proposed study does not meet this criterion. While FLOW states that data should be collected through surveys and interviews of known paddling clubs, customers of commercial whitewater outfitters, outfitters of tubing equipment and kayakers, canoeists, and rafters of varying abilities they fail to describe the level of effort or cost that such data collection would entail or the level of effort and cost that other elements of a contingent valuation study would entail.

In sum, FirstLight has not included FLOW's proposed study in its PSP because the proposed contingent valuation study will not inform the development of license requirements, is not accepted within the scientific community, and does not describe considerations of level of effort and cost.

4.5.2 Mitigation Impacts of the Connecticut River and Loss of Whitewater Recreation at and above Turners Falls Dam

New England Flow, American Whitewater, and The Appalachian Mountain Club (collectively referred to as FLOW) have requested that FirstLight conduct a study to assess regional whitewater boating resources in order to determine off-site mitigation.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

FLOW states that the goal of the study is to assess the presence, quality, access needs, flow information needs, and preferred flow regimes for regional whitewater boating resources that would mitigate for the loss of whitewater recreation at the Turners Falls Dam.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

FLOW is not a resource agency.

Public Interest Considerations (18 CFR § 5.9(b)(3))

FLOW states that the Turners Falls dam removes the public's opportunity to enjoy a whitewater boating resource and that conducting studies and implementing necessary measures to ensure the public has access to whitewater recreational resources is in the public interest.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

FLOW states that current and historic project operations at the Turners Falls Dam do not provide meaningful information for determining off-site mitigation.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

FLOW states that the construction of the Turners Falls Dam dewatered the Turners Falls bypass reach and the creation of the Turners Falls Impoundment "drowned upstream rapids, which would be sufficient cause for off-site mitigation."

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

FLOW proposes the following "process" steps: desktop analyses of candidate rivers, resource agency identification and feasibility assessment, and inter-agency meetings with stakeholders to explore opportunities for mitigation.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

FLOW states that it is willing to work with FirstLight on an off-site mitigation study to keep costs reasonable and the quality of information high. FLOW has also proposed that FirstLight conduct a controlled-flow whitewater boating study.

FirstLight's Rationale for Not Adopting the Proposed Studies

FLOW's study proposal is in essence a request to explore off-site mitigation opportunities to compensate for alleged impacts caused by initial Project construction. FERC's analysis, however in a relicensing proceeding is based on existing conditions.[34] FERC's environmental review focuses on the fact that the Project already exists and is part of the existing environment.[35] In its *Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,* FERC reiterates that FERC uses current conditions as its baseline for evaluating project effects and alternatives and that this consists of the environment as it exists at the time of licensing.[36] The results of the proposed mitigation study would not inform the development of license requirements to address effects, if any, of Turners Falls Project operation on whitewater boating.

FirstLight agrees that a controlled-flow whitewater boating and paddling study may have a nexus to the current operation of the Turners Falls Project and has included this study proposal in the PSP (Study 3.6.3). FirstLight's proposed study will evaluate the effects of Turners Falls operation on the availability of whitewater and other recreational boating in the Turners Falls bypass reach. FirstLight, however, has not included the proposed mitigation study in the PSP because it is not a study designed to evaluate the effects of current Project operation on recreational boating.

Similarly, FLOW's proposed study does not describe a study methodology, but instead a process for identifying off-site mitigation measures. Finally, FLOW fails to explain why its proposed whitewater boating study will not suffice at evaluating the effects, if any, of Turners Falls Project operation on the availability of whitewater boating in the Turners Falls bypass reach.

In sum, FirstLight has not included the proposed request to assess regional whitewater boating resources in order to determine off-site mitigation in the PSP because (1) it is not a study request but a proposal to investigate potential PMEs, (2) it is based on an assumption of pre-project conditions and thus there is no nexus to Project operation, and (3) fails to describe methodology, and level of effort and cost.

[34] *City of Tacoma,* 107 FERC ¶ 61,288, at 62,095 (June 21, 2004).
[35] *City of Tacoma,* 67 FERC ¶ 61,152, at 61,443-44 (1994).
[36] *Guide to Understanding and Applying the Integrated Licensing Process Study Criteria,* at p. 14 (Federal Energy Regulatory Commission, Office of Energy Projects, March, 2012)

4.6 Cultural Resources

4.6.1 Assess Preservation of Cultural, Historical and Educational Resources

Appalachian Mountain Club, Vermont River Conservancy, and Friends of the Connecticut River Paddlers' Trail (collectively referred to as "AMC") have requested a study regarding public education of the area's cultural resources and preservation of historical documents.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

AMC states that the goal of the study is to determine what actions should be taken to educate the public about an historical site that lies under the Turners Falls Impoundment, to determine what actions should (or should not) be taken to preserve artifacts, and to identify, preserve, and make available historical engineering drawings for the Projects to historians and researchers.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

AMC is not a resource agency.

Public Interest Considerations (18 CFR § 5.9(b)(3))

AMC states that historical records and education are valuable public resources.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

AMC states that there are many history books addressing the 1676 battle at Turners Falls and the King Phillip's War. AMC also cites two books regarding the engineering history of the Turners Falls site.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

AMC states that the Turners Falls Impoundment covers the site of the 1676 battle and probably artifacts. AMC also states that there may be Indian artifacts or burial grounds on the Turners Falls Project lands. AMC states that presumably FirstLight has in its possession historical records relating to the construction of the Turners Falls dam.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

AMC does not recommend a methodology other than to suggest that study methodology with respect to Native American use of the areas should be left to the Tribes, and to regional professional historians and others. AMC also notes the identity of a local organization with expertise in historical preservation and museum preservation.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

AMC does not describe level of effort and cost other than to state that there are academics and museum personnel who could do this study and make recommendations.

FirstLight's Rationale for Not Adopting the Proposed Studies

To the extent that AMC's request is to study or provide mitigation, protection, and enhancement for impacts resulting from original construction of the Turners Falls dam, as discussed previously in Section 4.5.2 of the PSP, such an approach would be inconsistent with FERC's environmental baseline, which looks at the impact of current Project operation and thus would not inform the development of conditions for a new license for the Turners Falls Project.

AMC's request is not a request for a study, but a request for PME. FirstLight is proposing to conduct a Phase 1A archaeological survey and a reconnaissance level historic structures survey for both the Turners Falls and Northfield Mountain Projects. See Studies 3.7.1 and 3.7.2. The results of those surveys will inform the need for more intensive cultural resources surveys. At the conclusion of cultural resources surveys, depending on survey results, FirstLight may prepare draft and final HPMPs, which will propose protection and mitigation measures for adverse effects, if any, to historic properties that are caused by the continued operation of the Project. It is premature to determine which measures, including education and preservation measures, should be included in the draft or final HPMP.

In sum, FirstLight has not included the proposed request for an assessment of cultural, historical and educational resources in the PSP because (1) it is not a study request but a proposal for PMEs, (2) to the extent it requests an assessment of pre-project conditions, there is no nexus to Project operation, and (3) fails to describe methodology, and level of effort and cost.

4.7 Other Project Relative Issues

4.7.1 Feasibility of Converting the Northfield Mountain Pumped Storage Project to a Closed-Loop or Partially Closed Loop System

The Town of Gill, LCCLC, FRCOG, FCD, and CRWC requested studies on the feasibility of converting the Northfield Mountain Pumped Storage Project into a closed-loop or partially closed-loop system.

Proponents' Description of Study Goals and Objectives (18 CFR § 5.9(b)(1))

Proponents state that the objectives of the study would be to determine: (1) candidate locations for placement of a lower reservoir; (2) costs and logistics of construction and modification of the current facility to convert to a closed-loop or partially closed-loop system; (3) 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 will be required to implement in order to protect habitat and native fauna; and (4) other ancillary costs or savings, such as eliminating requested studies, operational changes, or mitigation measures.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

The Town of Gill, LCCLC, FRCOG, FCD, and CRWC are not resource agencies.

Public Interest Considerations (18 CFR § 5.9(b)(3))

Proponents state that it is in the public interest to ensure high quality habitat for migratory diadromous fish, and the Northfield Mountain project reduces the quality of habitat for these species through increased turbidity and deposition of fine-grained sediments and that the likelihood of entrainment and entrainment mortality.

Proponents' Description of Existing Information (18 CFR § 5.9(b)(4))

Proponents state that data on the environmental effects of the Northfield Mountain project and other facilities that use fresh or salt water for generation and/or cooling are widely available, citing data submitted in the PAD and the required conversion of a coal powered plant from open to closed cycle operation.

Proponents' Description of Nexus to Project Operation and Effects (18 CFR § 5.9(b)(5))

Proponents state that converting the Northfield Mountain project to a closed loop facility would eliminate environmental effects on fisheries, water quality, and erosion of farmland.

Proponents' Explanation of How Methodology Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

Proponents' methodology includes: (1) 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 discharges; (2) provide an engineering analysis of structural modifications necessary to accommodate a full or partial lower reservoir in an alternate nearby location; (3) provide information on whether and how a smaller lower reservoir would act as a buffer to river level fluctuations and change the hydrologic pattern of flow on the Connecticut River, the water quality effects, and decrease the possibility of entrainment; (4) 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; (5) identify and make available any similar studies conducted during the planning phase of the existing facility in the 1960s or any other time; (6) provide a cost estimate of each option considered and evaluated; and (7) provide an itemized cost estimate of how halting 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 the projects, and fish protection measures.

Proponents state that the study methods are consistent with accepted practice for weighing costs and benefits of environmental impacts.

Proponents' Statement Regarding Level of Effort, Cost, and Why Alternative Studies Will Not Suffice (18 CFR § 5.9(b)(7))

Proponents' state: "The level of effort to compile existing information and to make the data available in a map should be low, as should development of contingency scenarios. 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."

FirstLight's Rationale for Not Adopting the Proposed Studies

The proponents' suggestion that a useful study could be accomplished at low cost with "some engineering and design work" demonstrates a profound lack of understanding of the study costs involved in any major new or modified ground disturbing project. Any study of converting the Northfield Mountain facility to a closed-loop system with a new lower reservoir would essentially require a comprehensive analysis comparable to that required for development of a license application for a major new project or major license amendment. It would necessarily include a comprehensive review of existing geological and hydrologic information and new site-specific geologic investigations of any places where the new lower reservoir and associated project facilities (e.g., new forebay, tunnels, penstocks, and powerhouse), detailed engineering feasibility and costs analyses of potential lower reservoir alternative sites, project facilities, and reconfiguration of the upper reservoir to operate in connection with the new reservoir and facilities, and studies and analyses of environmental effects in any area where a new lower reservoir would be located. The site investigations from the 1960s would be next to, if not entirely, useless for these purposes.

Moreover, the Commission has recently stated that while the Federal Power Act authorizes it to require modifications to an applicant's proposal to ensure that the project is best adapted to a comprehensive plan for developing or improving a waterway, the Commission does not believe it has authority to require a license applicant to construct and operate an entirely different project from the one it has proposed. *See Erie Boulevard Hydropower, L.P.*, 120 FERC ¶ 61,267 at P 97 (2007). That would certainly be the case here.

4.7.2 Creation of a Decommissioning Fund

The NPS and, jointly, the AMC, Vermont Resources Conservancy (VRC), and Friends of the Connecticut River Paddlers Trails (FCRPT) (collectively, the study proponents) have requested studies related to decommissioning of the licensed projects. NPS seeks a study of the "financial production" of each project, which would be used in the Commission's public interest analysis to evaluate a requirement for the licensee to have a decommissioning fund for each project. AMC, VRC, and FCRPT seek a study to "determine the appropriate decommissioning costs at the end of the project's lifetime and how such costs should be funded . . . in advance."

Proponents' Descriptions of Study Goals and Objectives (18 CFR § 5.9(b)(1))

The study proponents state that the goal of their proposed studies is the establishment of a decommissioning fund, so that the public will not be burdened by the cost of decommissioning the projects.

Relevant Resource Management Goals (18 CFR § 5.9(b)(2))

NPS is a federal resource agency. NPS states generally that its management goals with respect to the Connecticut River watershed are to promote a "water-based approach to conservation, outdoor recreation, education, and sustainable economic opportunities" and to "establish community-driven conservation and recreation for the 21st century."

Public Interest Considerations (18 CFR § 5.9(b)(3))

AMC, VRC, and FCRPT are not resource agencies. They state that the requested study is in the public interest because the project might one day be abandoned and the public might be required to bear the costs of remediating the site(s).

Proponents' Description of Existing Information and Need for Additional Information (18 CFR § 5.9(b)(4))

The study proponents allege that there are thousands of abandoned dams on New England waterways. They add that the physical and financial viability of the projects is at risk from various factors, such as extraordinary storms, foreign ownership, and international currency market fluctuations. NPS contends that decommissioning funds are commonly required for federally licensed facilities.

AMC, VRC, and FCRPT state that there appears to be no published information on the economic viability of the projects, which they believe is needed in order to establish their proposed decommissioning funds. NPS says essentially the same thing.

Proponents Description of Nexus Between Project Operation and Effects on Resources (18 CFR § 5.9(b)(5))

The study proponents state that there is a direct nexus between Project operations and the economic viability of the projects.

Proponents Explanation of How Methodology is Consistent with Accepted Practice (18 CFR § 5.9(b)(6))

The study proponents state that the financial viability portion of the study would follow "normal procedures" in accounting and financial management.

Proponents' Description of Level of Effort and cost, and Why Alternative Studies are Insufficient to Meet the Stated Information Needs (18 CFR § 5.9(b)(7).

The proponents state that the study would be "relatively inexpensive" and that they are not aware of any means other than decommissioning funds to protect the public.

FirstLight's Rationale for Not Adopting the Proposed Studies

The proposed studies are not appropriate because the Commission has consistently denied requests for the establishment of decommissioning funds in new licenses. The Commission has found that such funds "unnecessarily tie[] up substantial amounts of the capital of financially sound licensees . . . . for extensive periods." Project Decommissioning at Relicensing; Policy Statement, FERC Stats. and Regs.¶ 31,011 at p. 31,234 (1995). Also, the Commission has not required a decommissioning fund where: (1) there is no evidence the project is economically or physically unsound; (2) no party has suggested decommissioning in the foreseeable future; (3) there is no evidence indicating that the physical life of the project will end during the term of the new license; or (4) there is no indication that the licensee would lack the financial resources to decommission the project if it were to be decommissioned. *See*, *e.g.*, *Wis. Valley Improvement Co.*, 80 FERC ¶ 61,054 at p. 61,164 (1997); *N. States Power Co.-Wisconsin*, 78 FERC ¶ 61,120 at p. 61,460 (1997); *N. States Power Co.*, 78 FERC ¶ 61,363 at p. 62,511 (1997); *Wolverine Power Supply Coop., Inc.*, 85 FERC ¶ 61,030 at p. 61,090-91 (1998); *Potlatch Corp.*, 72 FERC ¶ 61,029 at p. 61,173 (1995). All these factors are present here. The Commission's policy has been found to be reasonable on judicial review. *See Kelley v. FERC*, 96 F.3d 1482, 1490 (D.C. Cir. 1996). Since there is no reason to impose the requested license condition, there is no reason to require the proposed studies.

In addition, the study requests are flawed because:

- The proponents' suggestion that extreme weather events put the licensed projects at risk has no support. The proponents have made no effort to explain how the existence of abandoned dam in New England, the vast majority of which are on small rivers or streams, and which were built as often as two hundred years ago using long since outdated construction methods, bear any relation to Commission-licensed projects, which are subject to perhaps the most rigorous dam safety requirements in the world.
- The useful physical and economic life of the projects cannot be determined. The Turners Falls project has been operating continuously for decades and there is no indication it cannot continue to be operated indefinitely. Similarly, all of the 17 pumped storage projects licensed by the Commission since 1958 and constructed are still operating and there is no reason to think any of them is approaching the end of its physical or economic life. Northfield Mountain is no different.
- The proponents' unsupported assertions notwithstanding, there are no "normal procedures" for estimating the potential cost of hypothetical decommissioning at an uncertain future time which could be far beyond the life of the next licenses, or even the next licenses after those. Any number of decommissioning scenarios that might be considered, and it is impossible to know with any certainty in advance which scenario would be adopted, let alone what engineering or environmental reviews would be appropriate, or the distant future legal and regulatory landscape.

Finally, NPS has made no effort to explain how the proposed study relates to its generally stated goals of promoting conservation and recreation. Rather, it merely cites the hypothetical future default which the Commission, with judicial approval, has stated is insufficient to require a decommissioning fund.