UNITED STATES OF AMERICA

BEFORE THE

FEDERAL ENERGY REGULATORY COMMISSION

TRANSCANADA HYDRO NORTHEAST INC.

Wilder Hydroelectric Project (FERC Project No. 1892-026)
Bellows Falls Hydroelectric Project (FERC Project No. 1855-045)
Vernon Hydroelectric Project (FERC Project No. 1904-073)

Updated Proposed Study Plan

July 8, 2013

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INTRODUCTION

Pursuant to the regulations of the Federal Energy Regulatory Commission (Commission or FERC), 18 C.F.R. § 5.11, TransCanada Hydro Northeast Inc. (TransCanada) filed its Proposed Study Plan (PSP) for the relicensing of the Wilder Hydroelectric Project (FERC Project No. 1892), Bellows Falls Hydroelectric Project (FERC Project No. 1855), and Vernon Hydroelectric Project (FERC Project No. 1904) on April 16, 2013. The PSP includes studies relevant and necessary to analyze the effects of continued operations of the projects. TransCanada proposed 33 studies and data collection efforts in response to informal comments from stakeholders during scoping meetings in January 2013, formal comments and study requests filed with FERC after the scoping meetings.

A series of eleven study plan stakeholder consultation meetings occurred during May, June and July 2013. As a result of the discussions, comment clarifications and alternatives suggested, updated versions (with marked up substantive) of each of the 33 study plans have been prepared and provided to the stakeholders through the various working group email lists. The updated study plans have been compiled and are being submitted to the FERC as a single source Updated Study Plan through this filing. The intent of this is to provide an "updated" basis for which comments from stakeholders, due on July 15, 2013, will hopefully be based upon.

Study Requests

TransCanada received a total of 245 individual study requests from FERC staff, federal and state resource agencies, municipalities, one regional planning commission, non-governmental organizations, and the public (collectively referred to as stakeholders; see Table 1). Additional comments without formal study requests were received from 21 commenters representing a state agency, municipalities, non-governmental organizations, a power producer, local conservation commissions, a heritage commission, a university, a farmers union, and residents.

Table 1. Stakeholders who filed formal study requests, and acronyms used in this PSP.

Request Submittal Authors	Acronym Used in the PSP
Appalachian Mountain Club, Vermont River Conservancy, and Friends of the CT River Paddler's Trail	AMC-VRC-FRs
City of Lebanon, New Hampshire Planning Office	Leb
Connecticut River Joint Commissions, Inc.	CRJC

Request Submittal Authors	**Acronym Used in the PSP**
Connecticut River Watershed Council	CRWC
Federal Energy Regulatory Commission	FERC
Lipfert, F. William Jr. and Jennifer Lipfert	Lipfert
Mudge, John B. T.	Mudge
National Park Service	NPS
New England Flow and American Whitewater	NEF-AW
New England Flow, American Whitewater and Appalachian Mountain Club	NEF-AW-AMC
New Hampshire Department of Environmental Services	NHDES
New Hampshire Fish and Game Department	NHFG
New Hampshire Natural Heritage Bureau	NHNHB
The Nature Conservancy	TNC
The Nolumbeka Project, Inc.	Nolumb
Town of Lyme, New Hampshire, City of Lebanon, New Hampshire, and O. Ross McIntyre	Lyme-Leb-McInt
Town of Rockingham, Vermont Conservation Commission	Rock
Trout Unlimited, Deerfield River Chapter	TU
Trustees of Pine Park Association, Hanover New Hampshire	Han

Request Submittal Authors	Acronym Used in the PSP
Two Rivers-Ottauquechee Regional Commission	TwoRiv
US Fish and Wildlife Service	FWS
Vermont Agency of Natural Resources	VANR
Vermont State Historical Preservation Office	VT SHPO

Some study requests did not meet one or more of the seven ILP study request criteria (18 C.F.R. § 5.9(b)) in substantive ways and either have been excluded from the PSP on that basis; or where reasonable and of nominal additional cost to the study, have been incorporated into study plans developed from other requests that did fulfill the ILP study criteria. Our responses to each of the 245 study requests were provided in the Study Request Responsiveness Summary, filed on April 15, 2013.Excluded studies were discussed at the initial study plan meeting on May 13, 2013 and in a study plan conference call on June 18, 2013. These particular study proposals continue to remain outside of our Proposed Study Plan.

Study Plans

This PSP includes 33 study plans, most of which incorporate multiple requests and encompass all three projects. Study plans that are specific to a project are so noted. The list of study plans, estimated costs, and implementation schedule are included in table 2.

Relationship Between TransCanada and FirstLight Projects

A number of study requests included study areas for TransCanada studies that are outside the proposed geographic study area. In general, the proposed study plans define the geographic study area as those lands within the project boundaries and the lands and waters affected by project operations in the riverine sections below Wilder and Bellows Falls dams.

The section below Vernon dam has also been identified as a potential instream study reach for some study requests, based upon a post-PAD report released by FirstLight, which contends it is not affected by the operation of the Turners Falls Project (FERC No. 1889). At this time, TransCanada disputes the results of the report, pending review and evaluation of the study.

TransCanada identifies the Vernon Project Boundary as the downstream side of Vernon dam and including the project lands surrounding the site of the facility, both upstream and downstream of the dam, because the upstream extent of the Turner

Falls impoundment, after construction of the Northfield Pumped Storage Project (FERC No. 2485), reaches and causes backwater effects up to the downstream face of the Vernon dam. Further, in its PAD for the Turners Falls Project, FirstLight denotes the upper boundary of the Turners Falls impoundment as the base of Vernon dam.

Considering the fact that Vernon discharges into an impoundment that is largely managed for the operational benefit of both the Turners Falls Project (TF) and the Northfield Mountain Pumped Storage Project, TransCanada acknowledges that under certain circumstances (extreme low TF impoundment conditions) the reach below Vernon dam may experience the effect of Vernon discharge to a greater extent than during normal conditions.

Therefore, the evaluation of Vernon Project impacts to the section below Vernon dam has been included in the updated study plans. However, TransCanada also proposes that the context of these evaluations will include an examination of the frequency, duration and periodicity of such conditions where Vernon Dam discharge is a significant and material influencing factor above those associated with the First Light projects.

Table 2. Summary of ILP study plans, costs, and schedule.

Study Number	**Study Title**	**Preliminary Estimated Cost ($s)**	**Preliminary Data Collection Initiatives**	**Study Year One**[a]	**Study Year Two** (including data analysis and reports for Year One studies)
1	Historical Riverbank Position and Erosion Study	55,000		x	x
2	Riverbank Transect Study	245,000	x	x	x
3	Riverbank Erosion Study	460,000		x	x
4	Hydraulic Modeling Study	170.000	x	x	x
5	Operations Modeling Study	239,000	x	x	x
6	Water Quality Study	205,000		x	x
7	Aquatic Habitat Mapping Study	275,000	x	x	
8	Channel Morphology and Benthic Habitat Study	175,000		x	x
9	Instream Flow Study	350,000 – 500,000		x	x
10	Fish Assemblage Study	220,000	x	x	

Study Number	Study Title	Preliminary Estimated Cost ($s)	Preliminary Data Collection Initiatives	Study Year One[a]	Study Year Two (including data analysis and reports for Year One studies)
11	American Eel Survey	85,000		x	x
12	Tessellated Darter Survey	85,000		x	x
13	Tributary and Backwater Fish Access and Habitats Study	50,000		x	x
14	Resident Fish Spawning in Impoundments Study	80,000		x	x
15	Resident Fish Spawning in Riverine Sections Study	60,000		x	x
16	Sea Lamprey Spawning Assessment	150,000		x	
17	Upstream Passage of Riverine Fish Species Assessment	138,000		x	x
18	American Eel Upstream Passage Assessment	210,000		x	x
19	American Eel Downstream Passage Assessment	200,000 – 250,000		x	x
20	American Eel Downstream Migration Timing Assessment	30,000		x	

Study Number	Study Title	Preliminary Estimated Cost ($s)	Preliminary Data Collection Initiatives	Study Year One[a]	Study Year Two (including data analysis and reports for Year One studies)
21	American Shad Telemetry Study - Vernon	208,000	x	x	
22	Downstream Migration of Juvenile American Shad - Vernon	200,000 – 250,000		x	x
23	Fish Impingement, Entrainment, and Survival Study	65,000			x
24	Dwarf Wedgemussel and Co-occurring Mussel Study	80,000 – 130,000	x	x	x
25	Dragonfly and Damselfly Inventory and Assessment	101,000	x	x	x
26	Cobblestone and Puritan Tiger Beetle Survey	45,000		x	x
27	Floodplain, Wetland, Riparian, and Littoral Habitats Study	198,000	x	x	x
28	Fowler's Toad Survey	56,000		x	x
29	Northeastern Bulrush Survey	23,000		x	x
30	Recreation Facility Inventory and Use & Needs Assessment	380,000		x	x

Study Number	Study Title	Preliminary Estimated Cost ($s)	Preliminary Data Collection Initiatives	Study Year One[a]	Study Year Two (including data analysis and reports for Year One studies)
31	Whitewater Boating Flow Assessment - Bellows and Sumner Falls	86,000		x	x
32	Bellows Falls Aesthetic Flow Study	40,000		x	
33	Cultural and Historic Resources Study	96,000 – 101,000 +	x	x	
TOTAL ESTIMATED STUDY COST:		**$5,272,000 - $5,477,000**			

a. Study Year One will begin after October 2, 2013 (20 days after FERC's study plan determination expected on September 12, 2013), unless specific studies are the subject of dispute by mandatory conditioning agencies. In those cases, Study Year One will begin on December 11, 2013, upon FERC's Study Dispute Determination (see 18 C.F.R. § 5.13(d) and § 5.14).

Immediate Study Plan Data Needs

The ILP study schedule dictates a study year to be from October through September. The seasonality of field investigation for different target species being studied also varies. Further, many studies are interrelated, with data from some studies needed for the analysis of others. In many cases, field work in study year 1 will be followed by analysis of project effects at the start of year 2 and reported on prior to the field session in year 2.

TransCanada is initiating specific data collection efforts identified in table 2 under "Preliminary Data Collection Initiatives" where those efforts will facilitate other studies that will rely on collecting baseline data starting in Spring 2013. TransCanada will explain the reasons for initiating this effort at its May 13, 2013, meeting, and will seek stakeholder and FERC concurrence for its initiative. Costs for these efforts are included in table 2.

Preliminary data collection initiatives, updated as of July 8, 2013 include:

Completed: Obtain Light Detection and Ranging or Laser Imaging Detection and Ranging (LiDAR) and Digital Photogrammetry of up to 185 miles of the Connecticut River, which would encompass all potential project-affected areas. Data from this will help to provide a current picture of the river corridor with immense detail and accuracy to support model refinement and numerous studies.

In progress: Obtain side-scan sonar data and bathymetry data in all accessible areas within the impoundments. Data will support habitat mapping, HEC-RAS model refinement, and numerous aquatic studies. Substrate and littoral zone analysis may also be conducted. Data and mapping would serve as the basis for selecting study sites and establishing transect locations for all other aquatic habitat studies.

In progress: Installation of pressure transducers for depth monitoring in a variety of locations both upstream and downstream of the dams. Data will support calibration of the hydraulic model, habitat index curves, reservoir operational characteristics, and would provide a monitoring record.

In progress: Erosion monitoring initial site identification and full river transect surveys, and installation of pressure transducers for continuous reservoir elevation data collection. This information will provide hydrographic and topographic cross sections and reservoir operational characteristics that can be used for model refinements and hydraulic modeling, and will support erosion studies.

TransCanada is also considering early implementation of the following studies:

Initial survey and site selection for Study 24, Dwarf Wedgemussel and Co-Occurring Mussel Study, Phase 1. This information is needed early to identify sites where dwarf wedgemussel densities are high enough to permit quantitative sampling, behavioral studies, or habitat studies for the study's Phase 2 survey in 2014. Early concurrence by resource agencies is needed to develop the timeline and plan for Phase 2.

Cultural and Historic Resources Study (Study 33), is proposed to be implemented in 2013 because some of the requested work was completed prior to the related study requests. The draft Phase IA archaeological reconnaissance reports for Wilder and Bellows Falls were submitted to the Vermont and New Hampshire State Historic Preservation Offices and Tribes on May 29, 2013 and filed with FERC on July 1, 2013. The Vernon Project archaeological monitoring program under its current Historic Resources Management Plan is scheduled to be conducted in 2013 with the report to be submitted before December 31, 2013.

Study Requests

As required under the Commission's regulations, 18 C.F.R. § 5.11(e), TransCanada held an initial consultation meeting to discuss the PSP on May 13, 2013. The purpose of this meeting was to clarify and discuss the PSP with Commission staff and stakeholders (specifically the study requestors); identify study plan interest working group participants; describe immediate data collection initiatives; and review the subsequent meeting schedule.

TransCanada has convened various resource working groups at subsequent meetings to engage with Commission staff and stakeholders in ongoing consultation prior to the stakeholder PSP comment deadline on July 14, 2013. The meetings are intended to provide a forum to work toward consensus on the final TransCanada Study Plan to be filed by August 13, 2013. Initial working group meetings were held as follows:

Table 3. List of study plan meetings.

Resource Area	Date	Location
Study Plan Overview	May 13, 2013	W. Lebanon NH
Erosion, Geology, Soils	May 16, 2013	White River Junction, VT and conference call-in
	June 20, 2013	Conference call-in
Water Resources,	May 16, 2013	White River Junction, VT

Resource Area	Date	Location
Modeling		and conference call-in
	June 20, 2013	Conference call-in
Aquatics	May 20, 2013	White River Junction, VT and conference call-in
	May 23, 2013	White River Junction, VT and conference call-in
	June 6, 2013	White River Junction, VT and conference call-in
	June 21, 2013	Conference call-in
Terrestrial	June 6, 2013	White River Junction, VT and conference call-in
	June 7, 2013	White River Junction, VT and conference call-in
	June 20, 2013	Conference call-in
Recreation, Aesthetics	June 7, 2013	White River Junction, VT and conference call-in
	June 20, 2013	Conference call-in
Cultural, Historic	June 7, 2013	White River Junction, VT and conference call-in
	June 19, 2013	Consultation meeting with Narragansett Tribe
	July 2, 2013	Conference call-in
Excluded Study Requests	June 18, 2013	Conference call-in

Notes from the formal May 13, 2013 study plan meeting were distributed to all attendees and the FERC on May 28, 2013 and posted to TransCanada's public relicensing website. All subsequent consultation meeting notes were reviewed verbally prior to the meeting conclusion and compiled with proposed actions to be undertaken by TransCanada (e.g., under review, acceptable, revisions to be made) and presented to all working group members prior to the study plan revision discussion meetings on June 1 and 2 , 2013. A copy of the meeting notes from May 13, 2013 and subsequent comments from the working group meetings are included in Appendix A of this Updated PSP.

Outside of the preliminary data collection and possible study initiatives described above, most studies are planned for implementation during one or two study years, following FERC's study plan approval and assuming no Notices of Formal Study Disputes are filed by mandatory conditioning agencies during the 20-day period after FERC's study plan determination which is expected on September 12, 2013.

Study progress reports will be submitted at important study milestones and will summarize, for each study:

- pre-field season activities completed or in progress;
- field season activities; and
- post-field season activities completed.

In keeping with the ILP study schedule, interim study reports for studies extending beyond one year will be submitted within one year of FERC's study plan approval, with final reports for all studies submitted within o years of FERC's study plan approval.

UPDATED STUDY PLANS

Updated Study 1

Historical Riverbank Position and Erosion Study

RELEVANT STUDY REQUESTS

FERC-03

STUDY GOALS AND OBJECTIVES

The goal of this study is to assess the historic erosion and river bank movement within the Wilder, Bellows Falls, and Vernon Project boundaries to consider the effect and contribution of project operations on erosion in a reasoned way. FERC contends that although erosion, in and of itself, is not necessarily an adverse effect, areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource are of concern. Potential resources that may be affected are aquatic, terrestrial, cultural, recreation, or socioeconomic.

Documentation of historic riverbank information, surveys, and photos would provide an opportunity to quantify or compare changes over an extended time period and provide a relative scale and potential quantification of erosion among various locations over time within each project along the Connecticut River. The results of this study alone will not enable a determination of the effects of project operations on erosion, but, together with other related studies, will facilitate conclusions as to the association and effect of project operations on active erosion at various locations within or areas affected by the three projects.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

No relevant resource management goals of agencies or Indian tribes with jurisdiction over the subject resources directly apply to this study.

ASSOCIATION WITH OTHER STUDIES

The results of this study, together with other studies, will facilitate assessments of the association and effect of project operations on active erosion at various locations. These studies include:

- Riverbank Transect Study (Study 2) – transects will be selected for more detailed monitoring and determination of project operations relative to conditions at specific erosion sites of interest.

- Riverbank Erosion Study (Study 3) – results will characterize the processes of erosion that occur, and attempt to ascertain the causes of erosion and the effects of erosion on other resources.

- Hydraulic Modeling (Study 4) and Operations Modeling (Study 5) - will provide water level, flow and velocity information over time.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Several studies of riverbank erosion have been conducted, but they have mostly addressed specific erosion sites along the shoreline, and did not include comparative mapping efforts to determine where the river channel has moved or by how much. Previous studies also did not estimate areas of land lost or gained as a result of those movements.

The study prepared for the U.S. Army Corps of Engineers (USACE) in 1979 (Simons et al., 1979) was one of the first comprehensive studies along the Connecticut River to assess the causes of river shoreline erosion. The study mainly provided a discussion of the various types of erosion taking place on the river at that time and identified specific erosion locations and various causes of erosion taking place. The 2010 erosion study conducted by Kleinschmidt Associates (Kleinschmidt, 2011) for TransCanada in the Wilder, Bellows Falls, and Vernon Project areas identified areas along the shoreline where erosion was classified as stable or active and provided mapping of these areas. However, that report provides a snapshot of relatively recent conditions and provides no perspective relative to changes in erosion sites over time. The mapping data that were obtained for that study may be used in this study.

Archival mapping and information is needed to identify where erosion has taken place and to characterize the degree of erosion that has occurred over time.

PROJECT NEXUS

Erosion is likely to occur whenever moving water intersects with land. It is a natural process with both beneficial and adverse potential effects. The PADs describe a daily run-of-river/peaking mode of operation that results in impoundment and tailwater flow fluctuations, resulting in fluctuations of water levels. As referenced in the PADs, Simons et al. (1979) identifies water fluctuations as a factor in erosion. Areas of excessive erosion that are a direct result of project operations or that may be having an adverse effect on another resource are of concern. The potential resources that may be affected are aquatic, terrestrial, cultural, recreation, and socioeconomic.

This study aims to identify riverbank erosion conditions observed over a longer time period, allowing a comparison of historic and present conditions. Coupled with information from related studies (2, 3, 4, and 5), these data could help provide a better understanding of potential project effects on erosion.

STUDY AREA AND STUDY SITES

The study area includes the shoreline of the Wilder, Bellows Falls, and Vernon impoundments, as well as the shoreline of the riverine reaches downstream of the

Wilder and Bellows Falls dams, and to approximately 1.5 miles downstream of Vernon dam to the lower extent of Stebbins Island. .

METHODS

The methods used for this study do not precisely follow those requested by FERC. The methods requested would require significantly more effort specifically as related to conducting literature and document search at local towns and Registry of Deeds for historical information, land purchases, easements, land surveys, and real estate data. TransCanada's estimation is that significant effort and cost would be required to acquire what is likely to amount to little to no relevant data and information. All acquired information would require extensive analysis, manipulation, and processing to enable even the most modest comparisons to existing aerial photogrammetry and mapping. Therefore, this study will use the following methods:

- Conduct a document search within TransCanada's own records to identify historical information on project maps locating the edge of river and erosion monitoring.

- Research available Federal Emergency Management Agency (FEMA) flood insurance studies where field surveys may have been conducted at key locations along the impoundments.

- Research available aerial photographic records, such as those available from the National Agriculture Imagery Program and Natural Resources Conservation Service (NRCS).

- Digitize the river's edge, islands, and bars from various historical references and attempt to overlay them for comparison. Lacking consistent reference points and control, overlaying these layers may require various map fitting functions to enable them to match up as best as possible. These efforts may introduce potential misrepresentations of the historical river's edge which would prevent calculation of total bank loss in any location. However, depending upon the age of the source data, it should be possible to identify significant areas of bank loss, channel migration, and the associated historical periods over which it has occurred.

Within reason, additional sources of valid (i.e., licensed survey) information on river bank changes will be sought by: 1) contacting riverfront landowners and municipalities with a mailing requesting maps and other relevant information; 2) speaking with NRCS personnel that have received requests for assistance from riverfront landowners; 3) conducting archival searches at state and local historical societies in instances where other data is not available; and 4) holding a meeting with the Erosion Working Group to explore further potential resources. These additional focused efforts will be restricted to areas where significant bank erosion and other channel changes are known to have occurred and where further refinement on the timing and magnitude of the changes is warranted

ANALYSIS

The information acquired will be used to qualify and attempt to quantify historic bank movement, bar growth or loss, and erosion. Results from related studies (2, 3, 4, and 5) will also inform the analysis and conclusions of this study. The mapping and information gathered will be overlain and compared to identify locations where the river channel and bars have moved over time. Where possible, efforts will be made to estimate the quantity of land lost or gained. Such estimates will depend on the variability, comparable accuracy, and degree of consistent horizontal control among the various sources to allow for comparable layering without significant adjustment.

At a minimum, it is expected that, given reasonable well depicted shorelines, significant areas of bank loss from erosion and channel migration will be detectable. Correlating bank loss to a specific period or time frame, historical hydrologic events, or other causal agents depends upon the accuracy and periodicity of the source information.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

This study involves gathering various forms of historical information including property maps, aerial photographs, and other maps and information that can be compared to assess river channel movement and erosion over time. This is a generally accepted document research methodology. Established GIS standards for geo-rectification will be used to compare the various aerial photos and maps with an investigation to be undertaken at the outset of the study to ensure recent advances are incorporated.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will summarize the data gathered and analyzed and present written and visual comparisons of data gathered from different time periods. All sources of information will be documented. Information will be presented in a GIS format to ensure the results can be readily shared. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the Preliminary Licensing Proposal (PLP) or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This is a one-year study. All research related to this study and the analysis will be completed during the first study year (2014).

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $55,000.

REFERENCES

Kleinschmidt. 2011. Lower Connecticut River Shoreline Survey Report—2010: Bellows Falls Project (FERC No. 1855), Wilder Project (FERC No. 1892), Vernon Project (FERC No. 1904). March 2011. Prepared for TransCanada Hydro Northeast Inc. Westborough, MA.

Simons, D.B., Andrews, J.W., Li, R.M., and M.A. Alawady. 1979. Connecticut River Streambank Erosion Study—Massachusetts, New Hampshire, and Vermont. Prepared for the U.S. Army Corps of Engineers, New England Division.

Updated Study 2

Riverbank Transect Study

RELEVANT STUDY REQUESTS

FERC-02,-04; NHDES-21a, -21b, -21c; NHFG-21a, -21b, -21c; VANR-01; CRWC-01, -02, -03; Han-01; Lipfert-01; Lyme-Leb-McInt-01; Mudge-01, TwoRiv-03

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, NHDES, NHFG, VANR, CRWC, and others have identified water level fluctuations and flow peaking related to Wilder, Bellows Falls, and Vernon Project operations as a potential contributing factor to bank erosion and soil loss in project-affected areas. In response to that request, the goal of this study is to monitor riverbank erosion at selected sites in the impoundments and project-affected riverine sections below Wilder and Bellows Falls dams.

The erosion monitoring will include repeated cross sections, ground photographs, and water level monitoring at 20 sites (10 associated with Wilder dam, 6 with Bellows Falls, and 4 with Vernon). Relationships observed between changing water levels and the timing of bank erosion will help establish whether water level fluctuations, described in terms of magnitude, periodicity and duration, and increased shear stresses resulting from project operations are correlated with erosion in project-affected areas. Observed water level fluctuations and shear stresses from non project-related factors will also be investigated.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to healthy ecosystems to support fish and wildlife. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to flow alteration, water level fluctuation and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.

ASSOCIATION WITH OTHER STUDIES

A number of other studies should be completed in conjunction with this study. The initial surveys of full river transects in this study will provide topographic cross sections that can be used in Hydrologic Engineering Center - River Analysis System (HEC-RAS) modeling to be conducted as part of the Hydraulic Modeling Study (Study 4). In turn, the modeling results from Study 4 will be useful in determining shear stresses acting on the monitored banks during different flow conditions. Water level monitoring as part of this study could prove useful in calibrating hydraulic modeling efforts in Study 4. Depending on the location of the monitoring sites, this study may also prove useful for the Channel Morphology and Benthic Habitat Study (Study 8) and other studies focused on habitat and recreational issues that might be affected by erosion.

The results of this study will also be used to help interpret longer term bank movement that will be assessed in the Historical Riverbank Position and Erosion Study (Study 1). An investigation of the processes and causes of erosion in the Riverbank Erosion Study (Study 3) will rely heavily on the results of this study and will be helpful in selecting sites representing a range of conditions, some having experienced significant channel migration and others exhibiting long-term bank stability.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Background information about project operations, river and watershed characteristics, and previous studies completed in the area were detailed in the PADs. Erosion in the project-affected areas was previously mapped by Simons et al. (1979) and Kleinschmidt (2011). Bank height, bank slope, land use, and land cover were identified at each erosion site in Kleinschmidt (2011); however, no assessment was made of the trends or rates of erosion at each project.

Surficial geology maps prepared on U.S. Geological Survey (USGS) 7.5' topographic quadrangles published by the NH Geological Survey are, or soon will be, available for most of the study area. NRCS soils maps have also been developed and are available for most of the project areas. A thorough review of these maps will be important for ensuring the selected monitoring sites encompass a range of soil types and geomorphic settings.

Glacial Lake Hitchcock occupied most of the Connecticut River Valley in the project areas at the end of the last ice age, depositing thick sequences of varved lacustrine clays and other fine sediments. These sediments have been investigated for many years by geologists (Ridge and Larsen, 1990) and a review of this literature as part of Study 3, the Riverbank Erosion Study, will provide additional information on the location, thickness, and stratigraphy of such deposits. These studies will be used to better understand conditions at monitoring sites where varved clays are present.

PROJECT NEXUS

Study requesters consider water level fluctuations and peaking flows downstream of dams as a potential cause of erosion. Simons et al. (1979) attributes water fluctuations, both natural and those associated with dam operations, to be a factor in erosion in the project-affected areas. This study will ascertain the relative importance of water level fluctuations associated with project operations in the erosion process relative to other contributing factors and how the importance of water level fluctuations in the erosion process varies with soil type and geomorphic setting. Water level fluctuations, particularly those associated with the projects, represent only one process increasing the potential for bank instability with the cumulative effect of multiple processes that either increase the driving forces of instability (e.g., high shear stress, water seepage) or decrease the resisting forces (e.g., loss of bank vegetation; loss of soil cohesion) ultimately leading to erosion.

Comparing the site-specific conditions at each transect study site with rates of erosion will provide key input to determining whether routine project operations, high flood flows, or a combination of factors is causing bank erosion.

STUDY AREA AND STUDY SITES

The study will be conducted at 20 bank transects (10 associated with Wilder, 6 with Bellows Falls, and 4 with Vernon). FERC requested 30 transects (10 for each project); the 10 proposed for Wilder are appropriate given the impoundment length and the higher rate of erosion compared to the other projects (Kleinschmidt, 2011), and the erosion concerns expressed by numerous study requesters. However, fewer sites are recommended at the other projects because of shorter impoundment length and lower rates of erosion. The 20 total transects will still enable a comparison of conditions at sites both upstream and downstream of each project and representing a range of soil types and bank characteristics. The exact location of the transect sites will be based on a review of previous erosion studies (e.g., Simons et al., 1979; Kleinschmidt, 2011), analysis of soils and surficial geology maps, initial field reconnaissance, inspection of historical aerial photographs, and examination of project operations data to ensure the sites encompass a range of soil types, stratigraphic conditions, vegetation densities, erosion types, bank slopes (and other morphological characteristics), water level fluctuations, and peaking flow conditions.

Once an initial list of potential transect sites is developed based on these criteria, an effort will be made to select sites that address site-specific concerns raised in study requests associated with the New Hampshire bank near Wilder dam such as at River Road in Lyme just south of the North Thetford Road; River Road a quarter mile south of the East Thetford Bridge, the Mudge and McIntyre properties in Lyme, Pine Park in Hanover, and the Lipfert property in Cornish. The final selection of monitoring sites will be done in conjunction with the erosion working group to ensure stakeholder input.

The study area includes the shoreline of the Wilder, Bellows Falls, and Vernon impoundments, as well as the shoreline of the riverine reaches downstream of the

Wilder and Bellows Falls dams and limited to approximately 1.5 miles downstream of Vernon dam to the lower extent of Stebbins Island.

METHODS

The following methodology will be used with tasks completed in the listed order, if possible:

Site Selection

The 20 transect sites will be selected so a range of soil types, stratigraphic conditions, vegetation densities, erosion types, bank slopes (and other morphological characteristics), water level fluctuations, and peaking flow conditions are incorporated into the analysis. Site selection will be based on a review of previous erosion studies (e.g., Simons et al., 1979; Kleinschmidt, 2011), analysis of soils and surficial geology maps, initial field reconnaissance, inspection of historical aerial photographs, and examination of project operations data. The 20 sites will be selected from a larger initial list that will detail information on location (detailed with a map and GPS coordinates), setting (bank height, composition, etc.), and landownership. The final selection of monitoring sites will be done in conjunction with the erosion working group for input on the number, location, and distribution of sites upstream and downstream of each dam.

Establishing Monitoring Sites

The initial monitoring of the sites will include establishing full river cross sections using standard topographic and bathymetric survey methods. The surveys will be completed using an electronic total station and referenced to a project datum, both vertically and horizontally. Permanent, recoverable control points at the site will also be established with benchmarks and GPS coordinates (and will remain in place following completion of the two-year monitoring study). Subsequent monitoring of the cross sections will include only one bank of the river and will extend from a point 50 feet upland from the top of bank to a wadeable depth into the water with data to be collected at a sufficient density to accurately describe the slope geometry. In addition to establishing the survey transects, the initial site monitoring will also characterize site and bank conditions with information to be collected on bank stratigraphy, soil type and horizons, bank stability, vegetation, water seeps, channel features (e.g., mid-channel bars), and valley features (e.g., downstream constrictions). Multiple oriented ground photograph stations will also be established at each site to capture changes in bank conditions through time; the ground photographs will be retaken at the same locations, as recorded with GPS coordinates, during each subsequent visit to the sites. GIS shapefiles will be established for each monitoring site showing the location of the cross sections and ground photograph stations as well as attribute tables providing information on landowners, bank composition, and other relevant information.

Repeat Surveys

As requested by FERC, surveys at the 20 sites will be resurveyed and ground photographs retaken at least four times per year for 2 years. The surveys will occur immediately after high spring flows, early and late summer, and then in late fall with additional surveys conducted within 15 days of any significant high water event (monitoring trigger flow to be determined after review of exceedance curves of natural inflows). Evidence for ice-related conditions will be recorded during the survey immediately following high spring flows. While NHDES, NHFG, and VANR have also requested monitoring of several bank transects on a biweekly basis for one year at 18 monitoring sites (three in each project impoundment and three downstream of each dam), this additional monitoring is not incorporated into this study as such information will only be valuable if active soil loss occurs nearly continuously throughout the year. The significant added cost is not warranted given the limited additional benefit to be gained from the more intensive monitoring. Periodic meetings will be held with the erosion working group during the two-year monitoring period to discuss the need and location for increased sampling frequency based on the initial monitoring results. The need for and extent of additional monitoring approaches (e.g., groundwater level monitoring) could also be discussed at such meetings.

Surface Water Level Monitoring

To monitor surface water levels, pressure transducers will be submerged in stilling wells placed in the river at the 20 monitoring sites. The transducers will be set to automatically record water levels at 15-minute intervals. To calibrate the submerged transducers, up to six additional transducers will need to be deployed to record changes in air pressure. These additional transducers will be placed at or near monitoring sites, but may not be needed at all sites because air pressure does not generally vary significantly over short distances with minimal elevation variations. Data will be retrieved from the transducers each time surveying is scheduled at the monitoring sites. The pressure transducers will be removed during the winter months to prevent breakage but the stilling wells will remain in place to ease redeployment of the transducers in the second year. Flow variation is generally limited in the winter months, so the absence of data collection in the winter months should not alter study results. Flow records at the dams will provide some information on winter flows if a significant rain-on-snow event occurs.

The bank monitoring techniques described above were selected to match as closely as possible those requested by FERC with water level monitoring added so correlations can be identified, if present, between erosion and high water events or frequent water fluctuations.

ANALYSIS

The data collected as part of this study will be analyzed to ~~determine if~~assess whether the timing of documented bank erosion is associated with flood events or project operational water level fluctuations. The repeated topographic surveys and ground photographs will document the location, amount, and timing of erosion for a two-year period. Site characteristics and recorded water levels will be compared with the erosion monitoring data to ~~determine if~~assess whether high rates of erosion are associated with certain soil types, bank heterogeneities (i.e., sand-clay interfaces), bank seeps, or water level fluctuations. Graphs, tables, and matched photos will be developed to highlight comparisons between different data sets and all data will be incorporated into a GIS database to ease comparisons between sites and sharing of information with interested stakeholders.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The various methods to be used in the Riverbank Transect Study conform to generally accepted scientific practice. Topographic surveys and repeat ground photography are standard methods that have been used in geomorphic monitoring studies for decades (Lawler, 1993). A further evaluation of monitoring approaches will be conducted when the study is initiated to ensure all of the work is conducted using established monitoring standards.

DELIVERABLES

A report will be prepared that presents methods, analysis and results of the study. The report will include GIS shapefiles of monitored sites, topographic cross sections showing changes through time, graphical presentation of water stage in relation to volumes of soil loss, bank features, and other site characteristics. The work products provided as part of this study will include:

1) A GIS shapefile of monitoring sites and table of site characteristics;
2) drafted overlaid topographic cross sections showing changes at each site through time;
3) bar graphs showing estimated volumes of soil loss through time and segregated by bank features (e.g., composition, slope, height); and
4) line graphs showing variations in water stage through time overlaid with bar graphs showing volume of soil loss during the time between survey events;

An interim study report will be prepared after the first year of study is complete synthesizing the above deliverables into a narrative that addresses the study goals and issues raised in various study requests. The report will be provided to stakeholders for review and comment. A draft final study report will be prepared after the study analysis is complete in study year two. Stakeholder comments on the draft final report will be included in the final study report with an explanation of any stakeholder comments not incorporated.

Interim and final study reports will be provided after completion of the first and second year, respectively of field work associated with this study and Study 3.

Results and conclusions will be reported in either PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be a two year study. Because final study reports are to be completed by September 2015 in keeping with the ILP schedule, two full seasons of monitoring is not possible, but two complete years of sampling over three seasons could occur. Site selection will occur in late 2013 after FERC study plan approval. Establishment of the monitoring sites could begin in late 2013 as well, permitting at least one round of surveying before winter 2013/2014 begins. A full year of monitoring would occur in 2014 and another partial year of monitoring completed in spring and early summer 2015. Hydraulic modeling (Study 4) will be integrated into the study after field sampling ends to analyze relationships between shear stress and bank erosion. The monitoring results will then be incorporated in to final study reports for both this study and the Riverbank Erosion Study (Study 3).

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this 2-year study is $245,000.

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Lawler, D.M. 1993. The Measurement of River Bank Erosion and Lateral Channel Change: A review: Earth Surface Processes and Landforms. Volume 18, pp. 777–821.

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Updated Study 3

Riverbank Erosion Study

RELEVANT STUDY REQUESTS

FERC-04; NHDES-21a, -21b, -21c; NHFG-21a, -21b, -21c; VANR-01; CRWC-01, -02, -03; Han-01; Lipfert-01; Lyme-Leb-McInt-01; Mudge-01; Rock-01; TwoRiv-03

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, NHDES, NHFG, VANR, and others have identified water level fluctuations and flow peaking from Wilder, Bellows Falls, and Vernon Project operations as a potential contributing factor to bank erosion and soil loss in project affected areas. In response to those concerns, the goal of this study is to provide baseline data relative to erosion in project-affected areas.

The objectives of this study are to:

- determine the location of erosion in project-affected areas and compare these locations with previously compiled erosion maps (e.g., Kleinschmidt, 2011; Simons et al., 1979);
- characterize the processes of erosion (e.g., piping, slumping, slips);
- ascertain the likely causes of erosion (e.g., high flows, groundwater seeps, eddies, water level fluctuations related to project operations); and
- identify the effects of shoreline erosion on other resources (e.g., aquatic habitat).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to healthy ecosystems to support fish and wildlife. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR	•	State water quality standards for designated uses of Class B waters relative to flow alteration, water level fluctuation and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.

ASSOCIATION WITH OTHER STUDIES

A number of other studies should be completed in conjunction with this study. To determine if erosion might be related to project-related water level fluctuations and peaking downstream of the three dams, Hydraulic Modeling (Study 4) and Operations Modeling (Study 5), will be critical in determining the flow velocity, stage, and duration along the riverbanks, all potential factors in the erosion process.

Flow deflection around sand/gravel bars and channel/valley constrictions are important factors in understanding the distribution of erosion, so the substrate related results of Aquatic Habitat Mapping (Study 7) will also be important for discerning the causes of erosion. A determination of how the amount and location of erosion has changed through time will be based primarily on the findings of the Historical Riverbank Position and Erosion Study (Study 1). Additionally, the Riverbank Transect Study (Study 2) will provide important information to be used in characterizing the processes of erosion and determining its causes.

All of the data collection for these studies could be completed simultaneously with this study, but ultimately the conclusions of this study will depend significantly on the results of those other studies. The results of this study will assist in drawing conclusions related to the Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27). The Recreation Facility Inventory and Use and Needs Assessment (Study 30) will identify recreation sites that may be affected by erosion.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Considerable information is already available that will be useful in this study. Much of this information has been detailed in the PADs, but the most useful sources of data are further described below. Erosion in the project-affected areas was previously mapped by Simons et al. (1979) and Kleinschmidt (2011). These data will provide the basis for determining if the location and amount of erosion has changed through time and in response to significant flood events such as Tropical Storm Irene. Erosion mapping has also occurred on other portions of the Connecticut River (Field, 2004) and will provide important comparative information on erosion in areas not affected by the projects.

Surficial geology maps prepared on USGS 7.5’ topographic quadrangles published by the NH Geological Survey are, or soon will be, available for most of the study area. NRCS soils maps have also been developed and are available online for most of the study area. The surficial geology and soils maps will provide critical baseline information on the erodibility and permeability of bank sediments, height of riverbanks, and valley constrictions, all important factors controlling erosion.

Glacial Lake Hitchcock occupied most of the Connecticut River Valley in the study area at the end of the last ice age, depositing thick sequences of varved lacustrine clays and other fine sediments. These sediments have been investigated for many years by geologists (Ridge and Larsen, 1990) and a review of this literature will provide additional information on the location, thickness, and stratigraphy of such deposits and thus will be helpful for understanding the distribution of erosion sites.

All of the existing information described above will be important for understanding the distribution, processes, and causes of erosion, but additional information is needed to fill in areas where surficial mapping has not been completed, and to provide greater resolution of surficial features and subsurface stratigraphy than is currently available.

PROJECT NEXUS

Project-related water level fluctuations and peaking flows downstream of dams is considered a potential cause of erosion by the resource agencies requesting this erosion study. While Simons et al. (1979) attributes all water fluctuations to be a factor in erosion in the project-affected areas, they also distinguish the effects based upon more extensive, sustained periods of inundation followed by rapid drawdown from restricted, sub-daily inundation. Considerable erosion also occurs on free-flowing portions of the Connecticut River not influenced by dams (Field, 2004), so erosion would likely still be occurring in the project-affected areas if the dams were not present. Water level fluctuations in general represent only one process increasing the potential for bank instability with the cumulative effect of multiple processes that either increase the driving forces of instability (e.g., high shear stress, water seepage) or decrease the resisting forces (e.g., loss of bank vegetation; loss of soil cohesion) ultimately leading to erosion.

Consequently, while project operations could be a direct cause of erosion, bank instability is most likely the result of the cumulative effects of both project and non-project related factors. Under some conditions, project operations could reduce bank erosion. Bank instability is greater where permeable sand layers occur above impermeable clay layers, because water seepage out of the bank becomes concentrated along a single layer (Lawson, 1985). Bank stability in project-affected areas is likely greater where water level fluctuations do not repeatedly expose a sand-clay interface in the bank sediments. Detailed information to be collected as part of this study on bank stratigraphy, depth to sand-clay interfaces, and their relationship to past water level fluctuations is needed to confirm if reductions in bank instability are resulting from project operations.

STUDY AREA AND STUDY SITES

The study area includes the shoreline of the Wilder, Bellows Falls, and Vernon impoundments, as well as the shoreline of the riverine reaches downstream of the

Wilder and Bellows Falls dams and limited to approximately 1.5 miles downstream of Vernon dam to the lower extent of Stebbins Island.

Mapping of erosion and other bank features will be done continuously along all banks in the study area, including both eroding and non-eroding areas. Several specific sites of erosion were mentioned in study requests by New Hampshire landowners and towns in the Wilder impoundment and just downstream, including River Road in Lyme just south of the North Thetford Road, River Road a quarter mile south of the East Thetford Bridge), Mudge and McIntyre properties in Lyme, and Pine Park in Hanover. The study area encompasses these sites as well as others known to be of concern to landowners and will gather information relevant to the site-specific requests.

METHODS

The following methodology will be used with tasks completed in the listed order, if possible:

Literature Review

A review of published literature will be undertaken on riverine and reservoir erosion and additional geological/hydrological studies completed within or near the study area. A thorough review of the literature will provide a full understanding of fluvial processes on large rivers and documented causes of erosion on rivers and dam-regulated impoundments. Citing relevant literature to support conclusions drawn from other studies is a standard practice in all technical and scientific research.

Watershed Characterization

General information on the drainage basin area is already available in the PADs, but additional information is needed on valley width, meander dimensions, and tributary influences. An effort will be made to compare variations in conditions on the Connecticut River adjacent to tributaries with different land use and human effects (e.g., tributaries with dams vs. tributaries without dams). Watershed characterization is an essential element of geomorphic studies and is necessary for establishing relationships between different features (e.g., distribution of erosion relative to the position along or tightness of a meander bend).

Analysis of Historical Aerial Photographs, Topographic Maps, and Archival Information

The materials for this analysis will be gathered as part of the Historical Riverbank Position and Erosion Study (Study 1) and will be important for reconstructing river conditions prior to the construction of dams, effects of other human activities (e.g., channel straightening, railroad construction, project operational changes) on channel migration, and the control of tributary confluences on channel morphology. A comparison of channel processes and rates of erosion before and after dam construction or operational changes may be possible depending on the information discovered. Historical documents can be a rich source of information for geomorphologists reconstructing historical fluvial processes and river channel locations (Gurnell et al., 2003). Furthermore, the use of historical ground photographs found in archival records collected for Study 1 may also be an important tool for documenting recent landscape change along rivers, particularly in New England (Bierman et al., 2005).

Bathymetric Survey

A bathymetric survey will be completed along 20 transects as part of the Riverbank Transect Study (Study 2). Additional bathymetric information will be collected throughout project-affected areas from the Aquatic Habitat Mapping Study (Study 7) that will benefit numerous studies including this study. For this study, bathymetric information will be critical for determining the depth of water along the riverbanks and for revealing submerged bars that may be deflecting flow toward the riverbanks or formed in response to eddies at channel/valley constrictions. Bathymetric surveys are standard practice for geomorphic studies of large rivers.

Surficial Mapping of Geomorphic Surfaces (i.e., Floodplain, Glaciogenic Terraces) on the Connecticut River Valley Bottom

Surficial maps for most of the study area have been published by the NH Geological Survey and will provide critical information on the height of river banks, subsurface material, and location of valley constrictions. Supplemental information will need to be gathered in areas not mapped and to provide greater resolution where multiple geomorphic surfaces of varying heights may be present in proximity to the river's shoreline. The additional mapping will be completed with topographic maps, aerial photographs, and field checking of more complex areas. Geologists with years of research experience studying Glacial Lake Hitchcock deposits will also be consulted. If Light Detection and Ranging (LiDAR) data are collected as part of other studies (e.g., Study 4), the resulting topographic information will help further refine the surficial geology maps, but the mapping could occur without such data. Surficial geological mapping serves as baseline data for most geomorphology studies.

Field Mapping of Bank Conditions

Several channel and river bank features will be mapped continuously along the river, using the most recent digital LiDAR data and color imagery as a base map, to locate the beginning and end points of mapped features (e.g., an eroding bank). The channel and bank features that will be mapped in the field include: 1) bank heights (possibly supplemented with surficial mapping results); 2) bank stability (e.g., severely eroding, moderately eroding, stable); 3) types of erosion features (e.g., piping, undercutting, slumping, tension cracks); 4) bank composition (e.g., alluvial floodplain sediments, non-alluvial glacial or lake sediments, or bedrock – supplemented with surficial mapping results); 5) grade controls (e.g., dams, waterfalls, bridges, other valley constrictions); 6) past management activities (e.g., location of berming, straightening, bank armoring, concentration of surface runoff); 7) depositional features (e.g., point bars, mid-channel bars, beaches, delta bars at tributary confluences); and 9) other features (e.g., large wood accumulations, deep pools, tributary confluences). One additional feature, the total width of mature trees growing along the river's edge, will be mapped directly from LiDAR data and color imagery. All of the mapped features will be input into a GIS database that will show the character of the channel and banks continuously along the river. Features mapped in other studies, e.g., the Floodplain, Wetland, Riparian and Littoral Habitats Study (Study 27), and the Cultural and Historic Resources Study (Study 33) may provide additional data for those locations. The subdivisions to be used in mapping the various features (e.g., moderately eroding for bank stability, point bars for depositional features) will be based on established terms or will otherwise be carefully described and presented to the Erosion Working Group for feedback before mapping begins.

The mapping will be completed using a hand-held ArcPad computer with an embedded Trimble GPS and will allow mapped data to be immediately input as a GIS shapefile. LiDAR data and color imagery depicting the study area will be loaded into the ArcPad computer to assist in accurately locating the position of mapped features. The analysis of GIS data of mapped features will provide: 1) statistical information on individual features (e.g., total length of eroding banks; percentage of channel banks that are bedrock); 2) comparative information between features (e.g., location of eroding banks in relation to areas of concentrated runoff); 3) a means of identifying the causes for certain channel conditions (e.g., eroding banks adjacent to mid-channel bars); and 4) a method for the rapid viewing of multiple parameters at the watershed scale (e.g., the distribution of erosion relative to the location of clay banks). Consequently, the mapping of channel features will be critical for determining the causes of erosion. The mapping of channel features is a common methodology in fluvial geomorphology and the techniques to be used are similar to the U.S. Environmental Protection Agency's (EPA's) National Hydrography Dataset Reach Indexing Tool.

Stratigraphic Descriptions

The composition of bank material will be characterized during the field mapping of bank conditions. However, the layering of sediments within the banks can play an instrumental role in bank stability with contacts between permeable sand above impermeable clay providing a zone along which water can preferentially seep out of the bank. Consequently, identification of the various sedimentary layers within a bank is critical to understanding the distribution and causes of erosion. Stratigraphic descriptions of at least 20 bank exposures will be completed as part of the Riverbank Transect Study (Study 2), but additional descriptions will be needed to fully characterize the range of conditions present in the study area. At least one stratigraphic column will need to be measured for each geomorphic surface identified during surficial mapping. Linking stratigraphic descriptions to geomorphic surfaces will enable generalizations of stratigraphic layering to be made over a broad area because stratigraphy will be generally uniform for a given surface. This will limit the effort needed to describe subsurface stratigraphy and will provide information on stratigraphy even where bank exposures are obscured due to vegetation, riprap, or other reasons. The stratigraphic descriptions will be completed using standard geological and soil techniques with the elevation of the top and bottom of each observed stratigraphic layer measured relative to the top of the bank with a measuring tape or stadia rod. The true elevation of the reference point at the top of the bank will be determined using survey grade GPS as the true elevation of stratigraphic contacts will be needed to make comparisons with water surface elevations established through hydraulic modeling. Each stratigraphic layer will be described in terms of texture (i.e., grain size), color, internal bedding, permeability, and other characteristics useful for determining the depositional environment of the sediment (e.g., lake, floodplain, delta). Stratigraphic descriptions are a common methodology used in many geomorphology studies.

Topographic Surveying

Topographic cross sections of the banks will be completed at 20 sites as part of the Riverbank Transect Study (Study 2) to closely monitor erosion over 2 years and better characterize the processes of erosion. However, additional surveying, including cross sections and plan maps, will need to be completed for other purposes in this study including comparing bank slopes of stable and eroding banks, determining the shapes and dimensions of slump features, and measuring the amount of bank recession that has occurred around fixed features (e.g., bridge abutments, riprap). Topographic surveying is an integral part of most geomorphology studies, and the standard surveying techniques used in such studies are described by Simon and Castro (2003).

Hydraulic Modeling

HEC-RAS one-dimensional (1-D) hydraulic modeling is being completed of the entire study area as part of the Hydraulic Modeling Study (Study 4). HEC-RAS modeling will provide information on flow stage, velocity, and shear stress, important factors in the erosion process. The FERC study request for a riverbank erosion study specifically requests that "bank shear assessments" be completed to compare different sites for their susceptibility to erosion, a request that will be the focus of the Riverbank Transect Study (Study 2). For this study, 2-D modeling at up to six sites using River2D may be necessary to understand complex sites where HEC-RAS modeling does not adequately describe eddy flows that might develop, for example, upstream of valley constrictions or flow deflection that might occur, for example, around a mid-channel bar or island. 1-D modeling assumes all flow is moving uniformly in a single, downstream, direction, where in reality a portion of the flow is often moving across the channel or even upstream as in an eddy. The 2-D modeling will occur in areas where such variations in flow direction are considered to be an important factor contributing to bank instability. 2-D modeling, if necessary, will occur in conjunction with the Instream Flow Study (Study 9), and only at selected sites, extending over only hundreds of feet of river.

The methods described above were selected to match as closely as possible those recommended in the relevant study requests, and the overall study approach has been crafted to address concerns raised in the various study requests and scoping meeting comments.

ANALYSIS

The data collected as part of this study will be analyzed within the context of the four study objectives of identifying the location, processes, causes, and potential effects of erosion. Changes in the location of erosion through time will be achieved through comparisons on GIS of at least three map years (1979, 2010, and to be completed in 2014) with pie charts and maps to be used to determine if river bank erosion has increased through time as suggested in some of the study requests. Historic maps and aerial photographs to be compared during the Historical Riverbank Position and Erosion Study (Study 1) may be useful for extending the temporal record of how the location and amount of erosion has changed through time.

Information collected on bank characteristics at multiple places within the study area will be compared with erosion processes described in the literature to establish how erosion proceeds through time at a given site. The results of this analysis will be presented as a channel evolutionary model that will illustrate with photographs, sketches, and tables how the morphology of the riverbank changes through time as erosion progresses and material is shifted from the upper bank to the lower bank and ultimately transported downstream. Information gathered during the Riverbank Transect Study (Study 2) will also be used in developing the evolutionary model of bank erosion.

An analysis of erosion causes will be completed by identifying the propensity of erosion to occur in association with certain conditions. For example, erosion focused in areas where sand-clay interfaces are frequently exposed due to water level fluctuations may suggest project operations are partially responsible for the erosion. Conversely, the presence of significant erosion on the outside bend of meanders may suggest higher shear forces from natural flood flows are contributing to bank erosion. The results of the Hydraulic Modeling Study (Study 4) and the Riverbank Transect Study (Study 2) will be important in establishing these associations and identifying the major factors contributing to erosion.

Maps showing the location of different bank conditions and features along the river will be used to investigate whether bank erosion has the potential to affect other resources. For example, if erosion is occurring where riparian vegetation is present then riparian habitat could be considered potentially affected by bank failure with the results of Floodplain, Wetland, Riparian and Littoral Habitats Study (Study 27) to be integrated with this study. Similar associations may also be established to identify possible effects on aquatic habitat. Habitats sensitive to fine sediment deposition, such as spawning gravel, could be considered threatened if considerable lengths of bank erosion are occurring immediately upstream. The Channel Morphology and Benthic Habitat Study (Study 8), the Aquatic Habitat Mapping Study (Study 7), and the Recreation Facility Inventory (Study 30), as well as several fish spawning studies (e.g., Studies 14, 15, and 16), will be needed to identify if and where effects on other resources are occurring as the result of bank erosion.

To the extent possible, all of the collected data and subsequent analysis will be incorporated into a GIS database with maps and attribute tables that can be readily shared with interested stakeholders. Periodic meetings will be held with the Erosion Working Group to solicit comments in order to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the two-year study period.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The various methods to be used in the Riverbank Erosion Study conform to generally accepted scientific practice as detailed in the Methods section above. A further evaluation of the proposed study methods will be conducted during the literature review at the outset of the study to ensure all of the work is conducted using established standards.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will include GIS shapefiles of monitored sites, topographic cross sections showing changes through time, graphical presentation of water stage in relation to volumes of soil loss, bank features, and other site characteristics. The work products to be completed as part of this study will include:

1) An annotated bibliography of local studies and published literature describing how a particular document relates to one or more of the study goals;

2) tables and figures documenting and illustrating how the character of the watershed (e.g., drainage area), valley (e.g., width), and channel (e.g., meander dimensions) vary in a downstream direction;

3) maps showing long-term trends in channel migration and bank erosion;

4) bathymetric contour maps and/or cross sections showing how the depth of the river varies across the river at selected sites;

5) surficial geology maps of the Connecticut River valley bottom within the study area presented on 7.5’ topographic quadrangles;

6) GIS shapefiles and summary tables of channel conditions for more than 300 miles of shoreline;

7) figures and tables of the stratigraphic and soil descriptions of bank sediments;

8) topographic cross sections and plan maps illustrating important bank and channel conditions;

9) maps and cross sections illustrating how flow stage, velocity, and shear stress vary with discharge for various points along the river based on hydraulic modeling results; and

10) an interim and final study report synthesizing the above deliverables into a narrative that addresses the study goals and issues raised in various study requests.

The interim study report will be prepared after the first year of study is complete. The report will be provided to stakeholders for review and comment. A draft final study report will be prepared after the study analysis is complete in study year two. Stakeholder comments on the draft final report will be included in the final study report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application**.**

SCHEDULE

This study will be conducted as a 2-year study. The literature review, watershed characterization, and mapping of geomorphic surfaces could begin in late 2013, following FERC's study plan approval, or in early 2014 with field mapping, supplementary topographic and bathymetric surveying, and stratigraphic descriptions completed in summer and fall 2014. Hydraulic modeling will be integrated into the study at the outset of 2015 to analyze the effects of large floods and water level fluctuations on bank erosion. Information from other studies will also be integrated into this study during 2015 to address project goals and analyze the results.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $460,000.

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Updated Study 4

Hydraulic Modeling Study

RELEVANT STUDY REQUESTS

FERC-01; FWS-01; NHDES-14a; NHFG-14; VANR-04; CRWC-11; TNC-01; TU-07

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, TNC, and TU indicated an interest in understanding the effects of changing flows and water surface elevations at the Wilder, Bellows Falls, and Vernon Projects on environmental resources. The goal of this study is to develop a hydraulic model to derive hydraulic indices and parameters such as water levels and flows across the study area and at locations of interest identified in other studies. The results of the hydraulic model will on its own, or in conjunction with, the Operations Modeling Study (Study 5), inform other studies thereby permitting the evaluation of the effects of project operations on aquatic, terrestrial, and geologic resources.

The objectives of this study ~~is~~ are to:

- develop relationships between ~~hydraulic parameters such as~~ water levels and flows throughout the project reservoirs and affected downstream reaches; and
- specific ~~at~~relationships at econodes of interest will serve as ~~for~~ inputs into ~~, and velocities for other studies including~~ the Operations Modeling Study (Study 5).

Study requests also identify an interest in understanding how operations at the three TransCanada projects affect operations of the FirstLight projects (Northfield Mountain Pumped Storage and Turners Falls). That is beyond the scope of TransCanada's hydraulic and operations models and is the responsibility of FirstLight to develop that determination. TransCanada will provide FirstLight with output from its models in the form of discharge at Vernon dam. This would serve as the upstream inflow in the model FirstLight develops to assess the effect on its operation.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study in their requests, as summarized below:

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect and enhance habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to flow alteration, water level fluctuation, and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) list due to flow alterations.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

ASSOCIATION WITH OTHER STUDIES

The operations model developed in Study 5 will use the hydraulic indices and parameters from this study, and derive a time-series database of hourly water levels and flows from operational scenarios. The results of this study and Study 5 will be used to assess potential project effects on the following, at a minimum: erosion processes (Studies 1, 2 and 3); aquatic resources (Studies 7, 8, 9, 12, 13, 14, 15, 16, 21~~2~~, 24, 25, and 26); terrestrial resources (Studies 26, 27, 28, and 29); cultural and historic resources (Study 33) and recreation and aesthetic resources (Studies 31 and 32). Figure 4-1 illustrates the relationships among the operations and hydraulic models and resource studies.

There may be instances when the results of the hydraulic model will be used by resource studies to establish that a particular resource is not affected by project operations due to its location outside the zone of influence or due to an upland position in terms of elevation. In these cases, there is no need to utilize the operations model to examine potential impacts on a time-series basis.

Determination of “no effect” in these cases will be based on the results of the hydraulic model.

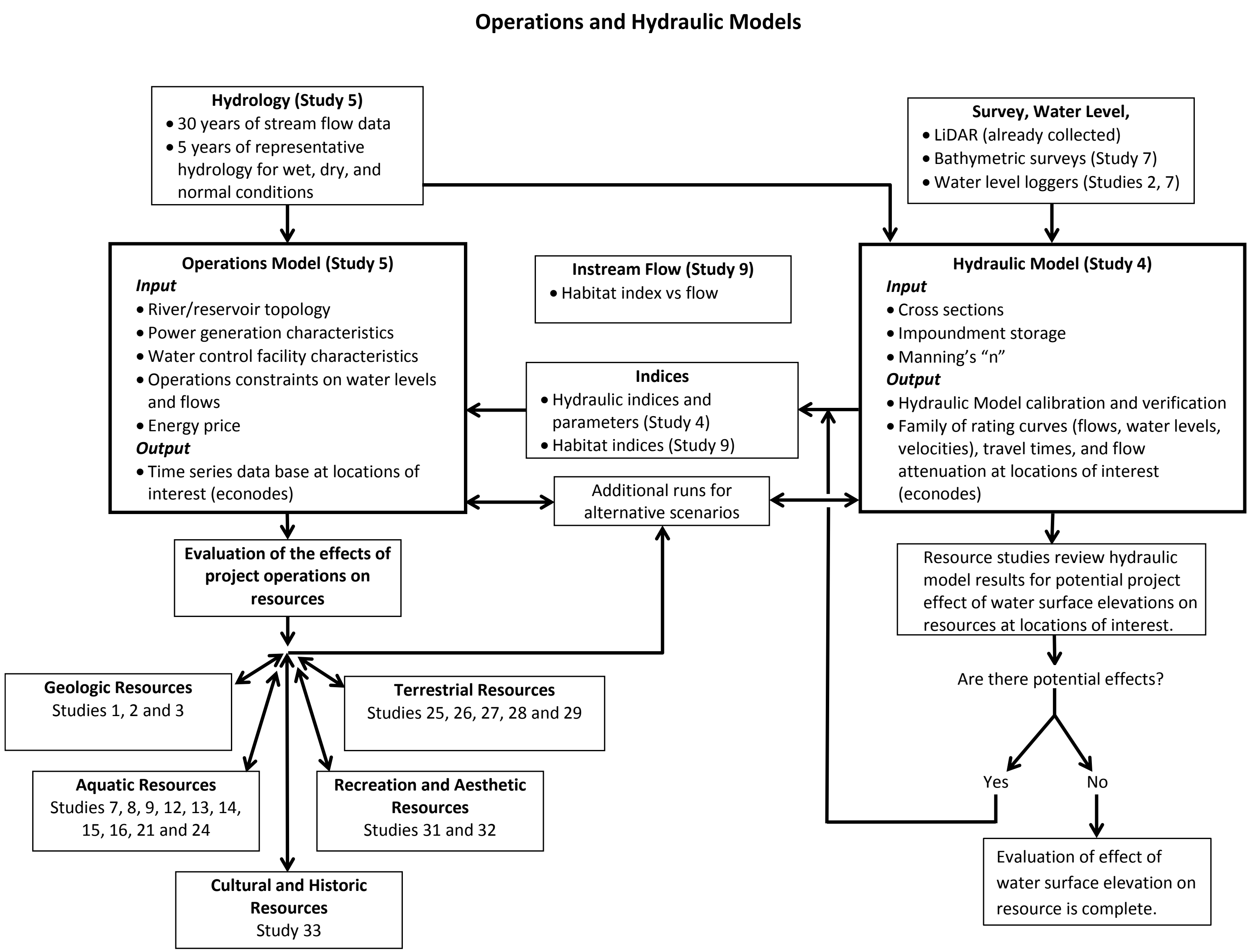

Figure 4-1. Relationship among models and resource studies.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The PADs for the Wilder, Bellows Falls, and Vernon Projects provide detailed information on current project operations including normal operations, inflow, river profile operation, high flow operation, and flood control and navigation. The PADs also provide information on the existing environment and resource effects. However, presently there is no tool that enables correlation of current project operations related to flows and water levels to observed shoreline phenomena (e.g., erosion), habitats, and distribution of biota at various locations other than at the dam or immediate tailrace. This study coupled with the Operations Modeling Study (Study 5) is designed to provide that determination.

PROJECT NEXUS

The three projects are operated to pass flows and maintain water levels in the impoundments in accordance with conditions established in the current license and in response to daily hydrologic conditions and energy prices. Operations modeling facilitates the optimization and simulation of detailed hourly operations over an annual period based upon those variables. The operations model, discussed in more detail in Study 5, will inform short-term operations scheduling by simulating the optimization of complex characteristics of energy pricing, inflows, minimum flows, and impoundment and tailwater conditions.

No changes are proposed to project operations and therefore, no new effects on environmental resources from operations are anticipated. For long-term planning purposes, and in light of the potential for expected variability in hydrology and energy pricing, the operations model (Study 5) will inform operations to balance license, hydrologic, energy, and environmental resource conditions.

The modeling conducted under this study will provide a key link to understanding hydraulic indices and parameters such as flow and water levels at locations of interest to provide information to the operations model (Study 5) to inform specific study objectives of other the studies cited above.

STUDY AREA AND STUDY SITES

The hydraulic model study area will include the main stem of the Connecticut River extending from immediately downstream of McIndoes dam to approximately 1.5 miles downstream of the downstream boundary of Vernon dam.

METHODS

The HEC-RAS software, Version 4.1.0 (USACE, 2010) will be used in this study to develop a model to perform 1-D hydraulic calculations for the study area. FERC referenced use of the HEC-RAS model in its study request.

The hydraulic model will simulate ~~steady~~ routing of river flow through impoundments and along river reaches for operations and hydrology scenarios developed for Study 5. River reach characterization will be performed by the selection of cross section locations using the Environmental Systems Research Institute (ESRI) Geographic Information System (ArcGIS) Version 10.0 (ESRI, 2010), HEC-GeoRAS Version 10 (USACE, 2012), and USGS topographic maps.

Cross sections will be placed around hydraulic structures, stream junctions, and locations of interest identified by other ILP studies. Cross section locations will be based on river morphology to capture changes in channel and floodplain width, slope, and storage. The HEC-RAS model will use GIS and Light Detection and Ranging (LiDAR)survey data provided by TransCanada ~~Digital Elevation Models (DEMs)~~ to derive the elevation data for the cross sections ~~(USDA, 2013; USGS, 2013)~~.

The LiDAR survey was performed by U.S. Imaging, Inc., under contract to TransCanada, from April 26 through May 8, 2013, in the Connecticut River Valley of New Hampshire and Vermont. Covering a swath about 1 mile wide, the LiDAR survey was centered on the Connecticut River and included the hydraulic model study area. The LiDAR survey utilized an Optech Orion M-300 scanner mounted in a Cessna Centurion C-210 aircraft. Optech Orion M-300 scanner specifications include an operational envelope of 100-2,500 meters above ground level and a laser wavelength of 1,064 nanometers. The scanner has a vertical accuracy of less than 10 centimeters at its maximum altitude of 2,500 meters and a relative accuracy of less than 2 centimeters. To perform the LiDAR survey, the system was flown for a total flight time of 34.2 hours at a height of 1,066 meters above ground level and a speed of 120 knots traveling from south to the north. The LiDAR system settings and flight parameters yielded a density of 3.8 points per square meter on a single flight line with 35% overlap for a resulting density of about 5 points per square meter. ~~DEM data will be~~ LiDAR survey data will be augmented by ~~more detailed~~ topographic and bathymetric survey data collected in Study 7 (Aquatic Habitat Mapping) and at locations of interest identified by other studies.

Specific steps to develop the HEC-RAS hydraulic model for the study area are as follows:

1) Hydraulic Model Setup:
    a. The hydraulic modelers will combine the topographic (LiDAR) and bathymetric survey data into a single terrain model.
    b. Cross sections will be developed in GIS from LiDAR (TransCanada), bathymetry (Study 7), and project data (dam dimensions and elevations). Cross section placement will include locations of interest to the hydraulic model, econodes identified in the operations model (Study 5),) and locations of interest identified by other resource studies.
    c. Impoundment storage will be based on bathymetry (Study 7) and available project data such as dam structures and foundations.
    d. Manning's n-values will be input for the main channel and overbanks based on a combination of readily available field and photographic

observations, published sources, and standard references (Chow, 1959; Barnes, 1967).

2) Hydraulic Model Calibration and Verification
   a. The HEC-RAS model will be calibrated to optimize model replication of observed data. Calibration will be based on a range of observed flows and water surface elevation data from USGS gages in the study reach and from water level logger data (Studies 2 and 7). Observed data such as water surface elevations, flow travel time, and attenuation of flows, will be compared to simulated HEC-RAS model data.
      i. USGS gage locations and data will be reviewed for the hydrology data set used in the operations model (Study 5) that represent wet, dry and normal conditions, and gage data will be selected for use in calibration.
      ii. The hydrology data set from the operations model will be routed in the HEC-RAS unsteady flow model to compute water surface elevations along the study reach for the wet, dry and normal conditions. For the unsteady runs, the three project impoundments will be modeled with dynamic routing using the St. Venant equations of Conservation of Mass and Conservation of Momentum (USACE, 2010).
      iii. Water surface elevations, flows, and flow travel times computed in HEC-RAS will be compared to the observed USGS gage data.
      iv. Manning's n-values will be adjusted in the HEC-RAS model, within an acceptable range, to achieve a "best match" to the observed data.
   b. Water level logger data measured in 2013 (Studies2 and 7) will be used to verify the HEC-RAS model.
      i. Three flow events (wet, dry, normal) will be identified for the period July through November 2013 using USGS gage data.
      ii. Water level logger data will be provided from Aquatic Habitat Mapping (Study 7) and Riverbank Transect Study (Study 2) at a 15-minute time-step for the three flow events.
      iii. Hydraulic modelers will develop a list of proposed level logger data and locations to use for the hydraulic model verification and provide those for consultation with the water resources working group.
      iv. Upon receiving comments, the final list of level logger data and locations will be identified for hydraulic model verification.
      v. Operations data (reservoir storage, total plant flow) will be provided (TransCanada) at the hydroelectric projects for the three flow events.
      vi. The HEC-RAS unsteady flow model will be used to simulate the three flow events and project operations, with a 15-minute time-step.
      vii. The computed HEC-RAS results (water surface elevations, flows and flow travel times) will be compared to the water level logger data.

viii. Flow travel Manning's n-value will be adjusted in the HEC-RAS model, within an acceptable range, to achieve a "best match" to the water level logger data.
ix. Travel time and flow attenuation information will be provided to operations model (Study 5) for operations model routing.

3) Sub-Hourly Flow and Elevation Rate-of-Change
   a. The hydraulic modelers will perform HEC-RAS model runs to compute the sub-hourly flow and elevation rate-of-change at locations of interest.
      i. Operations modelers and will provide hydraulic modelers with up-ramp and down-ramp flows across a 24-hour period for 5 scenarios.
      ii. Hydraulic modelers will perform HEC-RAS model runs to compute the flows and water surface elevations at locations of interest.
      iii. Hydraulic modelers will provide the time series of sub-hourly flows and water surface elevations to resource studies 3, 8, and 9 for 5 scenarios, 24-hours each.
      iv. Resource studies will assess the need to consider alternatives and inform the operations modelers.
      v. In the event there is a need to consider alternatives, the operations modelers will modify the unit loading and unloading procedures, configure the hourly operations model with sub-hour routing and operations procedure, and provide the resulting sub-hourly up-ramp and down-ramp flows and water surface elevations to resource studies, as applicable.
      vi. Figure 4-2 illustrates the relationship between the operations model, hydraulic model and resource studies for the sub-hourly flow and elevation rate of change.

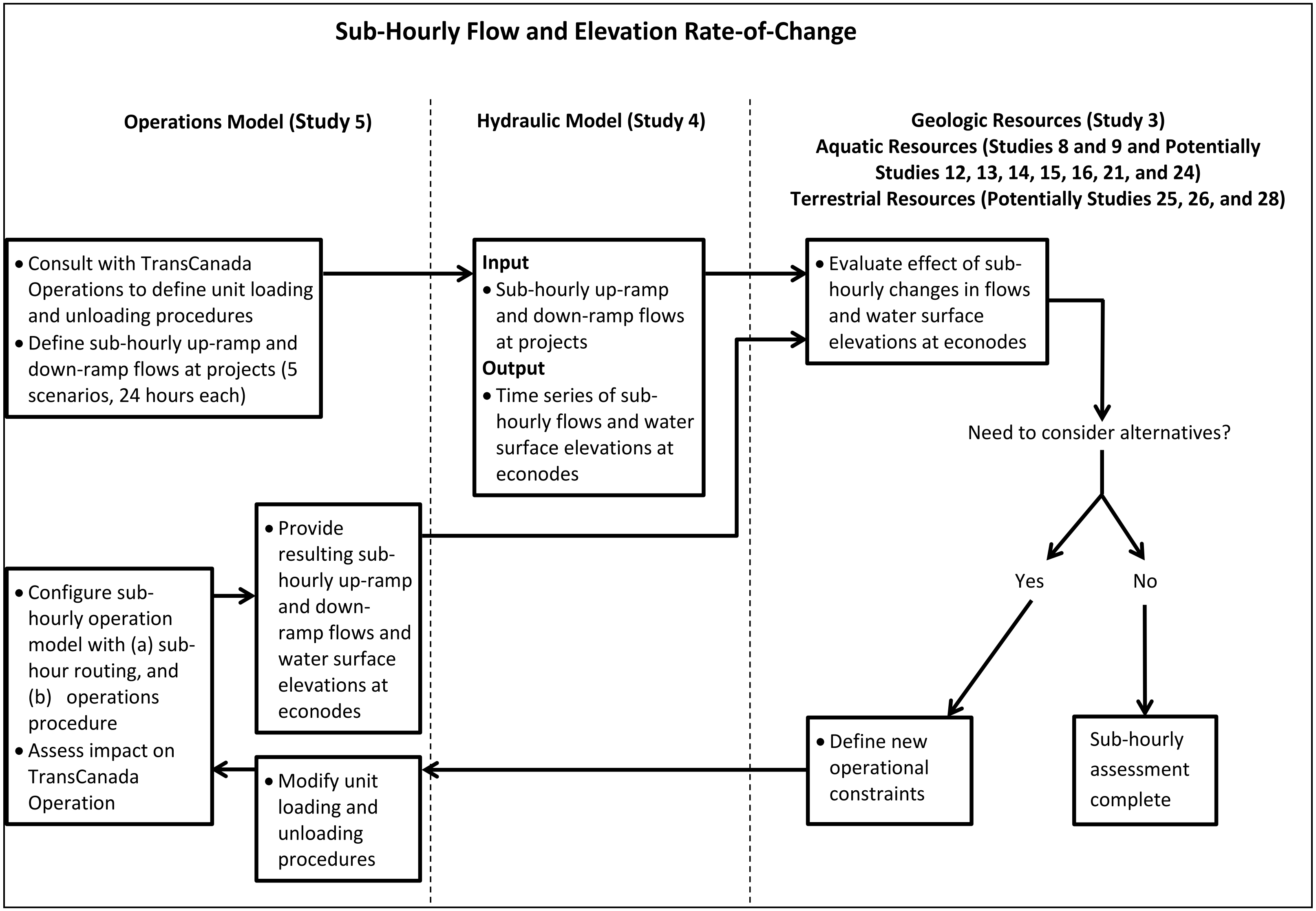

Figure 4-2. Sub-hourly Rate-of-Change.

4) Rating Curves for Operations Model
   a. Operations modelers will provide a range of discharge versus reservoir elevation conditions at the hydroelectric facilities.
   b. Using the calibrated and verified HEC-RAS model, a family of flow versus stage rating curves will be developed at econodes of interest for the range of discharge and reservoir elevations.
   c. The rating curves will be provided to the operations modelers in spreadsheet format.

The method for integration of this study with the Study 5 operations model, and other resource studies that will depend on hydraulic modeling to interpret project effects, will occur by the following process ~~(identical to Study 5)~~:

1. The existing operations model will be updated for base operating conditions (see Study 5).

2. ~~Site-specific t~~Topographic and bathymetric surveys, which will be collected as part of other resource studies, will be provided to the HEC-RAS modelers for hydraulic model setup. Hydraulic data collected as part of other field resource studies will be provided to the HEC-RAS modelers as a check for model ~~flow,~~ elevation~~, and velocity~~ at the specific locations where data was collected.

3. The HEC-RAS model will be set-up and run to derive the following relationships:

   a. econode water level as a function of flow rate at the econode for riverine sections;

   b. econode water level as a function of flow rate at the econode and the water level at the downstream reservoir, for backwater sections; and,

   ~~a.~~c. routing characteristics for all main stem river reaches (lag time and routing /attenuation parameters).

~~2.~~4. The operations model will be run using the hydraulic parameters derived from the HEC-RAS model. Data summarizing the effects at locations of interest will inform the other resource studies.

~~3.~~5. Additional model refinements will be made to both the HEC-RAS and operations models based on other resource studies, and additional model runs will be made, as applicable.

ANALYSIS

Hydrology and operation scenarios will be ~~exported from~~ provided by the operations model (Study 5) for use in ~~import into~~ the hydraulic model. The hydraulic parameters derived from the hydraulic model will then be formatted into hydraulic index curves for use in the operations model. ~~be provided for use in other studies.~~

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The HEC-RAS software program was designed by the U.S. Army Corps of Engineers to perform 1-D, hydraulic calculations for natural and man-made channels. HEC-RAS is widely used and accepted by the engineering community and regulatory agencies. For example, this model is the standard for USACE projects; the Federal Emergency Management Agency (FEMA) has accepted HEC-RAS for performing national flood insurance studies; NRCS has adopted HEC-RAS as their main river hydraulics model; the Federal Highway Administration has accepted it for ~~itsuse~~its use on highway hydraulics studies; and many state and local agencies across the country have also adopted HEC-RAS for use in hydraulic studies. HEC-RAS has become a standard in the industry for river hydraulic modeling.

DELIVERABLES

Hydraulic parameters will be developed and provided for use in the operations model and for analysis of project effects on resources that are the subject of other studies. A report will be prepared that presents methods, analysis, and results of the study.

Results and conclusions will be reported in either the PLP or draft license applications for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The hydraulic model will be preliminarily set up starting in January 2014~~by the end of 2013~~. Refinements to the model will be made in the first study year (2014) after ~~first year~~ 2013 ~~study~~ field work (~~topographic and~~ bathymetric surveys from Study 7, ~~river flow and~~ water level logger data ~~collection~~from Studies 2 and 7) becomes available~~ from other studies~~. Model calibration and verification will be performed in 2014. A~~runs, a~~dditional model refinements, and ~~additional~~ model runs will be made during the second study year (2015), as applicable.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is approximately $~~320~~170,000 for work performed in ~~2013 and~~ 2014~~, and includes costs for LiDAR and/or aerial photos~~. The preliminary estimated cost for work to be performed in 2015 cannot be estimated at this time and will be based on the specific areas of interest to be identified in other studies and the results of analysis performed from field studies.

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Updated Study 5

Operations Modeling Study

RELEVANT STUDY REQUESTS

FERC-01; FWS-01; NHDES-14a; NHFG-14; VANR-04; CRWC-11; TNC-01; TU-07

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, RWC, TNC, and TU indicated an interest in understanding the effect of operations at the Wilder, Bellows Falls, and Vernon Projects on environmental resources. The goal of this study is to develop an operations model that will provide information on the effect of flows and water levels, resulting from hydrology and operational scenarios, on environmental resources.

The objective of this study is to develop a time-series database of hourly water levels and flows for various selected operational scenarios, to enable other studies to assess the effects of project operations on aquatic, terrestrial, and geologic resources at locations of interest. The values will be available at many locations on the river system, including identified econodes.

Study requests also identify an interest in understanding how operations at the three TransCanada projects affect operations of the Northfield Mountain Pumped Storage and Turners Falls Projects. That is beyond the scope of TransCanada's hydraulic and operations models and is the responsibility of FirstLight to develop that determination. TransCanada will, however, provide FirstLight with output from its models in the form of discharge at Vernon dam. This would serve as the upstream inflow in the model FirstLight develops to assess the effect on its operation. This two model approach (TransCanada-First Light) will effectively meet the agency and stakeholder requests but will preserve the separation of operations decisions, which is a necessity and requirement within the power market in which we both operate our businesses.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect and enhance habitats for fish, wildlife and plants affected by the projects.
- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous

and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	•	State water quality standards for designated uses of Class B waters relative to flow alteration, water level fluctuation, and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

ASSOCIATION WITH OTHER STUDIES

The Vista Decision Support System (Vista DSS™) operations model in this study is TransCanada's central tool for assessing project effects on aquatic, terrestrial, and geologic resources under current operating scenarios. It will provide long time series of hourly values for reservoir water levels, flows at river locations, flows at water control structures, and power generation.

Completion of this study is dependent on hydraulic parameters from the hydraulic model (Study 4). These include:

- rating curves for econodes on riverine segments
  - relationship between flowrate and water surface elevation
  - relationship between flowrate and average section velocity
  - relationship between flowrate and average section shear stress
- rating curves for econodes on backwater river segments

- relationship between flowrate and downstream reservoir elevation, and water surface elevation
- relationship between flowrate and downstream reservoir elevation, and average section velocity
- relationship between flowrate and downstream reservoir elevation, and average section shear stress

- several time series of flow at every econode, to be used to derive routing characteristics of river reaches

Completion of this study is dependent on acquatic parameters from Aquatic Habitat Mapping (Study 7) and Instream Flow (Study 9). This includes the relationship between the defined fishery index and the econode flowrate and water surface elevation.

The results (time series of flows, water levels, velocities, shear stress and aquatic habitat indices) of this study ~~and Study 4~~will be used to assess project effects on the following, at a minimum:

- erosion processes (Studies 2 and 3)
- aquatic resources (Studies 8, 12, 13, 14, 15, 16, 22, 24~~, 25, and 26~~)
- terrestrial resources (Studies 25, 26, 27, 28, and 29); and
- recreation and aesthetic resources (Studies 31 and 32).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The PADs for the Wilder, Bellows Falls, and Vernon Projects provide detailed information on current project operations including normal operations, inflow, river profile operation, high flow operation, and flood control and navigation. The PADs also provide information on the existing environment and resource effects. However, presently there is no tool that enables correlation of current project operations related to flows and water levels to observed shoreline phenomena (e.g., erosion), habitats, and distribution of biota. This study coupled with the hydraulic model (Study 4) is designed to provide that tool.

PROJECT NEXUS

The three projects are operated to pass flows and maintain water levels in the impoundments in accordance with conditions established in the current license and in response to daily hydrologic conditions and energy prices.

In an operations environment, modeling facilitates the optimization of detailed hourly operations on a continuous basis, considering the key input variables and objectives. The inputs include inflows, constraints on impoundment water levels and river flows, and market prices. Objectives are first to meet defined constraints and then maximize the value of energy generation with the flexibility that remains. In the study environment, the modeling simulates or mimics the above stated process.

No changes are proposed to project operations and therefore, no new effects on environmental resources from operations are anticipated. For long-term planning purposes, and in light of the potential for expected variability in hydrology and energy pricing, the operations model will inform operations to balance license, hydrologic, energy, and environmental resource conditions.

The modeling conducted under this study will provide a key link to understanding hydraulic parameters such as flow and water levels at locations of interest, to meet specific study objectives of the other studies cited above.

STUDY AREA AND STUDY SITES

The operations model was developed to simulate operations of the Wilder, Bellows Falls, and Vernon Projects. Dams at these three projects create three impoundments, which are represented as "headponds" in the operations model. The model also includes the upstream Dodge Falls Hydroelectric Project (FERC No. 8011) and the Fifteen Mile Falls Project (FERC No. 2077).Three upstream storage impoundments, Lake Francis, First Connecticut Lake, and Second Connecticut Lake, are also included in the operations model.

The study focus area for the model is the Wilder, Bellows Falls, and Vernon Projects and their effects. Several large tributaries to the Connecticut River are included in the study area as hydrology inflows for the operations modeling. The hydrology data set represents inflows from large tributaries that include but are not limited to: Passumpsic, Waits, Ompompanoosuc, White, Ottaquechee, Black, Williams, and West rivers in Vermont, and the Ammonoosuc, Mascoma, Sugar, and Cold rivers in New Hampshire. In addition to tributary inflows, the hydrology developed for the operations model also includes uniform lateral inflows from upland watersheds.

METHODS

The Vista DSS™ software system developed by Hatch Ltd will be used in this study. Vista DSS™ is a proprietary system that provides a framework to model detailed operations of water resources and hydroelectric operations. It comprises nine integrated modules, under a Windows operating system, and uses robust database technologies and a sophisticated Windows user interface.

It is a network flow model that simulates operation of water control structures and effects in associated river reaches and reservoirs, and is used primarily to reliably meet license conditions (including minimum flows, and impoundment limits) and maximize value from energy production. A cornerstone of the model is the continuous determination of optimum operational actions on an iterative basis, responding to changing conditions such as hydrologic inflows and energy pricing.

The model consists of a series of nodes and arcs to define specific system features such as hydrology (inflows from tributaries and upstream watersheds), river junctions, impoundments, tailwater, spillways, and power generating units. In the model, "econodes" represent specific areas of interest. Econodes will be identified in the operations model to provide an understanding of the effect of flows and water levels resulting from hydrology and operational scenarios on environmental resources.

Specific steps to develop the operations model include:

- Revise the operations model developed in 1992 in the following areas:
  - Update the generating unit performance characteristics.
  - Update the operational constraints (license conditions).
  - Update the model hydrology dataset through 2011 thus having 30 years of hydrology available for the study. Each year of hourly analysis will yield 8760 data points for each result variable of interest.

    A representative 5-year subset of the available 30 years of inflow were selected for use in the present study. The selection was based on annual and spring total inflow volumes at Vernon and the system annual energy production. The selected years are, 1992, 1994, 1989, 2007 and 1990, corresponding to the following:

    - 5, 9, 14, 20, 25 ranking (out of 30) of the annual inflow volume at Vernon, and
    - 3, 8, 15, 22, 28 ranking of the system annual energy production

    It is not necessary to use all available hydrology for the study as the information on operational impacts can be well provided by a properly selected representative subset of the hydrology. The selected subset represents a range of flow conditions both annually and seasonally. The subset also represents a wide range of annual energy production and thus reflects the actual TransCanada interference in the river regime.

    Update the model with econodes that define areas of interest as identified from other resource studies.
  - Define econode elevation relationships with flows and downstream node elevations, using the hydraulic model results developed from Study 4.
  - Define new river reaches, associated with the updated econodes, and the routing parameters.

- Update econode environmental assessment indices rating curves (function of flow and/or elevation) from other studies.

- Define hourly market energy prices, which will guide hourly energy production. The hourly day-ahead price schedule for 2010 was selected for the model as it is deemed to be representative of the seasonal and within week fluctuating nature of historic market prices. However, hourly fluctuation in historic market prices typically reflects market conditions at the time that may not be present at the same time in another year. Therefore, to be more representative of TransCanada operation, the 2010 hourly prices were filtered by deriving the average hourly weekday and weekend prices for each month for use in the model.

- Run the operations model for a range of baseline operating conditions using five representative hydrology years.

- Provide time-series database of hourly water levels and flows and associated assessment indices to enable other studies to assess the effects of operations on environmental resources at locations of interest. The time-series database will enable assessments regarding the variability, rate of change, and frequency of fluctuation within the impoundments and tailraces based on criteria and areas of interest identified by other studies.

PROCESS

The method for integration of this study with the hydraulic model (Study 4) and other resource studies that will depend on hydraulic modeling to interpret project effects will occur by the following process:

1. The existing operations model will be updated for base operating conditions (discussed under the methods section).

2. Topographic and bathymetric surveys, which will be collected as part of other resource studies, will be provided to the HEC-RAS modelers for hydraulic model setup. Hydraulic data collected as part of other field resource studies will be provided to the HEC-RAS modelers as a check/calibration step for model flow, elevation and velocity at the specific locations where data was collected.

3. The HEC-RAS model will be set-up and run to derive the following relationships

    a. econode water level as a function of flowrate at the econode; for riverine sections;

    b. econode water level as a function of flowrate at the econode, and the water level at the downstream reservoir; for backwater sections; and

c. econode velocity as a function of flow/elevation at the node.~~routing characteristics for all main stem river reaches (lag time and routing/attenuation parameters.)~~

4. The operations model uses Muskingum Cunge hydrologic routing model to derive outflow at the downstream end of a river reach from inflow at the upstream end. The parameters of the model for all main stem river reaches (lag time, and routing/attenuation parameters) will be derived from the time series of inflow to and outflow from the reaches obtained from the HEC-RAS model.

~~4.~~5. The operations model will be run using the above hydraulic parameters derived from the HEC-RAS model. Data summarizing the effects at locations of interest will inform the other resource studies.

~~5.~~6. Additional model refinements will be made to both the HEC-RAS and operations models based on other resource studies, and additional model runs will be made, as applicable.

SUB-HOURLY MODEL CONSIDERATION

Sub-hourly modeling refers to the case where the model time granularity is shorter than one hour; for example a 5-min time step.

The need for sub-hourly modeling to evaluate the effect of rapid flow changes due to unit loading and unloading will be jointly investigated among the pertinent study groups as outlined in the following steps:

1. The operations modeling group (Study Plan 5) will consult with TransCanada Operations to define current unit loading and unloading procedures at the study projects. Based on the defined procedures, the operations study group will provide several (approximately 5) day-long time series of sub-hourly flows, to the hydraulic modeling group (Study Plan 4).

2. The hydraulic modeling group will perform HEC-RAS model runs to determine the flow sequence at the downstream econodes, using as input the flow sequence that contains realistic sub-hour up-ramps and down-ramps.. The results will define sub-hourly flow and elevation rate of change at each econode for each set of the test 24-hour long flow sequences. The time series of sub-hourly flows and elevations for each econode will be provided to the analysts involved with applicable erosion, aquatic and terrestrial studies

3. The erosion, aquatic and terrestrial study groups will review the sub-hourly flow and elevation rate of change for any issues and concerns. If there are concerns with the sub-hourly flow and/or elevation rate of change, recommendation for operations modifications to mitigate the concerns will be provided.

4. The operations study group will model the recommended changes with the Vista sub-hourly model (RT Vista) to assess the impact of these changes to TransCanada operation.

5. The resulting sub-hourly flows and elevations will also be provided to the erosion, aquatic and terrestrial study groups to review and examine potential alternative operations changes that mitigate the original concern.

Completion of steps 4 and 5 is dependent on issues and concerns identified in step 3. There will be no sub-hourly operation modeling if the erosion, aquatic and terrestrial study groups identified no concern with the sub-hourly econode flow and elevation from step 2.

ANALYSIS

Hydrology and operation scenarios will be exported from the operations model for import to the hydraulic model (Study 4). The hydraulic parameters derived from the hydraulic model will then be formatted into hydraulic index curves for use in other studies.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Vista DSS™ has become a standard in the water resource and power sector for operations analysis and simulation. This model is widely used by power companies for assisting in hydropower operations and for undertaking strategic studies. It has been implemented for many North American power companies (e.g., Manitoba Hydro [5,000-MW], Bonneville Power Administration [BPA; 20,000-MW], PacifiCorp, Tacoma Power, Southern California Edison, NextEra Energy, Nalcor Energy, Saskpower), as well as several international companies (Panama Canal Authority, Mighty River Power in New Zealand, and Volta River Authority in Ghana).

DELIVERABLES

The methods and results from the Hatch Vista operations model, alternative scenarios, and database development will be summarized in a final report.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The Vista DSS™ operations model will be set up for the base operating conditions by the end of 2013. The integration of hydraulic parameters from Study 4 will occur in the first study year (2014). Refinements to the model will be made after study field work (topographic and bathymetric surveys, river flow and water level data collection) becomes available from preliminary field work or other studies. Model runs, additional model refinements, and additional model runs will be made during the second study year, as applicable.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for operations model setup and execution for the base operating condition and five ~~three~~ alternative operations scenarios, including the addition of updated econodes and associated hydraulic parameters derived in Study 4 and aquatic habitat indices derived in Studies 7 and 9, is approximately $239,000. This is for the following assumed conditions and tasks:

- Assumptions
  - 25 econodes
  - 5 scenarios for analysis
- Tasks
  - Derive rating curves for econodes and routing parameters
  - Enhance model functionality to handle complex index relationships
  - Update operations model with econode locations and associated rating curves and routing parameters
  - Re-run base case operations (5 hydrologies) with updated model
  - Establish reporting formats, in association with other study teams
  - Analysis of new scenarios, including report preparation according to agreed formats
  - Derivation of sub-hour ramp-up and ramp-down flowsequences at project sites
  - If needed, one iteration of sub-hourly operations modeling
  - 3 on-site meetings (six man-trips)

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Additional Technical References:

Bridgeman, S.G., Huysentruyt, J., Allen, R.B., and Olason, T. 1996. Automation Strategies of New England Power Company for the Connecticut & Deerfield Rivers, H. G. Acres Seminar, Niagara Falls, Canada.

Bridgeman, S.G., Huysentruyt, J., Olason, T., Allen, R.B., Kirshen, P. 1996. Hydroelectric Generation Scheduling for the Connecticut and Deerfield River Systems, ASCE Proceedings of Fifth Water Resources Operations Management Workshop. Arlington, VA.

Bridgeman, S.G., Allen, R.B., Welt, F., Olason, T., Lafreniere, M., Babel, L., and Kuepper, B.P. 2001. Buena Vista, International Water Power & Dam Construction.

Hatch. 2013. *Vista* Decision Support System (*Vista* DSS™) Version 6.0.19.0., January 2013.

Olason, T., Welt, F., and Shields, D. 2005. Short-Term Generation and Transaction Scheduling at Manitoba Hydro using the Vista Decision Support System, Waterpower XIV, Austin, TX. July 18 – 22, 2005.

USGS. 2012. Gage Streamflow Data. http://waterservices.usgs.gov/rest/DV-Test-Tool.html.

Updated Study 6

Water Quality Monitoring Study

RELEVANT STUDY REQUESTS

FWS-20; NHDES-22a, -22b, -22c; NHDES-25a,-25b, -25c; NHFG-22a, -22b, -22c; NHFG-25a, -25b, -25c; VANR-02,-03b, 03c; CRWC-05, -06, -07, -08, -09, -10

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRASC stated that TransCanada should monitor water quality to determine the operational effects of the Wilder, Bellows Falls, and Vernon Projects on water quality.

The goal of this study is to determine potential project effects on water quality parameters of: dissolved oxygen (DO), water temperature, pH, turbidity, conductivity, nutrients, and chlorophyll-*a*. Documentation of these parameters will provide information on the effects of project operations on water quality over an extended period of time and during low flow summer conditions. The water quality data collected will be compared to Vermont and New Hampshire water quality standards to help determine if the projects are meeting state water quality standards.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to healthy ecosystems to support fish and wildlife. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR • State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.

ASSOCIATION WITH OTHER STUDIES

This study is directly associated with the Upstream Passage of Riverine Fish Species Assessment (Study 17) because water temperature will be continuously monitored in the fish ladders from as soon as ice-out condition occur until the beginning of ice-in conditions in early winter. This will enable the water temperature regime from April through May and October through mid-November to be characterized for use with interpretation of aquatic biota data early and late in the season (as requested during study plan meetings). The April and May water temperature data from the fish ladders will be supplemented by water temperature data collected during the Resident Fish Spawning in Impoundments Study (Study 14), and Resident Fish Spawning in the Riverine Sections Study (Study 15). In addition, continuous water temperature data will be collected at water level monitoring locations established during the Habitat Mapping and Bathymetry Study (Study 7). Water quality data collected in other aquatic resource studies will provide additional data points that will be included in the water quality dataset, as applicable. The results of this study will be used to inform the conclusions of other aquatic studies by documenting conditions that could influence behavior and distribution of biota, such as temperature, dissolved oxygen, and turbidity, and data on turbidity levels could be used with Study 3, the Riverbank Erosion Study, to document effects.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing information is extensive and was cited and/or summarized in the project PADs. Specific to the TransCanada projects, after the upgrade of four of the generating units at Vernon, NHDES issued a 401 Water Quality Certificate that required DO and temperature monitoring for the Vernon Project; sampling for this occurred in 2011 and 2012. In addition, water quality data (temperature, specific conductivity, pH, DO, nutrients, and chlorophyll-a) were collected by TransCanada in 2012 (Normandeau, 2013) in all three project areas from mid-June to mid-September as part of the 2012 Baseline Water Quality Study in accordance with a study plan that was reviewed and contributed to by NHDES and VANR.

Water quality data collected during the 2012 baseline study is representative of conditions during a low flow, warm weather period. Obtaining an additional year of water quality data during a warm weather period with more typical flows will better enable project effects to be distinguished from other factors that affect water quality. In addition, turbidity data and data from background monitoring stations upstream of the impoundments were not collected during the 2012 water quality sampling.

PROJECT NEXUS

The Wilder, Bellows Falls, and Vernon Projects impound respectively 45, 26, and 26 miles of the Connecticut River. The projects are operated primarily on a daily run-of-river basis, whereby over the course of a day, the projects pass the average daily inflow. Peaking often occurs during the course of the day, and the existing minimum flow requirements are 675, 1,083, and 1,250 cfs, respectively, although actual minimum flows are slightly higher to take advantage of generating unit efficiencies.

License authorized operating limits for Wilder, Bellows Falls, and Vernon impoundments are 5, 3, and 8 feet, respectively; daily fluctuations, based on inflow and operations, vary between projects but are in the range of 2 to 3 feet normally. Water quality, especially temperature and DO, can be affected by the impoundments and the operation of hydropower projects in general. This study will provide information on how the project operations may affect water quality within the impoundments and tailraces. This study will supplement TransCanada's 2012 study results included in Normandeau (2013). The data obtained by this study will document whether the Connecticut River in the vicinity of the projects is in compliance with the water quality standards of both states.

STUDY AREA AND STUDY SITES

The study area will include the Wilder, Bellows Falls, and Vernon impoundments, as well as riverine locations upstream of the impoundments, the project tailraces, the Bellows Falls bypassed reach, and the mouths of key tributaries. The study will include the same 13 stations sampled during 2012 and three additional background stations upstream of the influence of the three project impoundments. Thus, the study area will extend from above the upstream limit of the Wilder impoundment (at approximately river mile [RM]~~264~~265) to the tailwaters of the Vernon Project at the same station established during the 2012 sampling (V-TR). Station locations are described in Table 6-1 and Figure 6-1 depicts the approximate locations.

Table 6-1. Summary of water quality station locations, 2014.

Station ID	Description	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
W-04	Above the Wilder impoundment at about River Mile (RM) 265	44.12442	-72.04271
W-03	Wilder upper-impoundment at RM 259.0	44.10057	-72.04336
W-02	Wilder mid-impoundment at RM 236.0	43.88204	-72.17256
W-01	Wilder forebay at RM 217.5	43.66877	-72.30223
W-TR	Wilder tailrace - below dam and powerhouse at RM 217.3	43.66618	-72.30520

Station ID	Description	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)
BF-04	Above the Bellows Falls impoundment at about RM 202.3	43.47513	-72.38240
BF-03	Bellow Falls upper-impoundment at RM 194.5	43.45599	-72.39025
BF-02	Bellows Falls mid-impoundment at RM 184.4	43.29502	-72.40262
BF-01	Bellows Falls forebay at RM 173.8	43.13808	-72.44861
BF-BR	Bellows Falls bypass reach - approximately 2,100 feet below the dam in the bypassed reach	43.13620	-72.44040
BF-TR	Bellow Falls tailrace - below dam and powerhouse at RM 172.9	43.13156	-72.44179
V-04	Above Vernon impoundment at about RM 171.6	43.08745	-72.43449
V-03	Vernon upper-impoundment at RM 167.4	43.07041	-72.44458
V-02	Vernon mid-impoundment at RM 154.1	42.92997	-72.52601
V-01	Vernon forebay at RM 142.0	42.77271	-72.51082
V-TR	Vernon tailrace -below dam and powerhouse at RM 141.8	42.76932	72.51408

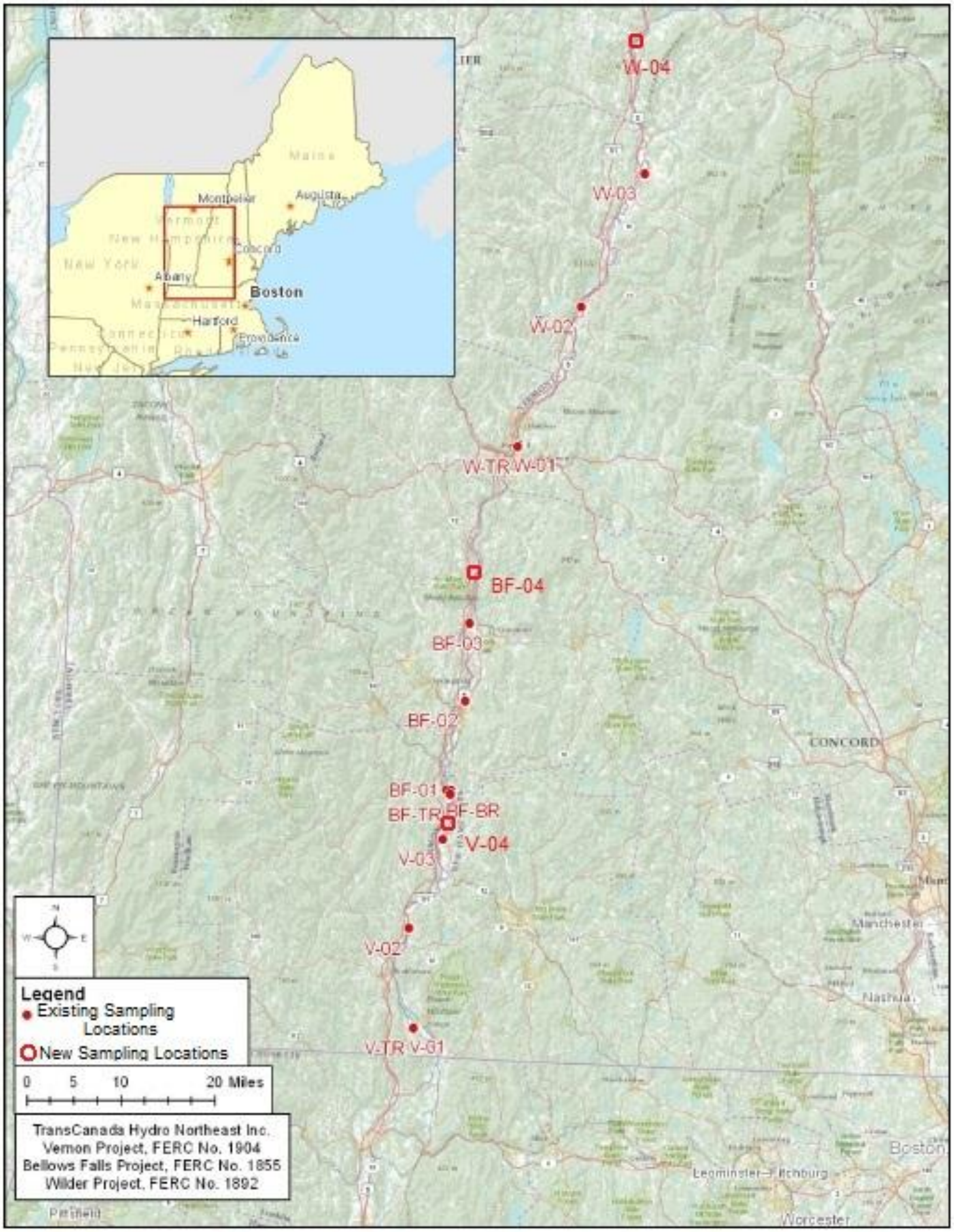

Figure 6-1. Locations of Connecticut River mainstem water quality monitoring stations, 2014.

Continuous water temperature monitoring at 15-minute intervals will be conducted at the mouths of the following 10 major tributaries to the Connecticut River: Waits, Ompompanoosuc, Mascoma, White, Sugar, Black, Williams, Cold, Saxtons, and West Rivers. Monitoring sites will be located such that the data are representative of the water temperature of the tributary inflow to the Connecticut River, but the exact locations will be located in the field as determined by access and the ability to capture representative water temperature of the tributary inflow. Continuous water temperature monitoring will also occur at the 16 locations in the Connecticut River as noted in the preceding paragraph. In addition, this study will include continuous water temperature monitoring at transects at the monitoring locations within the impoundments during the 10-day low flow period.

METHODS

The methodology for weekly impoundment vertical profiles, weekly impoundment nutrient and chlorophyll-*a* samples, and continuous (15-minute interval) datasondes for temperature, DO, specific conductivity, and pH in the project impoundments and tailraces will be similar as those used in the 2012 sampling program (Normandeau, 2013). It will not be feasible to conduct the weekly profiles in the three impoundments on the same day, but conditions permitting, the profiles will be conducted within three consecutive days of each sampling week. In addition, turbidity probes will be added to each of the mainstem Connecticut River multi-parameter datasondes. From the first week of June through September 30, tributary dataloggers will continuously monitor water temperature only. At each of the ~~three~~ four datasonde monitoring locations above or in the three impoundments, at least 10 days of data will be collected at 15-minute increments during a period of low flow (<3 x 7Q10) and high temperatures (preferably over 23°C) between June 1 and September 30.

At the datasonde monitoring locations within the impoundments, during the 10-day low flow and high temperature period, transects will be established for additional water temperature data collection. These transects will consist of three stations (including the mid-channel long-term datasonde) perpendicular to the flow with the water temperature dataloggers at depths of 1 meter, mid-depth, and 1 meter from the bottom recording at least 10 days of data at 15-minute intervals.

Study requesters recommended 15-minute increment water temperature datalogging at the transects and profiles from April 1 until November 15. However, the data from water temperature profiles and transects during the 10-day low flow and high temperature period, along with the other water temperature data will be sufficient to determine the effects of project operations on water temperature and to develop isotherm maps during the likely worst case time period for possible reservoir stratification. Continuous monitoring of water temperature at 15-minute intervals will occur in the fish ladders at all three projects from April, or after ice-out, through at least November 15, or when icing conditions preclude further monitoring, as specified in Upstream Passage of Riverine Fish Species Assessment (Study 17). Additional supplemental spring and summer water temperature monitoring will occur in near-shore habitat as described in Resident Fish Spawning in Impoundments and Riverine Sections (Studies 14 and 15). These water temperature data from the three other studies will provide sufficient characterization of the temperature regime of aquatic habitat without deploying additional temperature dataloggers in the spring and fall.

YSI 6920 V2 multiple-parameter water quality sondes will be used as in the 2012 study. The continuous monitors will be maintained, calibrated, and data-downloaded on a weekly basis during the monitoring period. This interval should be suitable for waters of relative high quality as found in this portion of the Connecticut River. Onset HOBO Water Temperature Pro v2 dataloggers or the equivalent will be used to record water temperatures at the 10 sites within the tributaries and the 9 mainstem Connecticut River stations not occupied by multi-parameter dataloggers. All sampling locations will be located and re-occupied by handheld GPS unit with a 10-foot horizontal level of accuracy. Table 6-2 below provides a summary of the water quality monitoring that will occur at each location and the sampling frequency and duration.

Table 6-2. Summary of water quality parameters, frequency, and duration to be monitored at each sampling location, 2014.

Task	Locations	Description	Sampling Frequency	Start Date	End Date
Continuous Monitoring with Multi-parameter Datasondes	W-01, W-TR, BF-01, BF-BR, BF-TR, V-01, and V-TR	Monitoring of DO, temperature, conductivity, turbidity, and pH via deployed datasonde with automatic logging	15 min.	1-Jun	30-Sep
Continuous Monitoring with Multi-parameter Datasondes	W-02, W-03, W-04, BF-04, BF-03, BF-02, V-04, V-03, and V-02	Monitoring of DO, temperature, conductivity, turbidity, and pH via deployed datasonde with automatic logging	15 min.	A 10-day low flow period between June 1 and Septemb er 30	N/A
Instantaneous Monitoring with Multi-parameter Datasondes	W-04, W-03, W-02, W-01, W-TR, BF-04, BF-03, BF-02, BF-01, BF-BR, BF-TR, V-04, V-03, V-02, V-01, and V-TR	Monitoring of DO, temperature, conductivity, turbidity, and pH via mobile datasonde. Measurements taken at 1 meter increments from the water surface to channel bottom	weekly	1-Jun	30-Sep

Task	Locations	Description	Sampling Frequency	Start Date	End Date
Water Sample Collection and Laboratory Analysis	W-01, BF-01, and V-01	Water samples collected as water column core from water surface to channel bottom. Laboratory analysis of nitrate/nitrite, total nitrogen, total phosphorus, total Kjeldahl nitrogen, and Chlorophyll-*a*	weekly	1-Jun	30-Sep
Water Temperature Continuous Monitoring	10 tributaries	Monitoring of water temperature with deployed datalogger	15 min.	1-Jun	30-Sep
Water Temperature Continuous Monitoring	W-04, W-03, W-02, BF-04, BF-03, BF-02, V-04, V-03, and V-02	Monitoring of water temperature with deployed datalogger	15 min.	1-Jun	30-Sep
Water Temperature Continuous Transect Monitoring	W-04, W-03, W-02, W-01, BF-04, BF-03, BF-02, BF-01, V-04, V-03, and V-02	Monitoring of temperature via deployed datalogger with automatic logging. Measurements taken at 1 meter increments from the water surface to channel bottom at three transect locations	15 min.	A 10-day low flow period between June 1 and Septemb er 30	N/A
Water temperature monitoring above Vermont Yankee discharge	V-02	Monitoring of temperature via mobile datalogger. Measurements taken at 1 meter increments from the water surface to channel bottom at three transect locations	weekly	1-Oct	15-Nov

Task	Locations	Description	Sampling Frequency	Start Date	End Date
Water temperature monitoring below Vermont Yankee discharge	V-01	Monitoring of temperature via mobile datalogger. Measurements taken at 1 meter increments from the water surface to channel bottom at three transect locations	weekly	1-Oct	15-Nov

Quality Assurance and Quality Control Procedures and Objectives

The inspection, testing, and maintenance of multi-parameter datasondes and dataloggers will be performed in accordance with the manufacturer's recommendations and the schedule included in Table 6-3. Datasondes and dataloggers deployed for continuous monitoring will be inspected for possible debris or fouling, cleaned as necessary prior to use or reuse, and tested through the Quality Control (QC) process outlined in Table 6-4. The condition of the sensors upon retrieval and deployment will be noted on the field data sheets. The water temperature dataloggers have an accuracy of +/-0.2°C in the 0° to 50°C range. Although the accuracy and reliability of these temperature units is quite high, temperature readings of the individual temperature dataloggers will be checked upon deployment and afterwards on a monthly basis by the use of a National Institute of Standards and Technology certified thermometer.

The Field Monitoring Team Leader will be responsible for the inspection, testing, and maintenance of field instruments for this project as summarized in Table 6-3 and 6-4. The Field Monitoring Team Leader will obtain spare parts and supplies for the datasondes and will review field notes from previous sampling events, to ensure that any previous equipment problems have been identified, and that all necessary repairs have been made.

Table 6-3. Summary of water quality instrument/equipment maintenance, testing, and inspection, 2014.

Equipment Name	Activity	Frequency of Activity	Acceptance Criteria	Corrective Action	Person Responsible
Multi-parameter Datasonde (YSI 6920)	Maintenance and Inspection (cleaning); Testing (operation)	weekly	Visible cleanliness; and normal operation	Repeat cleaning. If repeat cleaning does not correct the problem use alternate data logger.	Field Monitoring Team Leader

Equipment Name	Activity	Frequency of Activity	Acceptance Criteria	Corrective Action	Person Responsible
Onset HOBO Water Temperature Pro v2 dataloggers	Maintenance and Inspection (cleaning); Testing (operation)	monthly	Visible cleanliness; and normal operation	Repeat cleaning. If repeat cleaning does not correct the problem use alternate data logger.	Field Monitoring Team Leader

Instrument Calibration and Frequency

The multi-parameter datasondes will be calibrated and tested as per manufacturer's recommendations and outlined in Table 6-4 prior to use. At the continuous monitoring stations the sondes will be tested and calibrated prior to the initial deployment and downloaded and checked about halfway through the 10-day low flow period as well as at the end of the 10-day low flow period. During the weekly recurring sampling events the sonde will be tested and calibrated at the start of the sampling day and will be tested and calibrated again at the end of the sampling day.

All calibration data will be documented on field data sheets. When necessary, the batteries in the field instruments will be changed prior to calibration and redeployment of the instrument. The field crew will note on the field data sheet when batteries are changed.

Table 6-4. Water quality instrument calibration and frequency, 2014.

Instrument/Equipment	Calibration Method	Calibration Frequency
Water Temperature	Default Factory Calibration will be used	Check calibration upon deployment and afterwards on a monthly basis by the use of a National Institute of Standards and Technology certified thermometer.
Dissolved Oxygen	Saturated Air Method	Calibrate at start of sampling day (weekly profiles) or at time of data download (continuous monitors). Check calibration at end of sampling day (weekly profiles) and as needed
Specific Conductivity	One Point Calibration Method	Calibrate at start of sampling day (weekly profiles) or at time of data download (continuous monitors). Check calibration at end of sampling day (weekly profiles) and as needed

Instrument/Equipment	Calibration Method	Calibration Frequency
pH	Two Point Calibration Method	Calibrate at start of sampling day (weekly profiles) or at time of data download (continuous monitors). Check calibration at end of sampling day (weekly profiles) and as needed
Depth	One Point Calibration Method	Calibrate prior to vertical profile or deployment
Turbidity	Two Point Calibration Method	Check calibration on a monthly basis with zero NTU and 126 NTU solutions

ANALYSIS

Water quality results from this study as well as incidental data collected during other aquatic studies will be graphically compared to both state water quality standards and project operations, including hourly generation, impoundment elevation, discharge, and daily weather conditions at nearby National Oceanic and Atmospheric Administration (NOAA) weather stations during the study period, and will be compared to historical average daily weather conditions. In addition, the average daily flows at the West Lebanon and Walpole USGS gages during the May 15 to September 30 period as compared to the average daily values for the 1972 to 2012 period will be provided. The water quality results from this study will also be compared to water quality data gathered in 2012 to contrast weather and flow conditions between the two sets of water quality data. The information acquired will be used to qualify and quantify water quality data for the Connecticut River including background and tributary inflows, and identify project operations that may affect water quality. The possible effects of different flow and weather conditions during the different days that the weekly reservoir profiles are conducted will also be analyzed.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

This study involves collecting water quality data using methods and equipment generally accepted by the scientific community.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will present the results of the 2014 water quality monitoring program incorporating continuous temperature monitoring in the project fish ladders and compare the results with the 2012 water quality monitoring data presented in Normandeau (2013). As requested, water quality data will be provided to the NHDES in an Excel format suitable for uploading to their Environmental Monitoring Database.

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Water quality sampling specific to this study will begin by the first week in June and continue through ~~September 30~~November 15 of the first study year (2014). Water quality monitoring associated with other studies will be as described in those study plans.

LEVEL OF EFFORT AND COST

The preliminary estimated cost of this study is $~~185~~205,000 for ~~a~~ this one-year monitoring program.

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998-2010). Concord, NH.

Normandeau (Normandeau Associates, Inc.). 2013. 2012 Baseline Water Quality Study. Wilder Hydroelectric Project No. 1892, Bellows Falls Hydroelectric Project No. 1855, Vernon Hydroelectric Project No. 1904. Agency Draft Report. Prepared for TransCanada Hydro Northeast, Inc. February 8, 2013.

Updated Study 7

Aquatic Habitat Mapping Study

RELEVANT STUDY REQUESTS

FERC-05

STUDY GOALS AND OBJECTIVES

In its study request, FERC identified issues related to potential effects on fish and aquatic resources due to operations of the Wilder, Bellows Falls, and Vernon projects. Specifically, low flow conditions and low impoundment water levels at certain times may affect the ability of fish and other aquatic species to use aquatic habitats.

The goal of this study is to survey, identify and map aquatic habitat at the Wilder, Bellows Falls, and Vernon Project-affected areas and assess potential effects under current operations.

The objectives of this study are to:

- survey and map the aquatic habitat types distributed within the project impoundments, tailwaters, and downstream riverine corridors from the upper extent of the Wilder impoundment and downstream to Vernon dam, including the Bellows Falls bypassed reach and the tailwater just below Vernon dam; and

- describe potential influences of project impoundments and project operations on the distribution of aquatic habitat within the reaches to be assessed.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Since only FERC requested this study, there are no relevant resource management goals of agencies or Indian tribes with jurisdiction over the subject resources that directly apply to this study. However, since this study will inform numerous other studies as described below, resource management goals listed in the associated study plans can be considered relevant to this study.

ASSOCIATION WITH OTHER STUDIES

Aspects of several other studies are dependent on information gathered from this aquatic habitat mapping study. For all studies listed below, acquisition of aquatic habitat mapping data will need to be completed prior to commencement of these interdependent studies.

- Instream Flow Study (Study 9) will use the results of this study to assist with study site and transect selection and, to some extent, the proposed study method (i.e., 1-D, 2-D, Demonstration Flow Assessment).

- Resident Fish Spawning in Riverine Sections Study (Study 15) will use habitat types, depth, and substrate information derived from this study to locate suitable spawning habitat and assess project effects.

- Tributary and Backwater Area Fish Access and Habitats(Study 13)will use aquatic habitat data and bathymetry information collected during impoundment mapping as part of its assessment.

- Aquatic habitat data will be used in the analysis of distribution of resident riverine and diadromous fish species within project-affected areas (Studies 10, 11 and 12).

- Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27) will use aquatic habitat and bathymetric data to define the littoral zone, quantify the effects of water level changes on wetland and littoral vegetation communities, and quantify suitable habitat for aquatic vegetation.

- Temperature data collected in this study will also supplement data collected in the Water Quality Study (Study 6).

- Hydraulic Modeling Study (Study 4) and Operations Modeling Study (Study 5) will rely on the results of this study for modeling purposes, and these models will determine the association and effect of project operations on conditions observed at specific locations within the impoundments and downstream affected areas. These tools are critical for evaluating and determining potential influences of project operations on the distribution of aquatic habitat within the reaches to be assessed. They will also be critical to assessing project-related association and effects within the above-mentioned associated studies as well as numerous other studies.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Minimal information exists pertaining to characteristics, types, and proportions of aquatic habitat within the project impoundments, tailwaters and riverine reaches. A localized qualitative habitat evaluation was conducted by Yoder et al. (2009) in a few selected sites in conjunction with the assessment of fish assemblage in the mainstem Connecticut River. Specific aquatic habitat data within all project reaches is lacking, and this study will serve to fill those data gaps

PROJECT NEXUS

Currently, water levels in the impoundments, tailwaters, and downstream riverine areas fluctuate due in part from the daily operations of all three projects. In addition, there is no minimum flow requirement in the Bellows Falls bypassed reach. As a result, aquatic habitats may be exposed under low flow conditions, and low impoundment water levels may be adversely affected and/or not used by aquatic species during various life stages. Changes in flow or periods of low flow may also cause stranding and associated mortality of fish or other aquatic species (e.g., mussels and macroinvertebrates).

This study will help establish a baseline condition of aquatic habitats in the Connecticut River from the head of the Wilder impoundment to Vernon dam under current licensed project operations.

STUDY AREA AND STUDY SITES

The study area includes all project impoundments and riverine sections of the Connecticut River from the Wilder Project to downstream of Vernon dam. Impoundment sections include from Wilder dam upstream 45 miles, from Bellows Falls dam upstream 26 miles, and from Vernon dam upstream 26 miles. The total run-of-river distance of impoundments is approximately 97 miles. Riverine reaches consist of a 17-mile segment downstream of Wilder dam, a 6-mile segment downstream of Bellows Falls dam and approximately 1.5 miles downstream of Vernon dam to the downstream extent of Stebbins Island. In addition, the 3,500-foot-long Bellows Falls bypassed reach will be mapped as will the immediate tailwater section below Vernon dam.

METHODS

Aquatic habitat differs between lotic (flowing water) and lentic (standing water) ecosystems. As a result, the aquatic habitat mapping process and types of habitat identified differ. Bathymetric and habitat mapping of the lentic impoundment sections are anticipated to begin in the spring\summer of 2013. It is TransCanada's intent to conduct the bathymetric and habitat mapping of the three project impoundments with water levels at or near full pond elevations. TransCanada relicensing staff will consult with operations staff and work toward achieving these conditions to the extent allowable. Mapping of lotic riverine reaches will take place at the minimum flow or lowest flow available at the time of the survey. Mapping the lotic riverine reaches during these conditions will allow for the determination and mapping of the entire transition area from riverine to impounded habitat. As with the bathymetric and habitat mapping of the project impoundments, operations staff will be consulted to work toward achieving these conditions to the extent allowable. In addition to bathymetric and habitat mapping, information on changes in water surface elevations in selected mainstem, setback and tributary mouth locations will be collected using Onset HOBO water level data loggers.

Impoundment Aquatic Habitat and Bathymetry Survey Methods

Impoundment habitat data will be collected using a side scan sonar system (Humminbird® 1197c, Side Imaging system).Impoundment bathymetric data will be collected using a 200-kHz Odom® Hydrotrac single-beam echosounder (<0.03-ft (~0.01-m) vertical accuracy). This echosounder will be calibrated on a daily basis using the industry standard bar check method. Collection of habitat and bathymetric data in the impoundments will use a Real Time Kinematic (RTK) unit (Leica® Viva GS14) for positional information. The RTK unit has a horizontal positional accuracy of less than 0.03 inches (0.01 m) and will provide vertical water surface positional information at an accuracy of less than 0.1 ft (0.02-0.03 m) to compensate for fluctuations in water levels as well as differentials in water surface elevations within each impoundment. This allows the bathymetry survey to output river bed surface elevations by calculating the difference of the elevation of the survey vessel and the water depth while the survey is in progress. The RTK unit also provides horizontal positional information necessary for geo-referencing the side scan images collected for the assessment of impoundment habitat data.

Bathymetry and habitat data will be collected along pre-determined survey lines and can be collected concurrently in the central portions of the impoundments where the equipment used will operate on separate frequencies that do not interfere with each another. Bathymetry and habitat data will be collected separately along the shorelines of the impoundments to avoid interference between the collection of bathymetric data by the Odom echosounder and the 800 kHz side scan sonar frequency. Collection of shoreline impoundment habitat data using the side scan sonar data will occur only when the impoundment is within normal elevation range to ensure complete coverage of the shoreline habitat. Bathymetry data will be collected at a 2-foot interval scale in the center of the impoundments, and 1-foot interval scale in the backwater areas and along the shoreline of the impoundments, which will provide sufficient detail to assess the potential effects of reservoir fluctuations on aquatic habitat*.

Portions of the Wilder, Bellows Falls, and Vernon impoundments will not be able to be mapped using side scan sonar due to shallow water depths, turbulence (i.e., near rapids or falls), or dense beds of aquatic vegetation. Results from sections of the impoundments that are not accessible for quantification by side scan sonar will be presented in geo-referenced substrate classifications conducted using a technique appropriate for the conditions (e.g., view tube, ponar grab, wading). Those observations will be imported into GIS and used in conjunction with results of the side scan surveys.

Impoundment Habitat Data Processing

Accurate side scan track data will be imported into GIS and used to reference the sonar imagery to its place on the river bottom. The imported imagery will be used to create a GIS shapefile in PNG format with 2- to 4-inch resolution. The resulting shapefile will be subjected to visual quality control inspection for positional accuracy and image quality. When sufficient images are present to provide coverage of the impoundments, dominant habitat types will be delineated resulting in a 2-D representation of the riverbed divided into habitat types. A total of six substrate types will be identified based on the dominant habitat type, (1) sand/silt/clay, (2) gravel/cobble, (3) boulder, (4)rip-rap, (5) ledge, and (6) woody debris. Given the resolution provided by this technique, it is not possible to differentiate substrate types finer than gravel, and as a result, sand, silt and clay will be grouped into a single class. Likewise, gravel and cobble will also be classified as a single category,

* Mapping at 1-foot intervals beyond backwaters and shorelines remains under consideration; however, TransCanada believes that mapping at 1-foot in all areas less than 10 feet makes this approach unwarranted due to the high cost and effort needed to collect and process this level of data for any limited added informational benefit.

because the particle sizes cannot be differentiated in some cases. Habitat types will be delimited down to a minimum map unit of 100 ft^2 (0.002 acre). However, in most cases habitats smaller than this area will be discernible and included in the substrate dataset. The final product of this process will be a GIS shapefile containing the aquatic habitat types for each of the three project impoundments.

Classifications of all habitat types from side scan imagery will be validated while in the field. Validation of substrate classifications will consist of visual assessment using a view tube within shallow water habitats and/or clear water conditions. A copper pole or chain drag technique will be used to validate substrate classifications in deep water habitats or poor visibility conditions. These techniques rely on the resonance associated with the hardness and size of different substrate types as they come into contact with the metal probe. Ponar grab samples may also be employed for validating substrate classifications in deeper water areas. Each of these validations will have a recorded position associated with them and will be used as a quality control check for comparison to the final side scan impoundment habitat product.

Impoundment Bathymetric Data Processing

Bathymetric data will be imported into GIS, and positional data will be audited for outliers. The upper elevation of the operational range for each impoundment will be digitized based on available digital orthophotos and verified through the use of field observations during periods when inflows approach station capacity and/or during scheduled periods when impoundments are full. Using GIS, bathymetric data points will be spatially subsampled and interpolated to create a 3-D surface. The resulting surface will be verified by field observations and aerial photography. The 3-D surfaces generated for each impoundment will be converted to a series of 2-foot bathymetric contours with 1-foot bathymetric contours in the littoral portions of the impoundments.

Bathymetric data collected in each of the project impoundments will be subjected to the standardized guidelines and requirements for processing and generating deliverables for the NOAA Office of Coastal Survey hydrographic surveys (NOAA 2013). As part of this quality control process, the accuracy of soundings will be validated by checking the observed depth with a calibrated sounding pole or lead line deployed alongside the echosounder. In addition to field confirmation of soundings, the recorded depths at the intersections of crossing survey transects will be evaluated for differences using the Cross Check module of Hypack survey software. The observed differences in replicate depth readings will be summarized and the accuracy of the survey methods used to generate project bathymetry in the Wilder, Bellows Falls and Vernon impoundments will be included in the study report.

Riverine Aquatic Habitat Methods

Riverine habitat mapping will be performed drifting downstream in a small johnboat equipped with oars and a small outboard motor, or by canoe if boat access is limited or difficult. A depth transducer mounted to the side of the boat and a Trimble GPS unit attached to an onboard laptop computer or data logger will be used to continually monitor depth and record real-time GPS positions. The GPS will also be used to record habitat boundaries and any other features such as islands, split channels, and tributaries. In addition, a hand-held GPS unit will record habitat unit boundaries as a backup. In shallow areas, the survey will generally follow the thalweg (deepest part of the channel). In long pools and runs, the survey crew will attempt to locate the deepest portion of the channel. In instances of islands or split channels, the primary channel will be mapped, and a visual examination will be performed on the secondary channel to determine habitat type correspondence between the two channels. If differences are noted, the other channel will also be mapped. The Bellows Falls bypassed reach will be mapped on foot.

Riverine habitat types are often referred to as mesohabitats. Generally the three major mesohabitat types recognized are pool, run, and riffle although these types are often broken down into sub-types depending on the river channel morphology. Unless a specific type of habitat is considered important for a given aquatic species, the actual habitat types are not as critical as being consistent in identifying those types in the field. For this study the mesohabitat types expected to be used are:

- Pool – deep, low velocity with a generally well defined control and retains water at zero discharge;
- Glide – shallow with moderate velocity distributed across the channel, without a well-defined thalweg, sometimes referred to as shallow pool if velocities are low;
- Run – deep to moderately deep with fast velocity in a well-defined thalweg, surface may be turbulent, substrate variable;
- Riffle – shallow with gravel, cobble, or boulder substrate, fast water with turbulent flow or white-water, possible exposed substrate;
- Rapid – shallow bedrock, boulder with turbulent white-water flow and possible exposed substrate, may be brief and abrupt across the stream channel or extend for a greater distance; and
- Other – may include backwaters or other mesohabitat types if primary types are believed to be insufficient for characterization. The mapping protocol will allow for additional types or sub-types to be added according to the best judgment of the field personnel.

Pool and run habitat may be broken down further into deep and shallow depending on results of depth distributions derived from mapping results. Additional information that will be collected for each mesohabitat unit includes dominant and subdominant substrate and bank or instream cover type (ledges, boulders, vegetation, etc.). Substrate will be classified into (1) organics, (2) silt and clay,(3) sand,(4) gravel, (5) cobble,(6) boulder, and (7) bedrock.

Water Surface Elevation Monitoring

Onset Hobo water level loggers (vertical accuracy of +/- 0.1 in) will be installed at selected locations over the entire length of the study area. Information collected from these loggers will include water depth and 15-minute continuous temperature readings. Data collected will be used to describe potential influences of project impoundments and project operations on available aquatic habitat as well as other natural resources. Loggers will be installed at pre-determined locations (Table 7-1 and Figures 7-1 through 7-11) and their positions will be geo-referenced using RTK positional information so that their exact elevation is known relative to the specific project operational water levels (e.g. full pond).Proposed locations were selected to provide data for one or more of the following objectives:

- Hydraulic modeling (HEC-RAS) simulating river flow through impoundments and river reaches (Study 4)
- Assessment of project related erosion (Studies 1, 2, and 3)
- Assessment of changes in water surface elevations associated with project operations on setback habitat
- Assessment of changes in water surface elevations associated with project operations on tributary confluence area habitat
- Data collection of air barometric pressure required for the post-processing calculation of logger water depths

The level logger locations in Table 7-1 and Figures 7-1 through 7-11 include 68 sites and are proposed locations. TransCanada encourages applicable working groups to provide input into additional or alternative locations for data collection.

Table 7-1. Purpose and location of data loggers.

Site Number	Purpose	Comments	Study Area	Latitude	Longitude
1	HEC-RAS/ Erosion	Top of Wilder Haverhill, NH	Wilder	44.10301269	-72.0414226
2	Tributary	Haverhill, NH	Wilder	44.04782442	-72.06380857
3	HEC-RAS/ Erosion	South of Haverhill, NH	Wilder	44.01387998	-72.0987124
4	Setback	E Side, South of Haverhill, NH	Wilder	44.0103165	-72.08962096
5	Setback	Bradford, VT, Waits River	Wilder	43.99693061	-72.11780901
6	Barometer	Near Small Oxbow Setback sensor in Piermont, Northern Wilder Barometer	Wilder	43.97208156	-72.10735388
7	Setback	E side, Small Oxbow, Piermont, NH	Wilder	43.97162075	-72.10620485
8	HEC-RAS/ Erosion	Piermont, NH	Wilder	43.9682857	-72.09601695
9	Tributary	E side, Piermont, NH	Wilder	43.96773747	-72.0898037
10	HEC-RAS/ Erosion	North of Orford, NH	Wilder	43.91524466	-72.12621517
11	Setback	East side, North of Orford, NH	Wilder	43.91149844	-72.12822534
12	Setback	West side, South of Fairlee, VT	Wilder	43.88956932	-72.16609874
13	Setback	West side, North Thetford BR	Wilder	43.84132528	-72.18473849
14	Erosion/ HEC-RAS	Property: River rd at Lyme, South of N Thetford rd	Wilder	43.83922374	-72.18218009
15	Erosion/ HEC-RAS	Mudge Property	Wilder	43.82364493	-72.18715983
16	Erosion/ HEC-RAS	Between McIntyre and other property 1/4mi south of E Thetford Bridge	Wilder	43.8106702	-72.18227146
17	Setback	DS of Mudge Property and Grant brook	Wilder	43.79495434	-72.19017508
18	Setback/ Tributary	Hewes Brook	Wilder	43.78595427	-72.20040866

Site Number	Purpose	Comments	Study Area	Latitude	Longitude
19	Barometer	Near Hewes Brook Trib, Southern Wilder Barometer	Wilder	43.78540577	-72.20087804
20	Setback	Ompompanoosic west of 91	Wilder	43.7594839	-72.23536013
21	Setback/ HEC-RAS	E side, opposite Ompompanoosic River	Wilder	43.74977123	-72.22649517
22	Setback	West side below Ompompanoosic River	Wilder	43.74651952	-72.2363422
23	Erosion/ HEC-RAS	Pine Park, Dartmouth campus	Wilder	43.71344311	-72.28915482
24	Setback	Bloody brook 2, west side	Wilder	43.7033009	-72.30381991
25	Setback	Mink Brook, east Side	Wilder	43.69580845	-72.29587061
26	Tributary	Bloods brook, Large Sandbar	Wilder Riverine	43.6061732	-72.32702822
27	Setback	Small Backwater, West side	Wilder Riverine	43.586437	-72.35631272
28	Setback	Mainstem, paired with Small backwater West side logger	Wilder Riverine	43.58460958	-72.35535332
29	Setback	West side	Wilder Riverine	43.52585783	-72.39496278
30	Barometer	Near Bellows Riverine Setback	Wilder Riverine	43.52525965	-72.39520978
31	Setback	Mainstem, paired with west side hobo	Wilder Riverine	43.52485274	-72.39231302
32	Tributary	Blow-me-down brook, delta	Wilder Riverine	43.49415199	-72.37929261
33	Tributary	Mill Brook 4, West side, impacted upstream?	Wilder Riverine	43.47231425	-72.38719622
34	Tributary	Mill Brook 3, East side, Sand Bar	Wilder Riverine	43.47071525	-72.38596271
35	Erosion/ HEC-RAS	Lipfert Property, top of impoundment	Bellows	43.43658807	-72.39372927
36	Tributary	Mill Brook 2, Sand bar	Bellows	43.40163854	-72.40181563
37	Tributary	Blood Brook, sand bar	Bellows	43.36440474	-72.41474467
38	Tributary	Barkmill Brook, Sand bar	Bellows	43.36202908	-72.41200353

Site Number	Purpose	Comments	Study Area	Latitude	Longitude
39	HEC-RAS	Near Little Sugar R	Bellows	43.30741874	-72.3982702
40	Barometer	Near L. Sugar River Trib sensor	Bellows	43.30621465	-72.39650898
41	Tributary	Little Sugar River Sand Bar	Bellows	43.30615553	-72.39706432
42	Setback	Black river mouth	Bellows	43.26291977	-72.43183872
43	Setback	East side of River	Bellows	43.21116935	-72.43287997
44	HEC-RAS/ Erosion	US of Williams River	Bellows	43.19279328	-72.44530569
45	Setback	Herricks Cove	Bellows	43.18000565	-72.44789532
46	Setback	West side	Bellows	43.16621162	-72.44655521
47	Setback	East Side Behind RR	Bellows	43.15354147	-72.45780911
48	Tributary	Saxtons River Gravel bar	Vernon Riverine	43.12496631	-72.43771539
49	Barometer	Cold River	Vernon Riverine	43.11871233	-72.43045248
50	Tributary	Cold River Gravel Bar	Vernon Riverine	43.11796025	-72.43139257
51	HEC-RAS	Near Cobb Brook	Vernon Riverine	43.09451547	-72.43794799
52	Tributary	Cobb Brook Braided bar	Vernon Riverine	43.09446343	-72.43895735
53	Tributary	Great Brook Gravel bar	Vernon	43.04143539	-72.4579178
54	Tributary	Chase Brook Gravel bar	Vernon	43.01615053	-72.45427597
55	Tributary	Mill Brook 1, Big Gravel bar at mouth	Vernon	42.99883567	-72.45400186
56	HEC-RAS/ Erosion	Near E Putney Brook	Vernon	42.98691791	-72.46264883
57	Tributary	East Putney Brook Gravel Bar at mouth	Vernon	42.98594662	-72.46401396
58	Tributary	Canoe Brook Gravel bar at mouth	Vernon	42.94658237	-72.53127633
59	Tributary	Salmon Brook Gravel bar at mouth	Vernon	42.93439121	-72.52671733
60	Tributary	Catsbane brook	Vernon	42.91063467	-72.52498127

Site Number	Purpose	Comments	Study Area	Latitude	Longitude
61	Barometer	Near Catsbane Brook trib sensor	Vernon	42.91057349	-72.52647763
62	HEC-RAS	West river	Vernon	42.86932033	-72.55396104
63	HEC-RAS	West river	Vernon	42.86742366	-72.56000694
64	Setback	West river	Vernon	42.8615226	-72.56229122
65	Setback	Cersisimo Pool, documented Shad spawning and rearing site	Vernon	42.83117999	-72.54953973
66	Setback	Ash Swamp Brook	Vernon	42.80106497	-72.52725336
67	HEC-RAS/ Setback	For comparison to Ash Swamp Brook Setback	Vernon	42.79771999	-72.52851774
68	Setback	West side below Vernon Dam	Vernon Downstream	42.76727358	-72.51590984

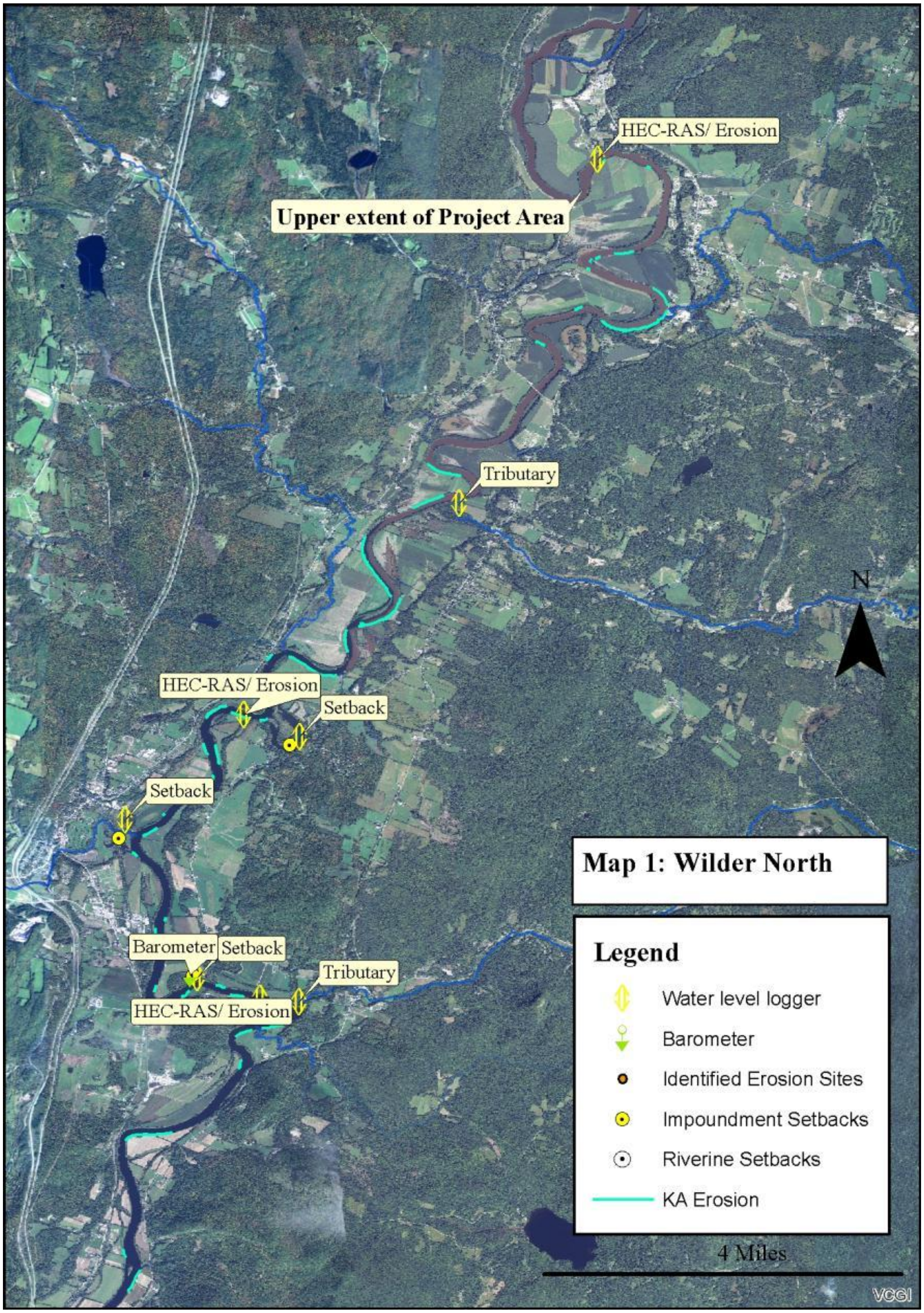

Figure 7-1. Placement of data loggers in Wilder north impoundment.

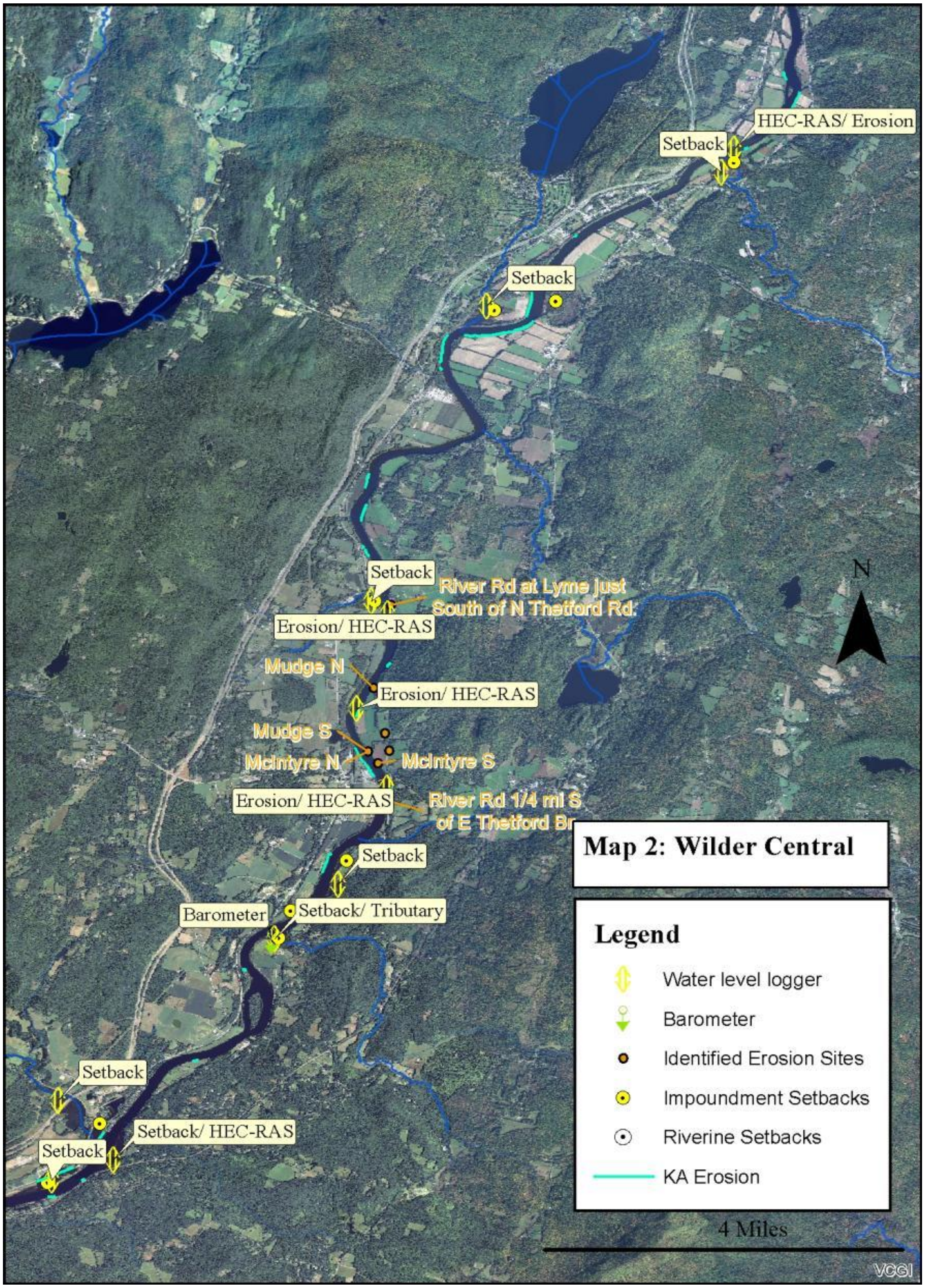

Figure 7-2. Placement of data loggers in Wilder central impoundment.

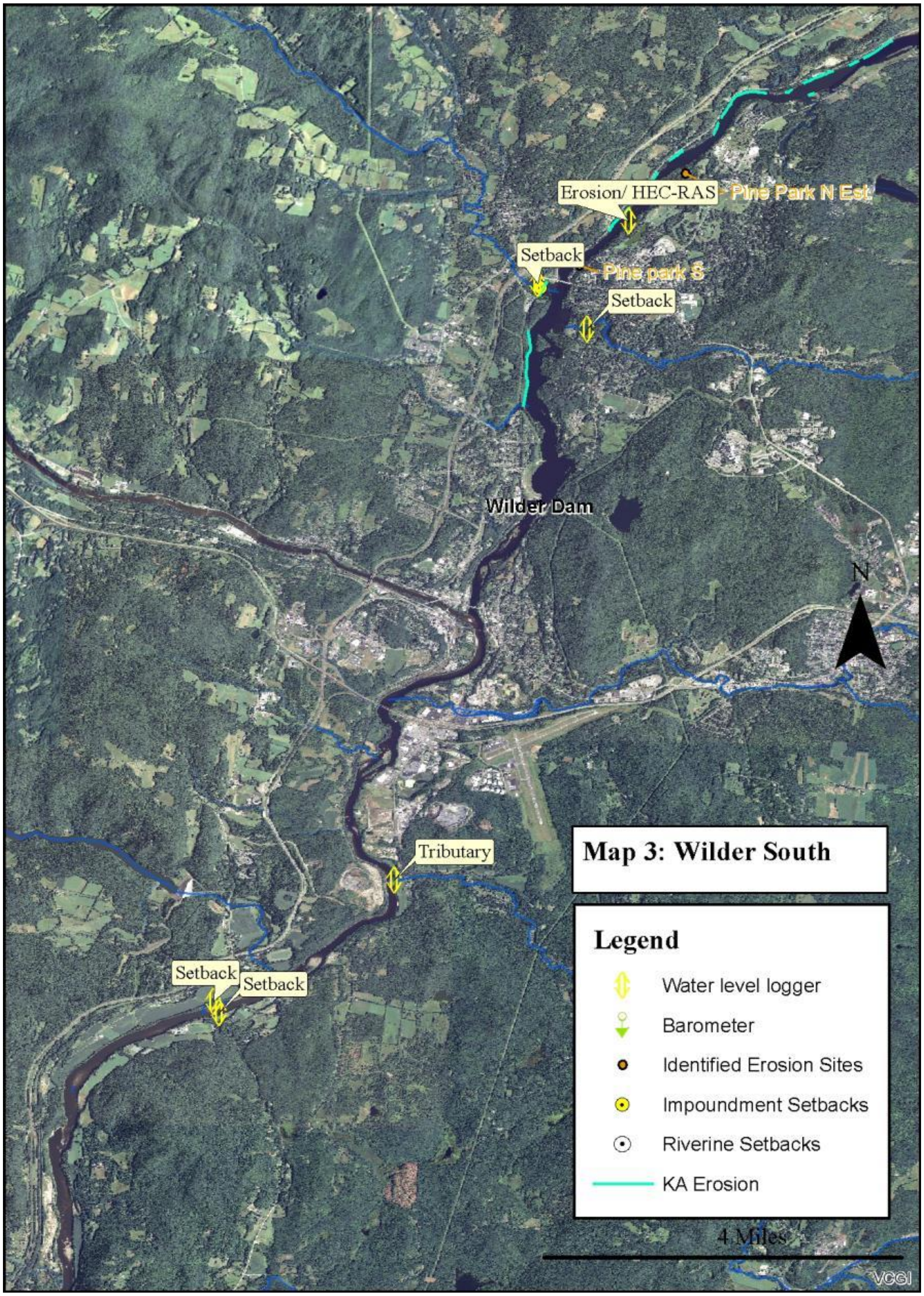

Figure 7-3. Placement of data loggers in Wilder south impoundment and riverine section.

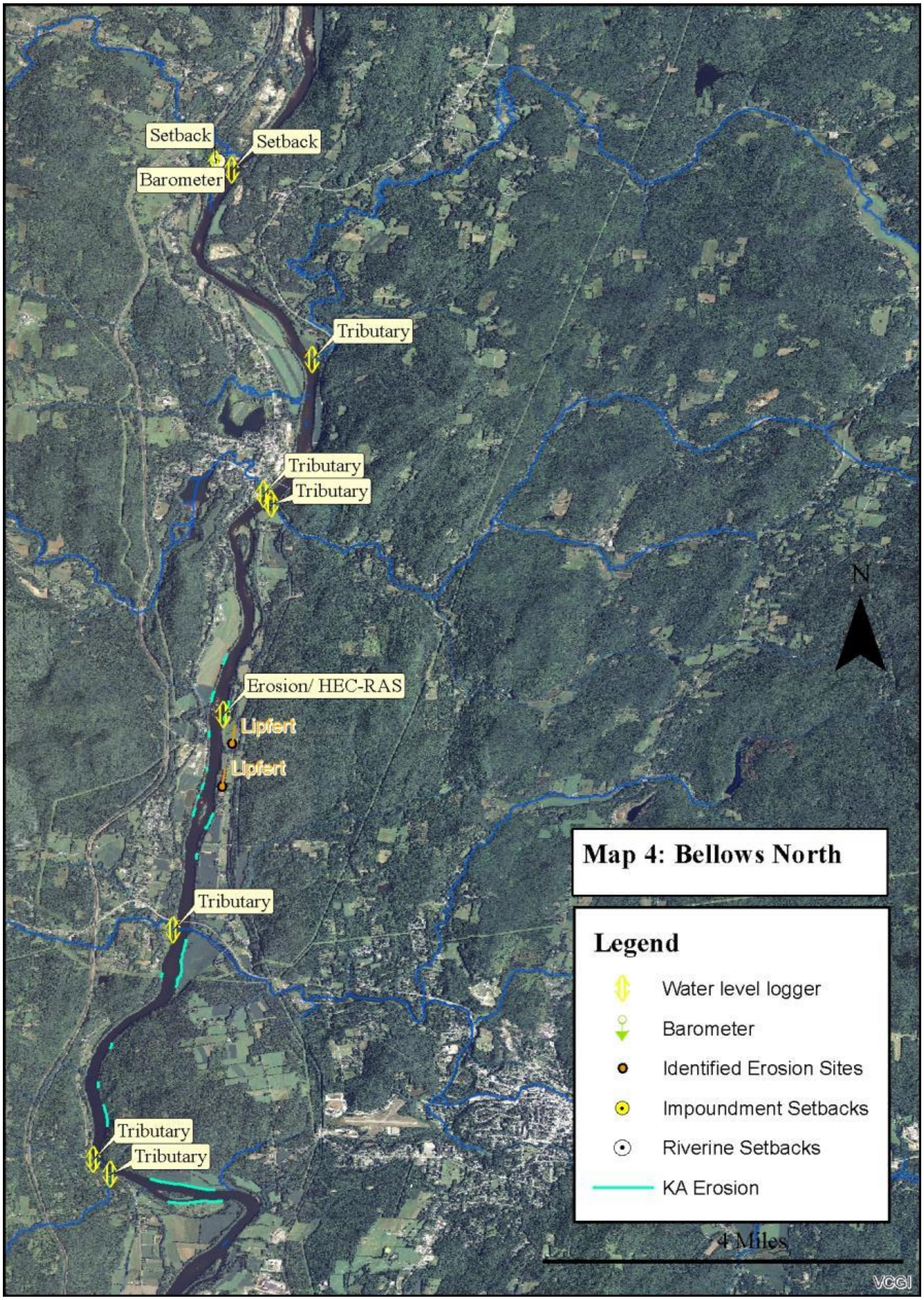

Figure 7-4. Placement of data loggers in Bellows Falls north impoundment.

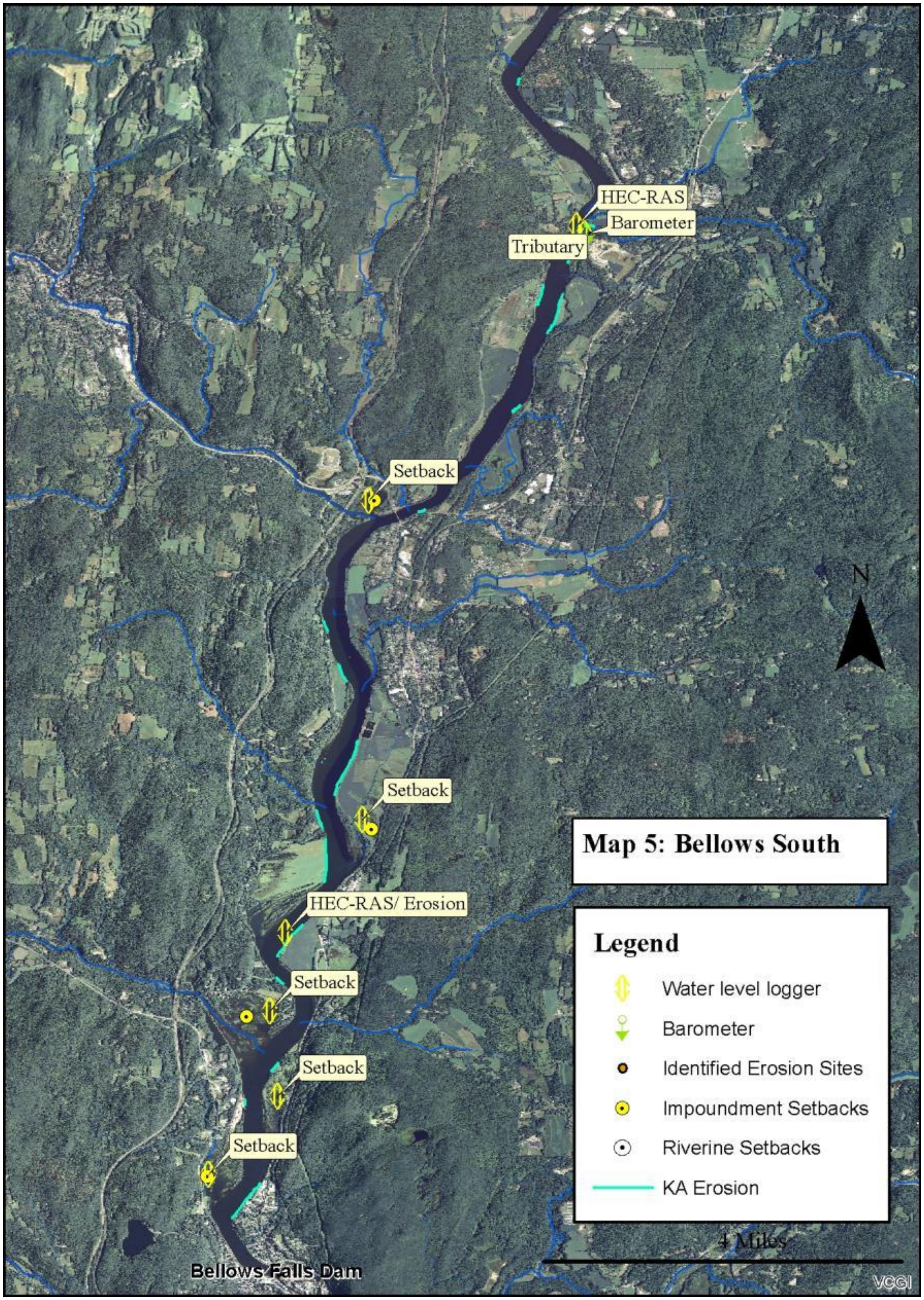

Figure 7-5. Placement of data loggers in Bellows Falls south impoundment.

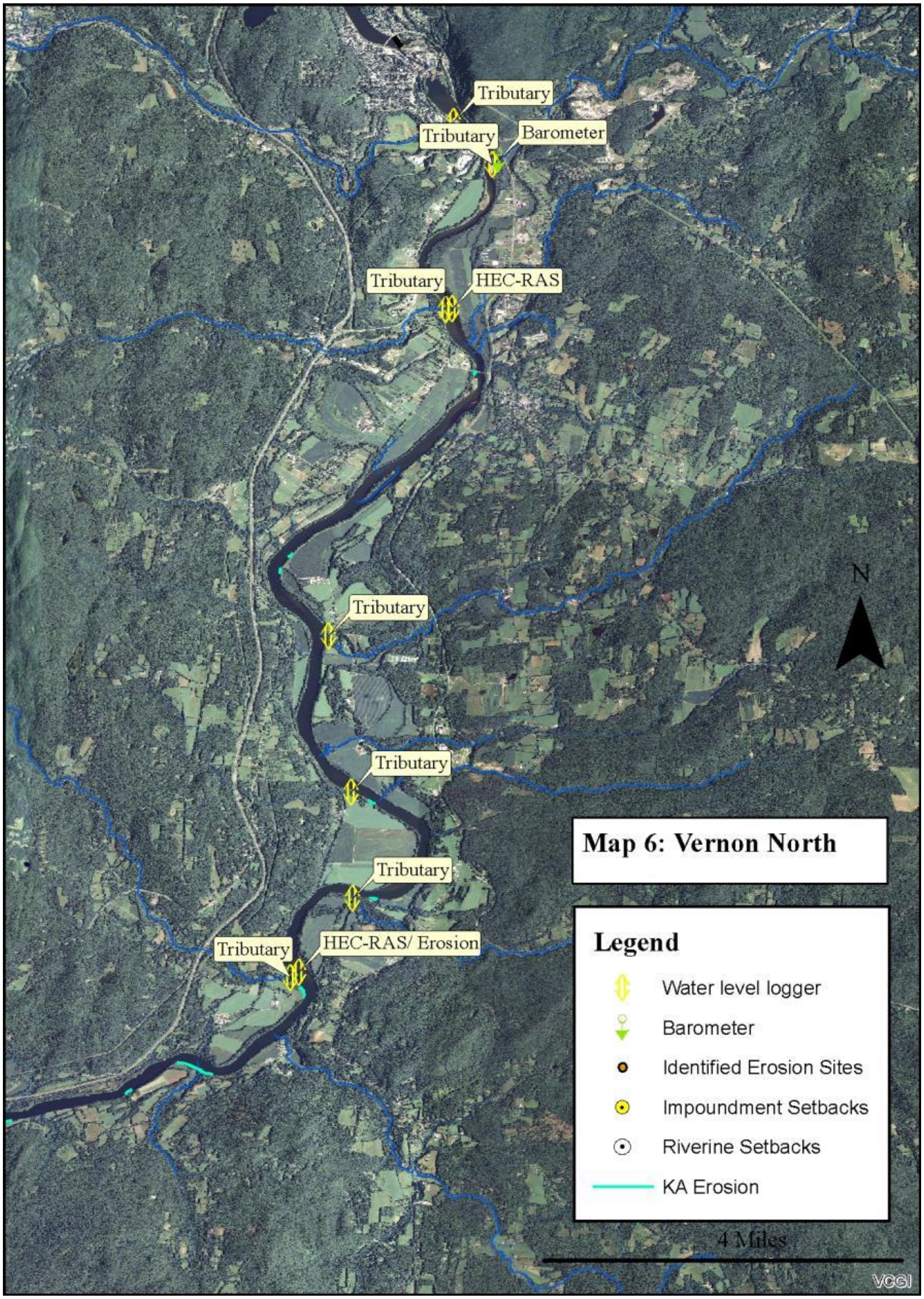

Figure 7-6. Placement of data loggers in Bellows Falls riverine section and Vernon north impoundment.

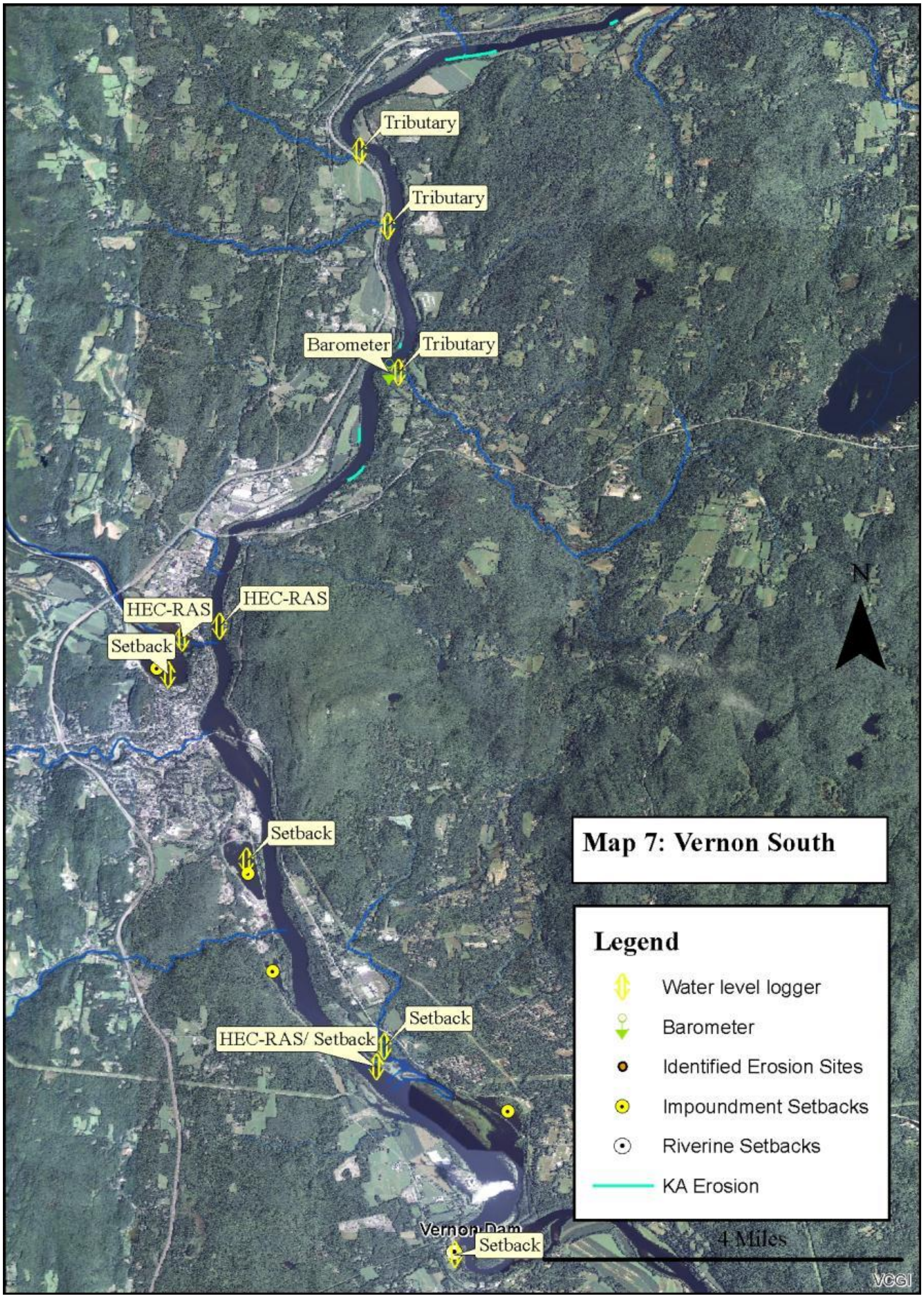

Figure 7-7. Placement of data loggers in Vernon south impoundment and tailwaters.

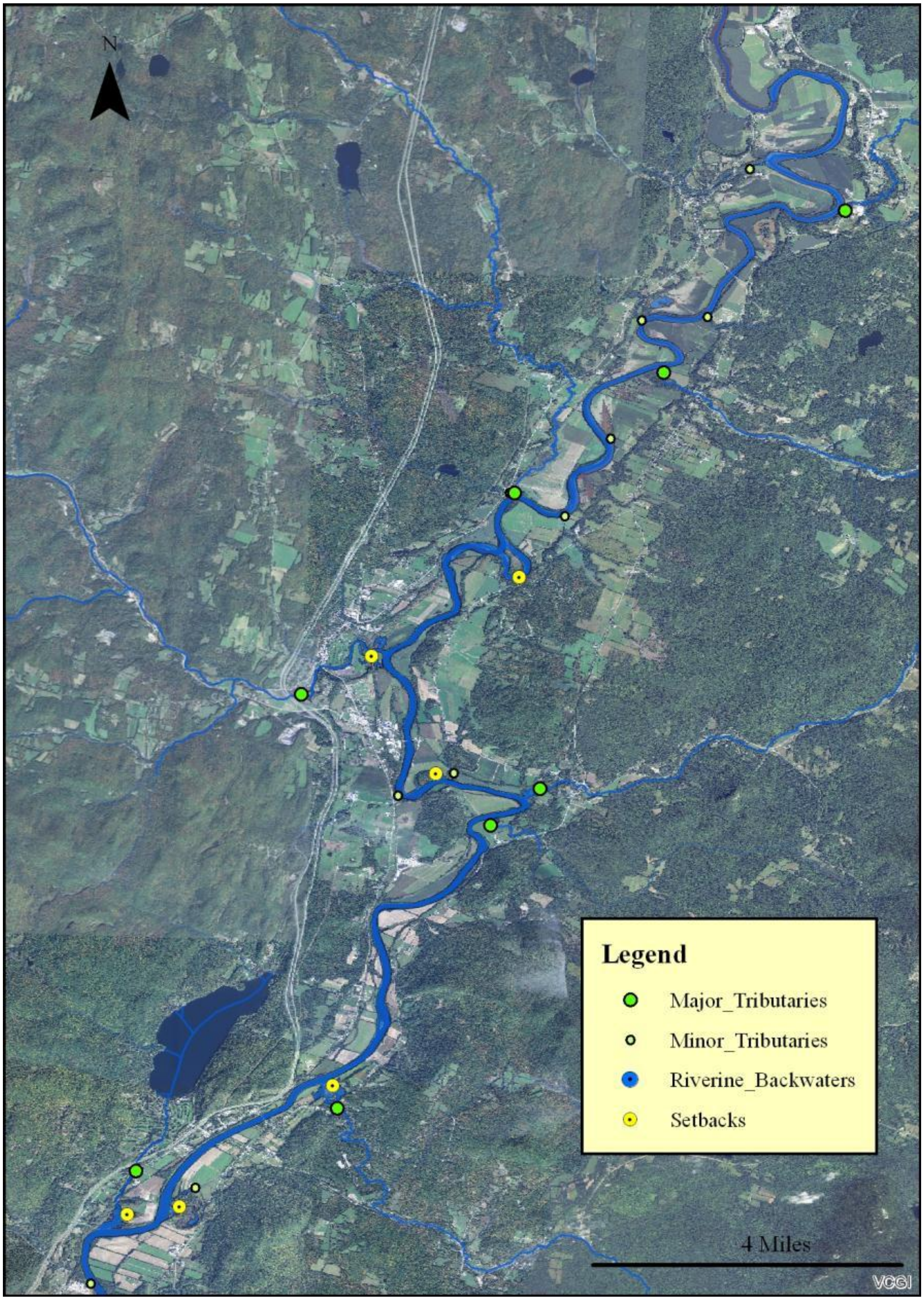

Figure 7-8. Placement of data loggers in Wilder north tributaries, backwaters and setbacks.

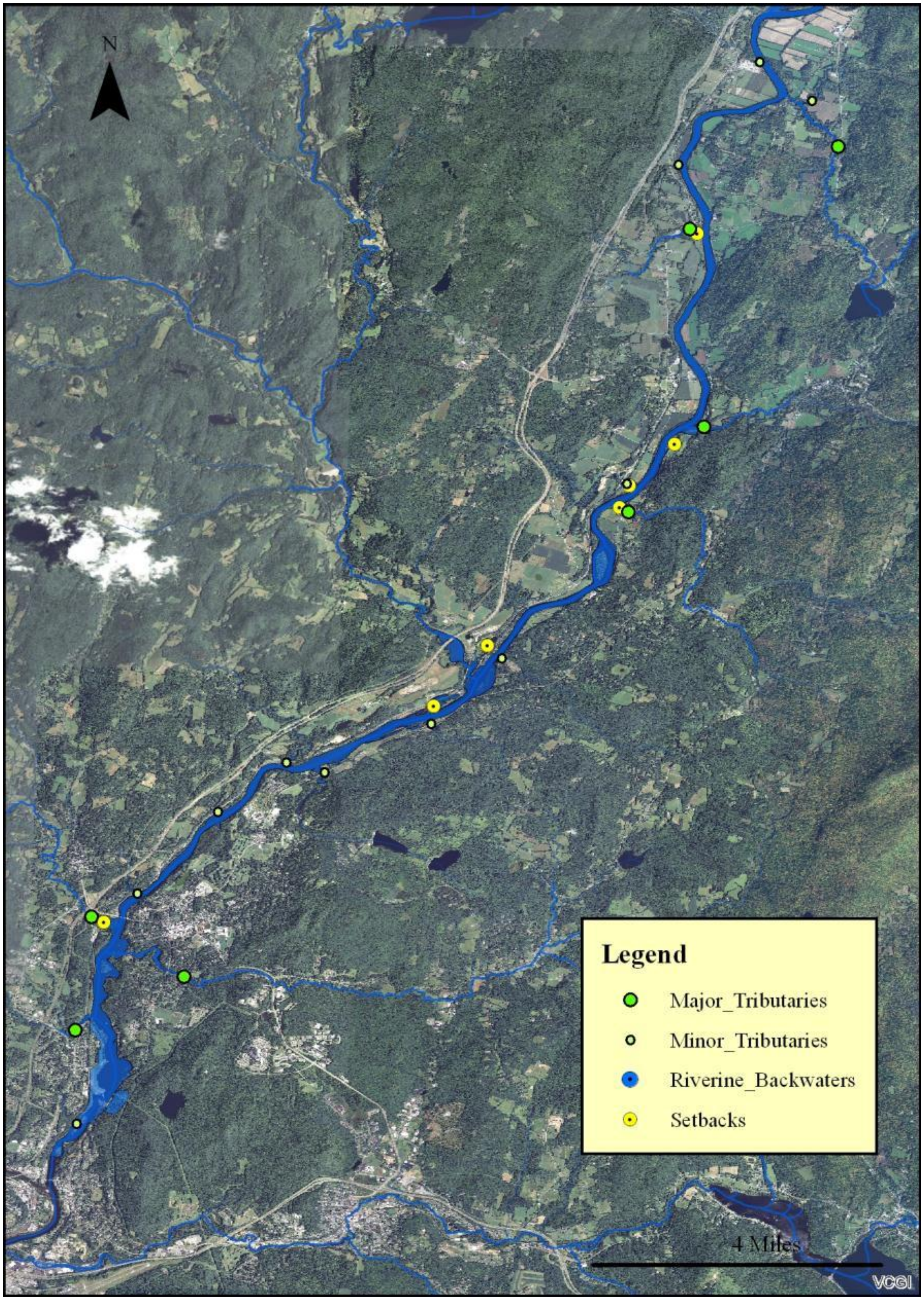

Figure 7-9. Placement of data loggers in Wilder south tributaries, backwaters and setbacks.

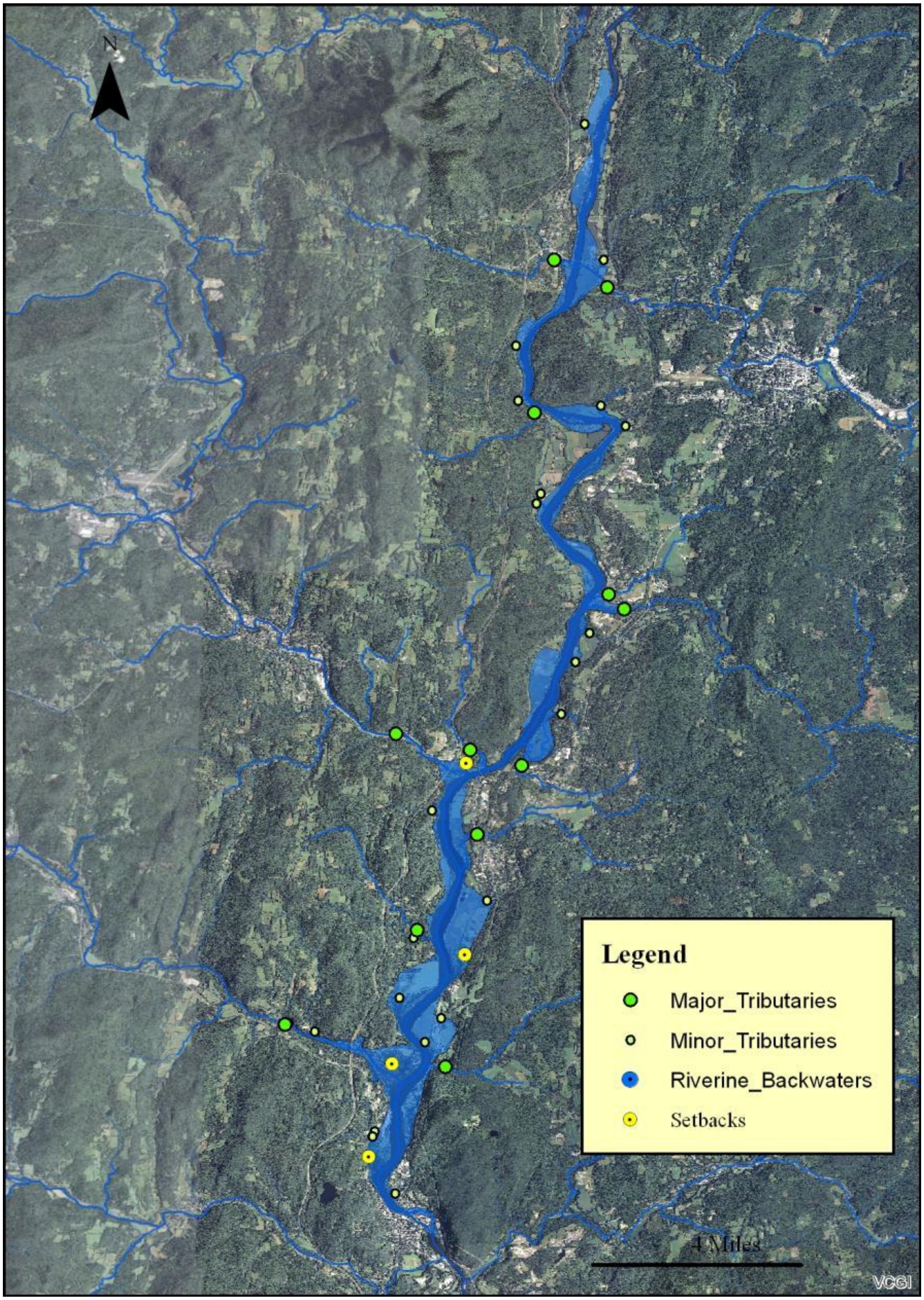

Figure 7-10. Placement of data loggers in Bellows Falls tributaries, backwaters and setbacks.

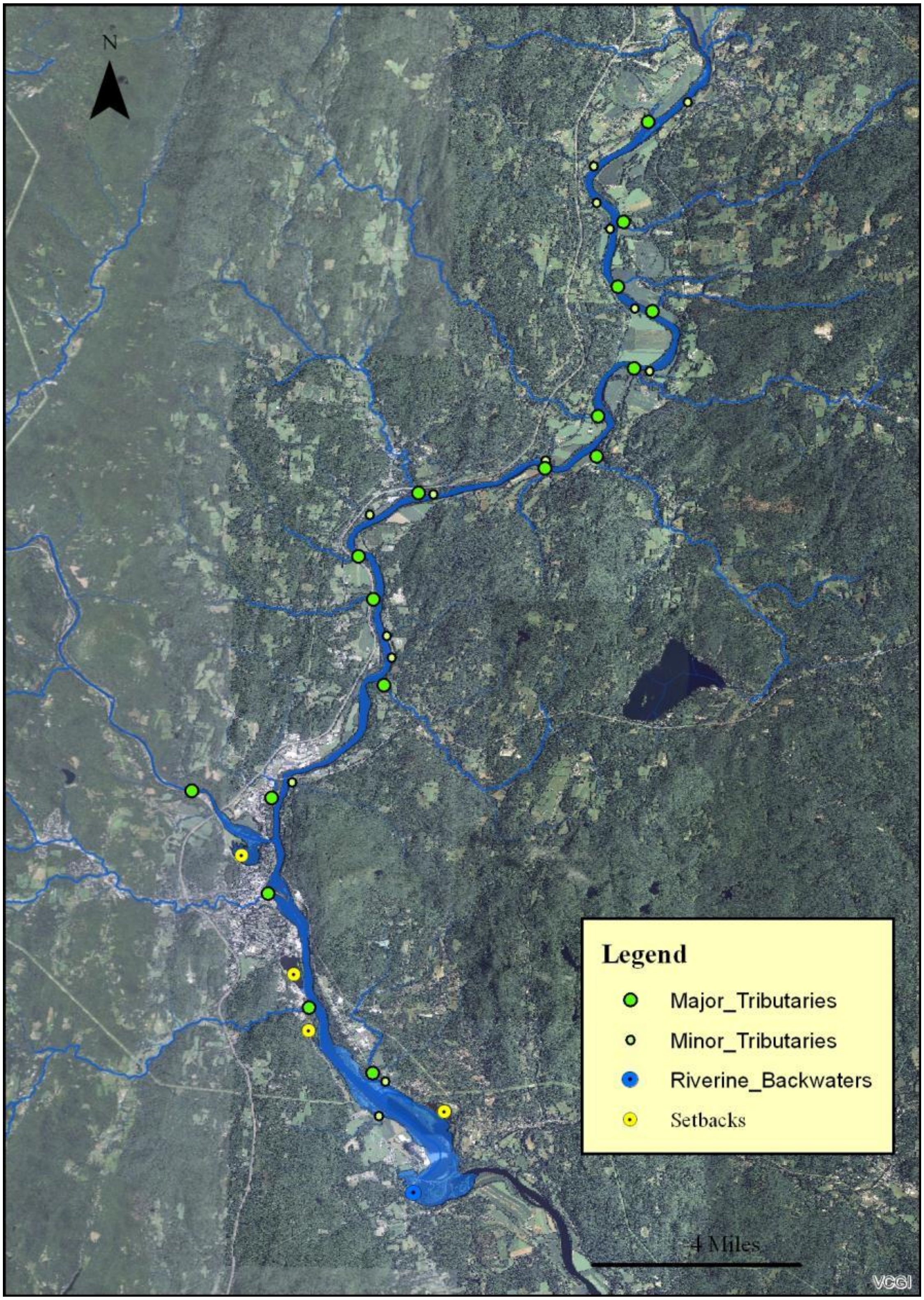

Figure 7-11. Placement of data loggers in Vernon tributaries, backwaters and setbacks.

ANALYSIS

Upon completion of collection, impoundment aquatic habitat and bathymetric data will be processed using ArcGIS. A GIS shapefile consisting of uniquely defined habitat polygons will be created for each impoundment using the habitat data collected during the side scan sonar sampling. A second GIS shapefile, composed of 2-foot bathymetric contours, will be generated for each project impoundment using data collected from the single beam echosounder. Finer resolution (i.e., 1-foot bathymetric contours) will be included in the littoral portions of the shapefile for each impoundment. Tabular and graphical output from the impoundment aquatic habitat and bathymetric study will also be used for presentation and analysis in other study reports that are dependent on results from this study.

Upon completion of the collection of riverine aquatic habitat mapping, the data will be entered into spreadsheets for review and summary. Frequency of habitat types will be developed, and habitat boundaries will be plotted on aerial maps to identify habitat area and locations. Data summaries from this study will also be presented in reports from other studies that are dependent on the results from this study.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Similar lentic and lotic surveys have been conducted for other FERC hydroelectric relicensings including the Brassua Project (FERC No. 2615), Green River Project (FERC No. 2629),Yadkin-Pee Dee Project (FERC No. 2206), Claytor Lake Project (FERC No. 739), Smith Mountain Project (FERC No. 2210), and most recently, the Turners Falls Project (FERC No. 1889).

DELIVERABLES

A study report will be provided after this one year study. Study deliverables will include a presentation to resource agency personnel and other relicensing participants. At a minimum, the report will include a summary of data collected, habitat descriptions, aerial and/or topographic habitat maps and flow and project operations during surveys. In addition, all data used to produce the report will be included in an appendix.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Impoundment aquatic habitat and bathymetry surveys will be conducted between June 2013 and November 2013. Surveying will take approximately 17 days for the Wilder impoundment, approximately 12 days for the Bellows Falls impoundment, and approximately 10 days for the Vernon impoundment. It is anticipated that all field work will take approximately 39 days. Data analysis and production of maps will be done completed by January 2014 to support the several dependent studies to be conducted in 2014 and 2015.

Riverine aquatic habitat mapping will take place under summer low flow conditions and project minimum flows. Surveys may be completed under scheduled shutdown or scheduled maintenance efforts if possible. Generally, a survey conducted by two individuals in a boat or canoe can cover 5 miles a day. Based strictly on river miles, the riverine surveys would take approximately 5 to 6 days. However, boat access constraints in some locations will increase the estimated survey time. Mapping of the Bellows Falls bypassed reach can take place anytime because flow levels in this reach are not a function of normal project operations.

LEVEL OF EFFORT AND COST

The estimated cost for this study is $~~170,000~~275,000.

REFERENCES

NOAA (National Oceanic and Atmospheric Administration, Office of Coast Survey). 2013. Field Procedures Manual. April 2013. http://www.nauticalcharts.noaa.gov/hsd/fpm/FPM_2013_Final_5_3_13.pdf

Yoder, C.O., L.E. Hersha, and B. Appel.2009. Fish Assemblage and Habitat Assessment of the Upper Connecticut River: A Preliminary Result and Data Presentation. Final Project Report. Submitted to U.S. Environmental Protection Agency, Region 1, Boston, MA. Center for Applied Bioassessment & Biocriteria, Midwest Biodiversity Institute, Columbus, OH.

Updated Study 8

Channel Morphology and Benthic Habitat Study

RELEVANT STUDY REQUESTS

NHDES-08; NHFG-08; VANR-08; CRWC-13

STUDY GOALS AND OBJECTIVES

In their study requests, NHDES, NHFG, VANR, and CRWC describe concerns regarding the potential for the Wilder, Bellows Falls, and Vernon Project facilities and operations to affect fluvial processes related to movement of coarse sediment (e.g., gravel, cobble) in the project-affected areas, and associate this concern with potential effects on benthic habitat. Specific concerns include interruption of sediment supply, composition, and transport, and associated effects on fluvial processes, including channel formation. Potentially affected resources include habitat for resident and anadromous fish and benthic habitat for aquatic invertebrates.

The goal of this study is to understand how the projects affect bedload distribution, particle size and composition in relation to habitat availability for different life-history stages of anadromous and riverine fish, and for invertebrates.

The objectives of this study are to:

- assess the distribution and extent of the existing substrate types, including gravel and cobble bars within the project-affected areas; and
- identify the current conditions of the channel and determine the stability of the present substrate/benthic habitat and potential project-related effects on these habitats.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

State resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them (specifically mentioning state-listed mussel species and sea lamprey, a state Species of Greatest Conservation Need (SGCN); and providing fish- and wildlife-based activities including viewing, harvesting and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD specific goals related to freshwater mussel habitats and sea lamprey, a state SGCN.

ASSOCIATION WITH OTHER STUDIES

Implementation of this study will be coordinated with other studies that address erosion, sediment transport, hydraulics, and associated fluctuations in water surface elevations, as well as those that address aquatic habitats for fish and invertebrates.

Information obtained as part of this study will provide information to help assess the suitability of habitats for other dependent studies including Tessellated Darter Survey (Study 12), Resident Fish Spawning (Studies 14 and 15), Sea Lamprey Spawning Assessment (Study 16), Dragonfly and Damselfly Inventory and Assessment (Study 25), and Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24). This study will also provide data for use in development of alternative scenarios to be run in the Operations Model (Study 5).

This study is also contingent on other studies because it requires substrate information from the Aquatic Habitat Mapping (Study 7) for areas not easily accessible; flow speeds, depths, sheer stress and sediment mobility developed as part of the Hydraulic Modeling Study (Study 4); sediment supply in the study area from the Riverbank Erosion Study (Study 3); and potentially site-specific information gathered from the Riverbank Transect Study (Study 2) and Tributary and Backwater Fish Access and Habitats Study (Study 13).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing information on channel morphology and benthic habitat in the project-affected areas is limited. The study requests reference previous studies performed on tributaries to the Connecticut River. While the described methodologies used for those studies may be relevant to this study, information that was developed as part of the referenced studies is of marginal relevance to the objectives of this study. This study will develop baseline information on channel morphology and benthic habitats to inform the related studies.

PROJECT NEXUS

Dams may affect geomorphic resources and associated benthic habitat and biota by affecting movement of sediment in riverine systems. This study will assess geomorphic resources and benthic habitat in the project-affected areas and whether identified geomorphic resources and benthic habitats may be directly and/or indirectly affected by project facilities and operations.

STUDY AREA AND STUDY SITES

The study area includes study sites in the riverine reaches in the project-affected areas as well as sites in tributaries that are not in the project-affected area. Study sites will be selected at three general areas, including:

- Upstream (US)-Type Study Sites: Upstream from the Wilder, Bellows Falls, and Vernon impoundments;

- Downstream (DS)-Type Study Sites: Downstream from the Wilder and Bellows Falls dams; and

- Tributary Study Sites: In selected tributaries to the Connecticut River in the riverine reaches downstream from the Wilder and Bellows Fall dams and in tributaries to the project impoundments.

Study sites at the head of the impoundments may be representative of both DS-Type and US-Type study sites, and will therefore provide for some efficiency in data collection. For example, a DS-Type study site downstream from the Wilder Project that is riverine at lower flows may be referenced as a US-Type study site upstream from the Bellows Falls Project if backwater effects propagate upstream from the Bellows Fall Project at higher flows.

There are over one hundred tributaries to the Connecticut River within the project-affected areas. Among potential tributaries to be included in this study, five were suggested by stakeholders in the study plan meeting as follows:

1. White River (Vermont) - confluence is 2.3 miles downstream of Wilder dam and upstream of the Bellows Falls impoundment;

2. Mascoma River (New Hampshire) - confluence is 3.2 miles downstream of Wilder dam and upstream of the Bellows Falls impoundment;

3. Williams River (Vermont) - confluence is within the Bellows Falls impoundment, 2.7 miles upstream of the dam;

4. Saxton's River (Vermont) - confluence is 1.2 miles downstream of Bellows Falls dam and upstream of the Vernon impoundment; and

5. Cold River (New Hampshire) - confluence is 1.8 miles downstream of the Bellows Falls dam and upstream of the Vernon impoundment.

METHODS

The methods used in this study will include desktop and field study to assess channel morphology and benthic habitats, and are consistent methodologies described in the study requests. Desktop studies will be used to preliminarily identify field study sites. Study site suitability will be field verified prior to performing the field studies. Field and desktop studies will be coordinated with other studies as appropriate.

1. The process of site selection will include:

2. Preliminary site identification and selection using desktop studies;

3. Development of a preliminary site selection report;

4. Stakeholder review of the preliminary site selection report;

5. Field-review (with stakeholders) of the sites described in the preliminary site selection report;

6. Selection of study sites following field visits to the preliminarily-identified sites; and

7. Development of a final site selection report which will be incorporated into the study report.

Preliminary (desktop) site selection will include review of aerial photographs, USGS topographic maps, previous project studies, and other readily available information. This work will use applicable substrate information collected in the Aquatic Habitat Mapping Study (Study 7) as well as information such as aerial imagery compiled in the early phases of other concurrent studies. Criteria used in the selection of preliminary study sites using preliminary information will include apparent depositional areas such as mid-channel bars and other features that may suggest active accumulation of coarse-grain sediments. The primary method for preliminary site section will be identification of areas with accumulations of apparently coarse sediment using aerial photographs.

Tributary study sites will be selected at representative locations in the vicinity of the confluences of tributaries with the Connecticut River in the project-affected areas. Selection of the these sites will be based on factors including potential sediment supply from the tributaries to the Connecticut River, and will include tributaries to the project impoundments and to riverine reaches of the Connecticut River downstream from the project dams.

Field verification of the preliminary study sites will be performed to establish approximately 12 DS-/US-Type study sites in the project-affected areas and up to 6 tributary study sites that are not in the project-affected areas. Factors considered in the selection of study sites will include safe access for performance of field studies; and presence of coarse-grain sediments. Tributary study sites will be selected in a similar manner to the DS- and US-types using existing information (e.g., aerial images), but information developed as part of other studies may not be available because these sites are not in the project-affected areas.

Field study work will be completed in 2014. Field verification of preliminary study sites will be performed in late 2013 after FERC study plan approval or in early 2014 prior to the initiation of site studies. Field studies will occur during low flows in the summer and again during the late summer/early fall of 2014. Field work will include two visits to each site for data collection, including observation and documentation of conditions.

Field study work will be performed during daylight hours and may require the use of small watercraft to safely and efficiently access study sites. Site visits will be coordinated to reduce the potential to encounter high flow conditions that could preclude effective performance of the field studies. Field investigations will include mapping of study sites using GPS equipment. Standardized field forms will be used and will include pebble counts using established methodologies (e.g., Wolman pebble counts); evaluation of substrate embeddedness; and photo-documentation of each site. Embeddedness refers to the extent which coarse substrates (i.e., gravel, cobble, and boulders) are covered or sunken into smaller-size substrates, such as sand and silt. Increased embeddedness reduces surface area and interstitial space suitable for use by macroinvertebrates and fish (for shelter, spawning, and egg incubation. In general, habitat suitability increases with decreasing embeddedness. Embeddedness will be quantified and reported using methods as generally described in Chapter 5 of "*Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers*" (Barbour et al., 1999) that was prepared on behalf of the USEPA.

The anticipated size of each study site is expected to be approximately 1 acre. Mapping of each study site will include delineating the approximate boundary using GPS equipment. It is expected that pebble counts and evaluation of embeddedness will be performed at up to six representative locations within each study site; these locations within each study site will be identified as point locations using GPS equipment.

ANALYSIS

Desktop studies will be performed as part of the reduction of field data along with analyses using information developed as part of other concurrent studies as described below. Pebble count and embeddedness data will be reduced and presented using standard methodologies and practices. The desktop analyses of field data will include reductions of pebble count information to provide gradations of coarse-grained material and qualitative descriptions of embeddedness.

Desktop analyses will include review of the HEC-RAS and operations model output (HEC-RAS model to be developed as part of hydraulic modeling in Study 4). Output data from that study's HEC-RAS model that will be used for this analysis include calculated flow speeds and shear stresses. HEC-RAS output data will not be available for tributary study sites, and associated analyses will therefore not be directly applicable to these sites. Analyses of tributary study sites will be performed using information on channel morphology and benthic habitats collected during site visits. Additional information that may be used as part of the analyses of tributary study sites will include information on fluctuations in water surface elevations obtained from the Tributary and Backwater Fish Access and Habitats Study (Study 13).

Additional analyses performed as part of this study will include review of information on coarse-substrate dependent biota in the project-affected areas. Reporting will include description of the suitability of the identified substrate characteristics for the dependent biota.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study approach uses generally accepted methodologies and practices and is consistent with recommended approaches presented in the noted study requests.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Desktop and field verification work will be initiated in 2013. Ideally, the preliminary site selection report will be provided to interested stakeholders in the late fall of 2013 and followed by site visits for field review in the late fall or early winter of 2013 or prior to the summer field season in the first study year (2014). Field work will be performed under suitable conditions in 2014; initiated in early summer of 2014 and continue through the fall of 2014. A final report including relevant data from related studies will be prepared after data from those studies are available, analyzed and incorporated into this study's results.

LEVEL OF EFFORT AND COST

The estimated cost for the study is $175,000.

REFERENCES

Barbour, M.T., K.D. Porter, S.K. Gross, and R.M. Hughes. 1999. "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates and Fish." Second Edition. USEPA, Assessment and Watershed Protection Division, USEPA 841-B-99-002, Washington, D.C., 1999.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

Updated Study 9

Instream Flow Study

RELEVANT STUDY REQUESTS

FERC-06; FWS-02, -03; NHDES-05, -10; NHFG-05, -10; VANR-06, -07; CRWC-12, -14; TNC-02

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, and TNC identified issues regarding the potential effects of current project operations on fish and aquatic resources in the riverine sections downstream of Wilder and Bellows Falls Projects and in the Bellows Falls bypassed reach. Specifically, requesters are interested in answering the following questions:

- are current minimum flows adequate to protect aquatic resources downstream of Project dams; and
- what is the effect of current project operations on fish and aquatic resources.

The goal of this study is to assess aquatic resources and habitat in the project-affected areas, and in the Bellows Falls bypassed reach under flow conditions affected by project operations.

The overall objective of this study is to assess the relationship between stream flow and resultant habitat of key aquatic species in riverine reaches downstream of Project dams. The specific objectives of this study are to:

- compute a habitat index versus flow relationship for key aquatic species in each project reach; and
- use the habitat index versus flow relationship to develop a habitat duration time series analysis over the range of current operational flows.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats;

providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, biological and aquatic community integrity, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
	•	Specific goals include protecting, enhancing, or restoring aquatic and riparian habitats, providing flows appropriate for resident fish and wildlife including freshwater mussels and benthic invertebrates and minimizing project effects on water quality and aquatic habitat.
	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	•	State water quality standards for designated uses of Class B waters relative to flow alteration, water level fluctuation, and anti-degradation provisions. The Connecticut River below Wilder dam is listed as impaired waters on the Section 303(d) due to flow alterations.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

ASSOCIATION WITH OTHER STUDIES

The Aquatic Habitat Mapping Study (Study 7) must be completed prior to commencement of this study. This study will use information from the aquatic habitat mapping as a basis for selecting study sites and establishing transect locations in riverine reaches relative to overall habitat type distribution, and will assist in identifying potential 2-D study sites. Potential 2-D study sites for this study may be selected based on results of early field work related to the Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24), the Riverbank Erosion Study (Study 3), and the Tessellated Darter Survey (Study 12), among others.

Studies that could be performed in conjunction with this study include the Bellows Falls Aesthetic Flow Study (Study 32) and the Whitewater Boating Flow Assessment (Study 31), reducing duplication of flow releases necessary to complete those studies.

Completion of this study is dependent on hourly time-step hydrology of project operations and alternatives from the Operations Modeling Study (Study 5) that will be part of the habitat time series evaluation.

Results of this study will assist in determining effects of downstream flow and water level fluctuations on fish spawning (Studies 15, 16, and 19) by assessing the relationship between flows and water levels on spawning habitat suitability in riverine reaches.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Little information exists pertaining to aquatic habitat or aquatic resources within flowing reaches downstream of project dams or the Bellows Falls bypassed reach. TransCanada is not aware of any previously conducted instream flow studies. Agency requests note there is no indication how current minimum flow requirements were established or what specific ecological resources they are intended to benefit. As described in the existing licenses for each Project the minimum flows equate to 0.2 cubic feet per second per square mile (cfsm) of drainage area, as was then recommended by the Coordinating Committee of the Connecticut River Basin Comprehensive Water and Related Land Resources Study, to reestablish historic low flow levels. The New England River Basin Commission, VANR, and EPA recommended the same minimum flow, with which FERC concurred. The Technical Committee for Fisheries Management of the Connecticut River Basin, NHFG, and FWS favored a minimum flow of 0.25 cfsm.

The Bellows Falls Project bypasses a 3,500-foot-long section of the Connecticut River. Presently this bypassed reach only receives flow when inflow exceeds the hydraulic capacity of the Bellow Falls station, or through leakage. The bypassed reach receives excess flow less than 30 percent of the time on an annual basis. In summer (July-September) the bypassed reach receives excess flow less than 10 percent of the time based upon analysis of 40 years of data as indicated in the Bellows Falls PAD. No information exists on the adequacy of the existing bypass flow regime to protect water quality and aquatic life.

This empirical study will provide information on the relationship between flow and habitat in the Connecticut River riverine sections of the project-affected areas.

PROJECT NEXUS

The projects are currently operated with minimum flow releases dating from issuance of the existing FERC licenses, and have not been reviewed since that time. Further, the projects generate power in a daily peaking mode resulting in potential within-day flow fluctuations between the minimum and the maximum capacity of each station. While the current licenses require a continuous minimum flow from the powerhouses of 675, 1,083, and 1,250 cfs, for the Wilder, Bellows Falls, and Vernon Projects, respectively, to what extent these flows protect aquatic resources is unknown in these reaches, especially in the context of the magnitude, frequency, and duration of flow changes. This study will help to establish a baseline condition of effects of licensed project operations on the spatial and temporal aspects of aquatic habitat and aquatic species below the dams and in the Bellows Falls bypassed reach.

STUDY AREA AND STUDY SITES

The study areas consist of an approximately 17-mile river segment downstream of Wilder dam, a 6-mile river segment downstream of the Bellows Falls Project, and the Bellows Falls bypassed reach. In addition, the reach between Vernon dam and approximately 1.5 miles downstream will be evaluated to determine the extent of riverine habitat.

METHODS

A standard approach to instream flow analysis since 1980 has been the Instream Flow Incremental Methodology (IFIM). The IFIM is a structured habitat evaluation process initially developed by the Instream Flow Group of FWS in the late 1970s to allow comparison of alternative flow regimes for water development projects (Bovee and Milhous, 1978; Bovee et al., 1998). The IFIM involves multiple scientific disciplines and stakeholders, in the context of which hydraulic habitat simulation studies are usually designed and implemented.

Critical stakeholder concurrence on study design elements, and overall adequacy for decision-making is one of the principal objectives of IFIM scoping, one of the first identified steps of the methodology (Bovee et al., 1998). Depending on the desires of the participants, the IFIM can be completely comprehensive for all aquatic aspects of flow regulation or tightly focused on topics of specific concern. This study plan utilizes hydraulic habitat modeling with 1-D and 2-D models as one aspect of the IFIM process and is directed at the evaluation of instream flow needs as related to aquatic habitat.

Specific elements of the Instream Flow Study are:

- Habitat Mapping
- Study Reach, Study Site, and Transect Selection
- Identify Key Aquatic Species and Life Stages

- Select Habitat Suitability Criteria
- Hydraulic Data Collection
- Hydraulic and Habitat Modeling
- Hydrology Development
- Time Series Analysis
- Dual Flow Analysis

Habitat Mapping

An instream flow study begins with a representative sample of hydraulic and physical habitat conditions within the study reaches. Generally, the samples are represented by cross sections for 1-D models or a topographic grid for 2-D models. This study will use data derived from the Aquatic Habitat Mapping Study (Study 7) to assist in determining the appropriate hydraulic modeling method, the placement of 1-D transects needed to adequately represent habitat in ~~proportion to that found in~~ a reach, and the location of any 2-D study sites.

Study Reach, Study Site, and Transect Selection

Preliminary river reaches to be studied are based on hydrology and channel morphology and include:

- Wilder dam to White River (1.5 miles), Wilder tailwater;
- White River to upper extent of the Bellows Falls impoundment (15.5 miles);
- Bellows Falls bypassed reach (3,500 feet);
- Bellows Falls dam to upper extent of the Vernon impoundment (6 miles); and
- Vernon dam downstream approximately 1.5 miles, the potential length of the riverine section.

Upon completion and analysis of riverine habitat mapping in the summer of 2013 a package with documentation and maps of proposed final reach delineation and study sites (both 1-D and proposed 2-D) will be distributed to the aquatics working group for review and comment. This will include potential transect locations for 1-D sites. Final study site and transect selection will be accomplished with interested working group members in the field. It is hoped this can be done in late fall of 2013 so field work can begin as soon as possible in 2014.

Study sites for 1-D transects will be based on the least available habitat type as derived from habitat mapping. For example, if riffle habitat accounts for the lowest percentage of all types in a reach, study sites would be selected to ensure that riffle habitat type is included in the sample by randomly selecting a riffle habitat unit. If deemed modelable, a transect would be established across that particular mesohabitat unit. Transects will then be placed across other meoshabitat types in the vicinity in relative proportion to the overall mesohabitat distribution. Depending on the number of samples needed, other riffle units would be selected through the same process. This process has the advantage of using randomization for selection without precluding the use of professional judgment for sites that are unrepresentative or unworkable. It also establishes a systematic approach and results in clusters of transects, minimizing the time required to travel between transects in the field.

The number of 1-D transects in a specific reach depends on the overall mesohabitat distribution and projected representation. ~~Generally each transect should represent no more than 10 percent of a reach, meaning at minimum, 10 transects should be placed to represent a reach.~~ The final study sites and number of transects will be agreed upon during consultation with the working group. 1-D transects will be located in all reaches except the Bellows Falls bypassed reach.

A 2-D study site may be selected to represent river channel areas or habitat too complex to be adequately modeled using 1-D transects. 2-D study sites are independent and not necessarily representative of all available habitat types. Potential 2-D modeling sites located within the reach between the White River and the upper extent of the Bellows Falls impoundment could include one of the major islands or an area of bedrock ledges known as Sumner Falls. The Bellows Falls bypassed reach, a complex series of bedrock and large substrate components, is also a candidate for a 2-D study. Pending results of the Dwarf Wedgemussel Study (Study 24) a 2-D site may be located to assess the effects of flow on mussels and their habitat. Actual site(s) will be proposed following riverine mapping and analysis. Final decisions will be made during consultation with the aquatics working group prior to the commencement of field studies.

Select Key Aquatic Species and Life Stages to Be Assessed

Study requests indicate target species for the instream flow study will include, but are not limited to:

- American shad
- Fallfish
- White sucker
- Yellow perch
- Smallmouth bass
- Walleye
- Longnose dace
- Mussels

- Tessellated darter
- Larval fish and eggs
- Macroinvertebrates

A proposed list will be distributed during the consultation process along with selection of habitat suitability criteria (HSC).

Select Habitat Suitability Criteria

Substrate size and cover classifications can vary greatly depending on the source of HSC. Preferably, HSC should be determined prior to field data collection if substrate and/or cover are a major component of the curves. This allows field personnel to document the specific information needed rather than try to collect an extensive amount of information to cover all possible data needs.

Selection of HSC will be completed in conjunction with working group consultation. No HSC are proposed at this time. Prior to commencement of the field portion of this study, a list of candidate HSC curves will be compiled based on the above species and any others identified through consultation. This list will be distributed to the aquatics working group for review and approval. Additional HSC may be added during the consultation process. It is anticipated that the initial proposed HSC will be distributed in the winter of 2013 at which time a meeting with the working group will be scheduled.

Hydraulic Data Collection

1-D Transects

Calibration flows (discharge and related water levels) are used to develop stage-discharge rating curves for each transect. The range of calibration flows depends on project operations and the agreed upon modeling range among TransCanada and the aquatics working group. For this study it is anticipated that calibration flow measurements will take place near the base minimum flow, at ½ to ¾ the maximum operational flow and at an intermediate flow. The basic rule-of-thumb for 1-D hydraulic models is they are most reliable between 0.4 times the low calibration flow and 2.5 times the high calibration flow. A minimum of three sets of calibration flow measurements will be acquired for each transect. When feasible, middle flow levels will be estimated based on rating curves from the Hydraulic Modeling Study (Study 4) HEC-RAS transects, thus reducing field time. Target calibration flows will be determined in consultation with the working group.

One complete set of depths and velocity measurements will be collected at each transect at the target high flow or the flow level that can be effectively and safely measured. Velocity data will be collected using an Acoustic Doppler Current Profiler (ADCP) mounted on a boat or encased in a rigid 4-foot trimaran hull that can be tethered to the side of a boat or other type of vessel. In areas that cannot be effectively measured using the ADCP such as shallow areas or areas inaccessible to a boat, velocity measurements will be acquired by wading techniques using electromagnetic or mechanical flow meters attached to top-set rods. Mean column velocity will be determined by a single measurement at six-tenths of the water depth in depths less than 2.5 feet, and a two-tenths and eight-tenths measurement for depths between 2.5 feet and 4.0 feet. All three points will be measured where depths exceeded 4.0 feet, if possible. The number of verticals (depth, velocity, and substrate points) across each transect will depend on ADCP settings and boat speed. In most instances data is collected at intervals of between 1 to 2 feet.

Substrate and/or cover information will be collected across each transect at low flow or when visibility is best. For deep areas where the bottom is not visible, an underwater camera may be deployed to discern substrate and cover. Classification of substrate and cover will be determined based on agency consultation in the selection of HSC.

Field data collection and the form of data recording will basically follow the guidelines established in the IFG field techniques manuals (Trihey and Wegner, 1981; Milhous et al., 1984; Bovee, 1997). Additional quality control checks that have been found valuable during previous applications of the simulation models will be employed. Basic field measurement protocols are as follows:

- Staff gages are established and continually monitored throughout the course of collecting data at each study site.

- Headpins and tailpins consisting of either rebar or spikes will be established for each transect.

- An independent benchmark, an immovable object or additional rebar, will be established for each transect or set of transects.

- All elevation surveying will be done using auto-level and telescoping stadia rod. Upon establishment of headpin and tailpin elevations, or during calibration flow surveys, a level loop will be shot to check the auto-level measurement accuracy or field errors. Allowable error tolerances on level loops will be set at 0.02 foot.

- Water surface elevations will be measured on both banks on each transect. If possible, on more complex transects such as riffles with uneven water surface elevations, additional measurements may be taken across a transect.

- Pin elevations and water surface elevations will be calculated during field measurement and compared to previous readings to confirm accuracy.

- Photographs will be taken of all transects at the three calibration flows. An attempt will be made to shoot each photograph from the same location at each flow level.

Field Data Collection (2-D)

The 2-D model requires a detailed topographic and bathymetric map of the study site. Bathymetry data will be collected using an ADCP or depth transducer and a Real Time Kinematic (RTK) GPS. Out-of water topography will be acquired with a stationary and/or robotic total station also tied to an RTK-GPS. In the event LiDAR data are available, this may also be incorporated, which would reduce the amount of field time needed. Bathymetry will be acquired at the highest flow possible to reduce the amount of time needed to survey bank areas. In addition to topography, substrate and cover information will be collected by identifying and surveying substrate and/or cover breaks in enough detail to be incorporated into the model.

Upstream and downstream boundaries of a 2-D study site require rating curves that cover the range of flows that may be modeled. A single calibration flow with associated water surface elevations is required for a 2-D site, although additional flows and elevations can assist with model calibration. Water surface elevation measurements can take place independent of the topographic mapping.

ANALYSIS

Hydraulic Modeling and Habitat Modeling

For 1-D applications in this study, the hydraulic models and habitat index simulations will be derived from the computer program SEFA (System for Environmental Flow Assessment, http://sefa.co.nz/). This program was developed jointly by originators of the primary models used in instream flow studies, Tom Payne (RHABSIM), Bob Milhous (PHABSIM), and Ian Jowett (RHYHABSIM) and merges and expands on the capabilities of these older software packages.

For 2-D applications in this study, the River2D model will be used (Steffler and Blackburn, 2001). River2D is a two-dimensional, depth-averaged hydrodynamic and fish habitat model developed for use in natural streams and rivers. The fish habitat module is based on the PHABSIM habitat index approach, adapted for a triangular irregular spatial grid network. Habitat analysis uses habitat suitability inputs like those used by PHABSIM.

Time Series and Hydrology

The major basis for habitat time series analysis is that habitat is a function of stream flow and that stream flow varies over time. A habitat time series displays the temporal habitat change for a particular species and life stage during selected seasons or critical time periods under various flow scenarios. Typically, results are represented by habitat duration curves indicating the quantity of habitat that is equaled or exceeded over the selected time period. Hydrology and flow scenarios to be assessed will be determined from results of the operations model (Study 5) and with input from the working group.

Dual Flow Analysis

The concept of a dual flow analysis (also known as effective habitat) is that some immobile aquatic species or life stages become established at particular locations that provide a given amount of suitable habitat under certain flows, and assumes the organism is unable to move to more suitable habitats. If the flows change or fluctuate, the location may provide less, more or no suitable habitat under a fluctuating flow regime. The evaluation of flow fluctuations involves comparing habitat at a range of flows with habitat at a base or given flow. The amount of usable habitat under a flow fluctuation is the minimum amount of habitat at a particular location over the fluctuation range. The numerical evaluation of habitat suitability is to sum the available habitat over a reach, study site or individual transects. The assumption is that the habitat value of a location is the minimum of the habitat at the low point of the flow fluctuation, at the high point of the fluctuation, or the habitat at base flow. Thus, at each simulated flow, the amount of suitable habitat is the amount of habitat that overlaps in space the suitable locations that were available at the base flow. Typically results are presented as tables or graphs showing the minimum amount of suitable habitat between two or more paired flows.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology using IFIM is consistent with generally accepted practices and was identified by resource agencies as the preferred method.

DELIVERABLES

Upon completion of the Aquatic Habitat Mapping Study (Study 7), TransCanada will produce and distribute a pre-selection package of potential study sites, transect locations and species and life stage lists, and HSC for working group review, discussion, and approval.

A report will be prepared that presents methods, analysis, and results of the study. It will also include summary of data collected, hydraulic modeling results and calibration details, and habitat and time series modeling results. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Habitat mapping will completed in the summer of 2013. Proposed instream flow study reaches, sites and transects will be distributed to the working group in the fall of 2013 followed by study site and transect selection based on consultation. Field work to collect hydraulic data will commence in spring 2014. Most field work will be completed in one year, though additional data collection may be necessary depending on the results of initial modeling runs, results of associated studies, and identification of additional study needs. Below is tentative schedule for the instream flow study:

Task	Proposed Completion Date
Habitat Mapping (field data collection)	August/September 2013
Habitat Mapping (analysis and results)	October 2013
Proposed study reaches, sites and transects and consultation	October 2013
Study site and transect selection (field) and consultation	Fall 2013?
Proposed species and life stage list and HSC and consultation	November 2013
Final HSC	Winter 2013
Determine target flows for 1-D and 2-D sites	Winter 2013
Commence field data collection	Spring/Summer 2014
Hydraulic and Habitat modeling	Fall 2014
Determine additional data collection needs	Fall 2014
Draft Report	Fall/Winter 2014
Final Report	December 2014

LEVEL OF EFFORT AND COST

The preliminary estimated cost of this study is dependent upon on the number of 2-D study sites, and on the number of 1-D transects used. Estimated study costs for three 2-D sites and as many as 50 1-D transects is $350,000 to $500,000. This estimate does not include costs for additional 2-D sites identified as sites of interest in other studies (e.g., Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24) and Riverbank Erosion Study (Study 3).

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Updated Study 10

Fish Assemblage Study

RELEVANT STUDY REQUESTS

FERC-07; FWS-15; NHDES-13; NHFG-13; VANR-13; CRWC-15; TNC-04

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, and TNC requested a baseline fish assemblage study for the Wilder, Bellows Falls, and Vernon Projects. As stated in the project PADs, a thorough and comprehensive assessment of the fish assemblage present in the project-affected areas of the Bellows Falls and Wilder Projects is limited.

Study requests submitted by the resource agencies indicated that previous surveys conducted by Vermont Yankee in the Vernon impoundment relied on sampling techniques and objectives that differ from those requested for this study. It is TransCanada's opinion that when combined with the sampling ~~proposed as part of~~ methods in this fish assemblage study plan, the surveys previously conducted by Vermont Yankee in the Vernon impoundment will provide a valuable source of information related to the occurrence, distribution, and relative abundance of fish species present in the Vernon Project-affected area because ~~they~~ those studies ~~have~~ relied on a variety of sampling methods (boat electrofishing, trap nets, and beach seining) and have been conducted on a seasonal basis over an extended period of years.

The goal of this study is to ~~determine~~ characterize the occurrence, distribution, and relative abundance of fish species present in the project-affected areas. Specific objectives include:

- documentation of fish species occurrence, distribution, and relative abundance within the project impoundments, tailwaters, and downstream riverine sections;
- comparison of historical records of fish species occurrence in the project-affected areas to the results of this study; and
- description of the distribution of resident/riverine and diadromous fish species within the reaches of the river and in relationship to data gathered by related studies, state agencies' surveys, and other information as available (e.g., surveys conducted by Vermont Yankee in the Vernon impoundment).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
	• General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
	• General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	• VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

Resident/riverine and diadromous fish species sampled from the project impoundments, tailwaters, and downstream riverine sections during this study will be combined in GIS with habitat information collected during the Aquatic Habitat Mapping Study (Study 7) to examine the relationship between species occurrence, distribution, and relative abundance as it relates to habitat types. Species occurrence, distribution, and relative abundance data collected during this study may also be used in a supportive role to augment aspects of species-specific studies (e.g., the Sea Lamprey Spawning Assessment [Study 16], American Eel Survey [Study 11], and American Eel Upstream Passage Assessment[Study 18]). In particular, detection of sea lamprey and American eel during this study may provide valuable insight on particular aspects of those studies such as lamprey spawning areas or eel congregation areas.

Information collected on the presence and relative abundance of small-bodied benthic fish species during the Tesselated Darter Survey (Study 12) will be used to augment findings related to this study and will enhance the knowledge of species occurrence, distribution, and relative abundance in the project areas. Where habitat and sampling gears are appropriate (e.g., backpack electrofish sampling in the Bellows Falls bypassed reach), sampling for both this study and Study 12 will be conducted concurrently.

Information collected during this study will also be used in the development of a target species list for the Fish Impingement, Entrainment, and Survival Study (Study 23). The determination of that target species list is dependent on the findings of this study.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Some site-specific data on general species presence/absence was provided in the Wilder and Bellows Falls PADs, and only minimal additional information on fisheries resources is available. Therefore, fishery agencies and other stakeholders have requested additional fisheries abundance data to assess potential effects of project operations on this resource.

The most relevant fish study related to the Wilder and Bellows Falls Project-affected areas is a Connecticut River electrofish survey conducted during 2008 (Yoder et al., 2009). Whereas some sampling was conducted in project-affected areas during the 2008 survey, the total number of sample locations was limited, and each location was sampled only a single time during the later summer-early fall. Similarly, although considerable fish data has been collected by Vermont Yankee for many years in the vicinity of Vernon dam, objectives for those surveys differ from those requested for this study. NHFG also conducts periodic surveys in the Connecticut River near the projects, but those surveys also have not been extensive and do not meet the objectives of this study.

PROJECT NEXUS

Operations at the Wilder, Bellows Falls, and Vernon Projects potentially affect the availability of instream habitat on which fish species depend. Habitat for fish species may be related to project operations in terms of flow (water depth and velocity and their timing, duration, frequency, and rate of change), as well as the interactions of flow with other habitat variables such as substrate, vegetation, and cover. Operations both upstream (i.e., impoundment levels) and downstream (i.e., flow fluctuations) may affect habitat, which may consequently lead to changes in the distribution, abundance, and behavior of fish species.

This study will help to establish a baseline condition on the extent of the fishery of the Connecticut River in the project-affected areas under current operations and will ~~The baseline condition assessed during this survey will not only represent~~

~~current project operations but will also~~ represent the ~~extent of~~ available habitat within project operational ranges for resident and diadromous fish populations. When combined with Aquatic Habitat Mapping (Study 7), results from this study will allow for the contribution of both factors (project operations and available habitat) to the baseline fisheries conditions to be examined for limiting or non-limiting influences.

Furthermore, several fish species considered to be an SGCN in New Hampshire and/or Vermont have been documented in the project-affected areas, and this study will assist in identifying those populations.

STUDY AREA AND STUDY SITES

Sampling will be conducted to ~~determine~~ characterize the baseline fish assemblage within project-affected areas from the upper extent of the Wilder impoundment downstream to Vernon dam, as well as in the Bellows Falls bypassed reach. This approximately 120 mile reach of the Connecticut River has been initially divided into seven strata:

- Wilder impoundment (RM 262.4 - 217.4)
- Wilder downstream riverine corridor (RM 217.4 – 199.7)
- Bellows Falls impoundment (RM 199.7 – 173.7)
- Bellows Falls bypassed reach (approximately 3,500 ft long)
- Bellows Falls downstream riverine corridor (RM 173.7 – 167.9)
- Vernon impoundment (RM 167.9 – 141.9)
- Downstream of Vernon dam to the downstream extent of Stebbins Island (RM 141.9 – 140.4)

Proposed strata have been delineated based on a combination of general river morphology and project structures. Following review of the aquatic habitat mapping (Study 7), significant heterogeneity within habitat types may require the creation of additional strata. Each strata will be delineated in 500 m segments using ArcGIS. Due to its relatively short total length, the Bellows Falls bypassed reach will be delineated into 100 m segments.

~~Approximately 10 sample stations (4 shoreline electrofish transects (set up in a paired-bank design) and 4 to 6 netting locations) will be established within each of the upper, middle, and lower portions of the impoundments. Between 4 and 12 sample stations will be established in each of the riverine sections downstream of the Wilder and Bellows Falls Projects, including the tailraces, setbacks, and the Bellows Falls bypassed reach, to the extent safe conditions allow for necessary access. The final number of sampling locations will be proportional to reach length and will depend on suitability of the selected sampling gears for habitat conditions present in those reaches.~~

METHODS

Sampling techniques for this study~~, whichhave been selected based on recommendations and information provided in the study requests,~~ include electrofishing (boat, pram, and backpack), ~~and~~ gill netting with experimental mesh nets, and trap netting. Electrofishing will be conducted along 12-15randomly selected 500 m segments within each stratum with the exception of the Bellows Falls bypassed reach where five 100 m segments will be sampled and downstream of Vernon dam to the lower end of Stebbins Island where three 500 m segments will be sampled. The use of experimental gill nets is intended to target fish species that utilize areas too deep or far from shore to effectively sample by electrofishing. An experimental gill net will be set at a suitable location along each segment selected for electrofishing. Should water depths or habitat conditions within a particular randomly selected segment be unsuitable for the use of experimental gill nets or an important setback-backwater area lie within the randomly selected 500 m segment, a trap net will be substituted. Trap nets are appropriate for low flow, shallow water sampling in littoral areas. The exact location for placement of the sampling gear will be determined in the field and will be based on suitable conditions for the gear type. No netting will be conducted within the Bellows Falls bypassed reach and sampling there will rely solely on electrofishing

~~Exact sampling locations that are representative of the full extent of habitat types within the study area will be established prior to the first sampling event and provided to the fisheries stakeholder interest community prior for discussion and review.~~ Sampling locations will be uniquely keyed by an identification code, and a more precise location will be identified using GPS such that lat~~t~~itude/longitude coordinates of the locations or limits of the sampling areas can be used to present the information in a GIS dataset. Sampling will be conducted across multiple seasons including spring (May-June as flow conditions permit), summer (July-August), and fall (September-October). Sampling segments will be randomly selected within each season (spring, summer, fall). ~~, and sampling stations will be maintained during all three seasons to allow for comparison of seasonal catches.~~

~~Study requesters recommended conducting replicate sampling in accordance with methods described in MacKenzie et al. (2006). Pending detailed review of that source document and agency consultation, a limited number of replicate samples may be conducted to provide estimates of species detection probability. Pending detailed review of references cited in agency study requests, sample replicates may be gathered temporally, using different methods, by independent observers, by randomly sampled spatial replicates, or by other means (MacKenzie et al., 2006).~~

Boat Electrofish

Boat electrofish ~~stations~~ sampling will be the primary sampling technique ~~established~~ conducted within ~~inthe~~ each randomly selected 500 m segment. Should the field crew be unable to sample a particular segment due to either safety or access issues, a randomly selected alternate location will be chosen. ~~boatable study reaches including the project impoundments, tailraces, and downstream riverine sections between the Wilder and Vernon Projects. Electrofish transects will use a~~

~~500-meter (1,640-foot) paired shoreline design.~~ Each randomly selected 500 m shoreline ~~transect~~ segment will be sampled ~~once seasonally,~~during the daylight hours and sampling will consist of a single pass along the shoreline and out to water depths of about 6 to 8 feet ~~and~~ in an upstream direction. In the event that a setback area lies within the randomly selected 500 m mainstem segment, the electrofish crew will first complete the mainstem transect. Following completion of all data collection for the mainstem segment, they will return to the setback area and electrofish the boatable portion of that setback that lies within the area of ~~P~~project influence. The setback will be assigned a unique sample identification code and sampling and environmental parameters for that area will be recorded separate from the adjacent mainstem area.

During boat electrofish sampling, s~~S~~cap netters on the bow of the electrofish boat will net and place stunned fish in an onboard live well for processing once the full ~~transect~~ 500 m sample segments complete.

Following completion of the full ~~transect~~500 m sample segment, biological data will be collected from captured fish. All individuals will be identified to the species level and enumerated. Total length and wet weight will be recorded for each individual. If there are more than ~~50~~ 35 individuals for any one species within a particular sample, then a representative subsample of ~~50~~ 35 individuals will be measured and weighed and the rest of that species will be counted.

The date, start and end time, sampling effort (seconds fished), water quality parameters (temperature, DO, pH, ~~and~~ conductivity, and turbidity), weather, cloud cover, water depth,~~;~~ and velocity will be recorded for each ~~full transect~~randomly selected sample segment. Habitat and substrate types along the sampled transect will be obtained following the integration of sampling coordinates and available habitat (as determined by aquatic habitat mapping in ~~(~~Study 7~~)~~) in GIS.

Pram/Backpack Electrofish

In cases where access within a particular strata is limited and does not permit boat electrofishing (e.g., Bellows Falls bypassed reach), pram and/or backpack electrofish sampling will be conducted at randomly selected segments. Should the field crew be unable to sample a particular randomly selected segment due to either safety or access issues, a randomly selected alternate location will be chosen. Sampling will be conducted by anchoring a fine mesh seine at the downstream end of the sample station. A pram or backpack electrofish unit and two to three biologists will move in a downstream direction towards the seine while actively netting stunned individuals and kicking the substrate to drive additional stunned individuals towards the collection net. Field crews will record the start and end coordinates for each pram/backpack electrofish sample. In addition, the date, start and end time, sampling effort (seconds fished), water depth, velocity, water quality (temperature, DO, ~~and~~ pH, conductivity, and turbidity), weather, and dominant substrate will be recorded. Factors such as the presence/absence of cover and proportion of available cover will also be recorded for shallow water samples. The total fish catch will be processed following the same methods as boat electrofish samples.

Experimental Gill Net

Gill net stations will be established at a suitable location along each 500 m segment randomly selected for electrofish sampling~~in the boatable study reaches with appropriate water depths and flow conditions for effective use of the gear~~. Gill nets will be experimental and will be constructed using 4 to 5 panels of increasing mesh size (e.g., 0.75-, 1.0-, 1.5-, 2.0-, and 2.5-inch stretch mesh). Gill nets will be deployed perpendicular to the shoreline in areas where water depths are greater than the net height and capture area is maximized. Nets will be set and allowed to fish for an approximate 24-hour period ~~prior to pulling~~to minimize netting mortality. Gill net samples will be conducted during the evening and night hours when fish species are most likely to be captured by the gear due to the reduced visibility associated with low light levels. Field crews will record the set coordinates for each sample. In addition, the set and pull date and time, water depth, velocity, water quality (temperature, DO, pH, ~~and~~ conductivity and turbidity), and weather conditions will be recorded. The total fish catch will be processed following the same methods as boat electrofish samples.

Trap Net

In the event that habitat or flow conditions are unsuitable or an important setback-backwater area lies within a randomly selected 500 m segment, a trap net will be substituted in lieu of the experimental gill net. Trap nets will be deployed with their primary lead set perpendicular to the bank and the wings will be extended at an approximate 45° angle. Care will be taken to avoid setting trap nets in areas with sudden changes in bottom topography as gear effectiveness can be reduced by setting on steep banks or in deep water; and in areas that could become dewatered due to flow fluctuations over the set period. Nets will be set and allowed to fish for an approximate 24-hour period prior to pulling. Field crews will record the set coordinates for each sample. In addition, the set and pull date and time, water depth, velocity, water quality (temperature, DO, pH, conductivity and turbidity), and weather conditions will be recorded. The total fish catch will be processed following the same methods as boat electrofish samples.

Bald eagles are known to inhabit project-affected areas, and some stakeholders indicated in the study plan meeting that trap nets could possibly entangle eagles. Bald eagles are federally protected under the Bald and Golden Eagle Protection Act (16 U.S.C. §668-668c) and are state-listed as Threatened in New Hampshire and Endangered in Vermont. As such, if trap nets are deemed necessary, TransCanada will consult with agencies on trap placement and will obtain all necessary species permits in advance of trap net deployment.

ANALYSIS

Data recorded for each sample will include the specific location (coordinates), collection date and time, gear type, sampling effort (duration of electrofish or net set time) and associated habitat/environmental variables including water quality parameters (temperature, DO, pH, ~~and~~ conductivity, and turbidity), weather, cloud cover, water depth and velocity as well as project operational information and conditions (upstream discharge and or impoundment elevation at the dam) at the time of sampling. These data will be reported in tabular format as well as included in the attributes table associated with the sampling location included in the GIS datasets.

Habitat and substrate information for each sample location will be obtained following the integration of sampling coordinates and available habitat, as determined by aquatic habitat mapping (Study 7), in GIS and will be also be presented in the attributes table associated with each unique sampling location. An appendix table of the biological data (i.e., length and weight) will be provided for all fish caught by location and season.

Summary statistics will be calculated by stratum and sampling technique and will be ~~and~~ included in the GIS dataset on a seasonal basis. Summary statisticss ~~for each study reach and~~ will include taxa richness, species composition, Shannon Diversity Index, and relative abundance (i.e., catch-per-unit-of-effort (CPUE)). Values of CPUE for each stratum and sampling technique will be calculated as the sum of catch from all samples within that stratum by the sum of the effort expended within that stratum. Effort will be made to incorporate a size class component into the determination of relative abundance for fish by stratum. Measures of variance (e.g., standard deviation (SD), coefficient of variation (CV)) will be calculated with the latter (CV) permitting direct comparisons of catch among gear types. Relative abundance will be examined on a seasonal basis as it relates to habitat/environmental variables (e.g., water quality, habitat, velocity) and project operational information (e.g., discharge, impoundment elevation).

Finally, historical records of fish species occurrence in the project-affected areas including state agency surveys, and other information as available (e.g., surveys reported by Entergy for Vermont Yankee where publicly available)will be compared to the results of this study. The presence of invasive or introduced fish species will be noted during the analysis.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Previous relicensing efforts have relied on a seasonal combination of boat electrofishing and gill netting to collect baseline fisheries information (e.g., Yadkin Project, FERC No. 2197, and Tapoco Project, FERC No. 2169).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of this 1-year study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014). Sampling locations will be identified during late 2013 and shared with ~~the fisheries interest community~~the aquatics working group for ~~discussion and review~~consultation and approval. Prior to any fish assemblage field sampling the appropriate scientific collection permits will be obtained from both NHFG and VANR. The primary field effort associated with baseline fish assemblage sampling will be conducted during the spring (May-June), summer (July-August), and fall (September-October) seasons of 2014. It is anticipated that ~~9 to 12~~approximately 14 days of boat electrofishing ~~and approximately 12 days of gill~~and netting effort will be necessary to complete the number of proposed samples in the mainstem river during each season~~within each of the project impoundments and downstream riverine corridor study reaches(spring, summer, and fall sampling combined)~~. An additional several days will be required seasonally to conduct general fisheries sampling within the ~~tailraces and downstream riverine corridor study reaches~~Bellows Falls bypassed reach.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $220,000.

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Updated Study 11

American Eel Survey

RELEVANT STUDY REQUESTS

FWS-08, NHDES-07, NHFG-07, VANR-15, CRWC-25, TU-05

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified potential issues related to Wilder, Bellows Falls, and Vernon Project operations on the distribution and relative abundance of American eels in mainstem habitat upstream of the project dams. In response to those requests, the goal of this study is to provide baseline data relative to the presence of American eel upstream in the project-affected areas.

The specific objectives of this study are to:

- ~~determine~~ characterize the distribution of American eel in the project impoundments and riverine sections upstream of Wilder, Bellows Falls, and Vernon dams; and
- ~~determine~~ characterize the relative abundance of American eel in the project impoundments and mainstem riverine sections upstream of the dams.

RELEVANT RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American eel including protecting, enhancing, and restoring aquatic and riparian habitats; understanding the baseline condition of eel presence within and upstream of the projects; and minimizing project effects on eel in the projects and moving up and downstream. Goals reference the ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008) and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin (CRASC, 2005). • General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect and enhance habitats for fish, wildlife and plants affected by the projects.

NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	American eel is a state SGCN. Specific goals including minimizing project effects on eel inhabiting the project area or moving through the area during upstream and downstream passage. Goals reference ASFMC 2000, ASMFC 2008 and CRASC 2005.
	•	General goals related to sustainable fish populations, habitats, recreational fishing and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	•	American eel is a state SGCN. Specific goals related to American eel including protecting, enhancing, and restoring aquatic and riparian habitats; understanding the baseline condition of eel presence within and upstream of the projects; and minimizing project effects on eel in the projects and moving up and downstream Goals reference ASFMC 2000, ASMFC 2008 and CRASC 2005.
	•	State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	•	VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD 2006) and Vermont's Wildlife Action Plan (Kart et al., 2005).

ASSOCIATION WITH OTHER STUDIES

This study is part of a group of studies related to American eel in the project areas. Related studies include the American Eel Upstream Passage Assessment (Study 18), American Eel Downstream Passage Assessment (Study 19) and American Eel Downstream Migration Timing Assessment (Study 20). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river and project areas and potential project effects.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

As described in the PADs, a limited number of American eels were collected during sampling for the Fish Assemblage and Habitat Assessment of the Upper Connecticut River study (Yoder et al., 2009). A single eel was collected from the Vernon impoundment upstream of Vernon dam. No eels were observed during sampling conducted within the Bellows Falls impoundment or upstream of Wilder dam. No eels have been collected since 2004 during Entergy's annual sampling in the vicinity of Vermont Yankee. However, as noted in the PAD for the Vernon Project, 262 immature American eels were documented moving upstream through the upstream fish ladder at Vernon during 2012 (Lael Will, Vermont Fish and Wildlife, personal communication). As stated in its study request, NHFG has documented the presence of American eel upstream of both the Bellows Falls and Wilder dams.

Although evidence exists that American eels are moving upstream of the Vernon, Bellows Falls, and Wilder dams, the distribution and relative abundance of American eels in the mainstem habitat upstream and in the project areas remains unknown. The results of this study will help to characterize the presence of eels above project dams and may inform prescriptions for potential downstream passage requirements in the new licenses.

PROJECT NEXUS

If eels are accessing and using habitat upstream of the projects in numbers sufficient to maintain species success and re-population in those areas, then current species distribution and abundance data are important to collect. When coupled with timing and route-specific survival estimates for out-migrating silver eels (Study 19), the distribution and relative abundance data collected for this study can help to ~~determine~~ identify the critical population sizes in each project area that might trigger the need for downstream eel passage.

STUDY AREA AND STUDY SITES

Surveys will be conducted for the presence and relative abundance of American eels in the project waters upstream of each dam from the upper extent of Wilder impoundment downstream to Vernon dam. This approximately 120 mile reach of the Connecticut River has been divided into five strata:

- Wilder impoundment (RM 262.4 - 217.4)
- Wilder downstream riverine corridor (RM 217.4 – 199.7)
- Bellows Falls impoundment (RM 199.7 – 173.7)
- Bellows Falls downstream riverine corridor (RM 173.7 – 167.9)
- Vernon impoundment (RM 167.9 – 141.9)

Proposed strata have been delineated based on a combination of general river morphology and project structures. Each stratum will be delineated in 500 m segments using ArcGIS. These segments will be consistent with those established for the baseline fish assemblage sampling (Study 10). The Bellows Falls bypassed reach will be sampled for eels as part of the American eel upstream passage assessment (Study 18).

Study requests indicated that the survey area for eel sampling conducted upstream of each dam should include lakes and ponds associated with tributaries (including but not limited to, Spofford Lake and Lake Morey). These areas are outside of the FERC designated project areas ~~,however,~~ and have no nexus with project operations and~~,~~ therefore, ~~will not be~~are not included in this study.

~~Sampling locations will be distributed throughout the study area. A total of 29 sample stations will be established upstream of Wilder dam, and 17 sample stations will be established upstream of each the Bellows Falls and Vernon dams.~~

METHODS

Sampling techniques for this ~~1~~one year assessment of American eel distribution and relative abundance upstream of the projects are as presented in the study requests and include electrofishing and eel traps.

Electrofish Surveys

American eel will be surveyed using a boat-mounted Smith-Root electrofishing system. Within each strata, 500 meter(m) segments will be randomly selected for eel electrofish sampling. The total number of randomly selected segments within a stratum will be proportional to the contribution of the total length of that stratum to the entire study reach. A total of ~~29, 0.6-mile (1-km)~~37 shoreline ~~transects~~ segments will be ~~established~~ randomly selected in the Wilder impoundment, 15 in the riverine section downstream of Wilder, 22 in the Bellows Falls impoundment, 5 in the riverine section downstream of Bellows Falls and 22 within the Vernon impoundment. ~~upstream of Wilder dam, 17, 0.6-mile (1-km) shoreline transects will be established upstream of Bellows Falls dam, and 17, 0.6-mile (1-km) shoreline transectswill be established upstream of Vernon dam. Shoreline electrofish transects will be spaced at approximately 2.0-mile (3.2-km) intervals over the full length of the reach.~~ For each shoreline transect, the bank to be electrofished (east or west) will be randomly selected prior to sampling. Should the field crew be unable to sample a particular segment due to either safety or access issues, a randomly selected alternate location will be chosen. ~~Field crews will record the coordinates for the start and end points of each shoreline transect.~~Any setbacks or tributary confluence areas that lie within a shoreline transect will be sampled to the extent that conditions allow for sampling gear access and the sampled waters are still under the influence of project operations. Sampling will occur during the evening and night hours (6:00 PM to midnight) when American eel are most active.

Each shoreline transect will be sampled one time, and sampling will consist of a single pass along the shoreline and out to water depths of approximately 6 to 8 feet and in an upstream direction. Scap netters on the bow of the electrofish boat will net and place stunned eels in an onboard live well for processing once the full ~~0.6-mile (1-km)~~ 500 m shoreline transect is complete. Any eels observed during electrofish sampling but not netted will be noted on the field data sheet for that particular sample. Non-target fish species will not be collected.

Following completion of the entire ~~0.6-mile (1-km)~~500 m shoreline transect, biological data will be collected from captured eels. Each eel will be assigned a length class (0 to 6 inches, 6 to 12 inches, 12 to 18 inches, >18 inches). The first 10 individuals within each length class will be individually measured for total length and wet weight. Additional eels within a particular length class will be enumerated, and a batch weight will be recorded. In addition to length and weight, the first 10 individual eels in the >18-inch length class will also have eye diameter measurements recorded. To facilitate collection of length and weight data as well as prevent unnecessary injuries to the eels, it may be necessary to anesthetize individuals using an appropriate anesthetic for the species (i.e., ice, clove oil, MS-222). Each eel will be marked in an effort to identify individuals who may have already been captured to avoid overestimating eel abundance. Any recaptures will be recorded. Eels will be marked using either a combination of clips to the dorsal and/or anal fins or by visual implant elastomer tags which have been shown to have no significant impacts to growth or mortality in the closely related European eel (Simon and Dorner, 2011). Following processing, and after full recovery from anesthesia, if used, all eels will be returned to the river.

The date, start and end time, sample effort (i.e. seconds fished) water quality (temperature, DO, pH, ~~and~~ conductivity, and turbidity), weather, cloud cover and dominant substrate will be recorded for each ~~0.6-mile (1-km)~~500 m shoreline transect.

Eel Traps

Eel trap stations will be established at a suitable location along each 500 m segment randomly selected for electrofish sampling. Eel traps will be deployed at a total of 37 500-m shoreline transects in the Wilder impoundment, 15 in the riverine section downstream of Wilder, 22 in the Bellows Falls impoundment, 5 in the riverine section downstream of Bellows Falls, and 22 within the Vernon impoundment. Should any strata be non-conducive to boat electrofish sampling, assessment for the distribution and relative abundance of eels will rely solely on eel traps. ~~Eel traps will be deployed at 29 locations upstream of Wilder dam and 17 locations upstream of each of the Bellows Falls and Vernon dams. Eel trap locations will be spaced at approximately 2.0-mile (3.2-km) intervals over the full length river upstream of each dam.~~ Eel traps will consist of standard double-entry, galvanized wire mesh cylinders approximately 2.5~~-~~feet long. Eel traps will be weighted to remain on station for the duration of their soak time and will be retrievable via a float line. Traps will be baited using dead herring or other appropriate bait (e.g., chicken liver, cat food, canned fish). At the time of deployment, field crews will record the coordinates for the sampling location as well as the set date and time. Traps will be checked after approximately 24 hours of soak time~~ and then pulled after 48 hours of soak time~~.

Eel trap catch will be processed identically to catch for electrofish samples. All eels will be assigned a length class and enumerated. A subset of eels will be measured for length and weight to provide a representative sample of individuals from each length class represented in the total catch. The set, check and pull dates and times, water quality (temperature, DO, pH, conductivity, and turbidity), weather, cloud cover, water depth and dominant substrate will be recorded for each sample.

ANALYSIS

Results of this study will be presented in graphical and tabular format. Species distribution data will be displayed on maps of the sampled study areas. Abundance data, in the form of raw catch and catch-per-unit-of-effort will be presented in tabular format. Length frequency data will be presented graphically. Occurrence of silver eels (as indicated by eye diameter measurements) will be presented in tabular format.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Previously conducted (Saluda Hydroelectric Project, FERC No. 516) and active (Eastman Falls Hydroelectric Project, FERC No. 2457) relicensing efforts have relied on a similar combination of electrofish and eel trap sampling for the purposes of describing eel distribution and relative abundance in hydroelectric project areas.

DELIVERABLES

A report will be prepared that presents methods, analysis and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The field effort associated this study will be conducted during the summer months (July-September) of the first study year (2014). It is anticipated that ~~a total of~~approximately 15 nights of boat electrofishing will be necessary to survey all ~~63~~ shoreline transects. Total sampling time for each eel pot will be ~~48~~ 24 hours, and the total number of days required to deploy and fish each station will depend on the number of eel traps available.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $85,000.

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Updated Study 12

Tessellated Darter Survey

RELEVANT STUDY REQUESTS

FWS-14, NHDES-23, NHFG-23, VANR-16, CRWC-31, TNC-06

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TNC indicated that Wilder, Bellows Falls, and Vernon Project operations may affect the distribution and abundance of the tessellated darter within project-affected areas. The goal of the study requests is to assess the effects of project operations on populations of tessellated darter, a New Hampshire Species of Greatest Conservation Need and known host species for the federally listed endangered dwarf wedgemussel (DWM).

~~This study plan differs from that requested by resource agencies and NGOs. Those study requests sought to (1) determine the distribution and abundance of tessellated darter within the project-affected areas and (2) determine the effects of project operations on the distribution and abundance of tessellated darter. Determination of effects on tessellated darter due to project operations is not an achievable goal without a baseline data set for comparison. Based on the life history characteristics of tessellated darter, the collection of a baseline data set encompassing several generations to account for natural variability in the population in project-affected and nonproject-affected areas would require years of study and is not a realistic undertaking for the 2-year relicensing study period.~~

~~As a result,~~ TransCanada's specific objective for this study is to characterize the distribution and relative abundance of tessellated darter within project-affected areas. With this information, some judgments on whether the DWM population is constrained due to distribution and abundance of tessellated darters may be feasible.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- Tessellated darter is one of three host species in the Connecticut River for the gloclidia of DWM, a federally listed endangered species. The goal for DWM is species recovery for removal under the Endangered Species Act in accordance with the FWS Dwarf Wedgemussel Recovery Plan (FWS, 1993) and Five Year Review Summary and Evaluation (FWS, 2007).
- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives;

and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- Tessellated darter is a state SGCN.
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- Tessellated darter is a state SGCN.
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD general goals related to resource conservation, fish, and wildlife recreation and use, and human health and safety.
- Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

Information collected during Aquatic Habitat Mapping (Study 7) will be used ~~for~~ to ~~determination~~ characterize habitat conditions at each unique~~of~~ sample collection location~~s~~ and may provide insight into species distribution and abundance. Likewise, areas targeted as most likely to provide appropriate habitat for DWM (Study 24) and incidental observations of tessellated darter during that study will aid in the location of sampling efforts to characterize the distribution and relative abundance of tessellated darter within the project-affected areas.

Information collected on the presence and relative abundance of small-bodied benthic fish species during this study will be used to augment findings related to the determination of the baseline fish assemblages (Study 10). Where habitat and sampling gears are appropriate (e.g., backpack electrofish sampling in the Bellows Falls bypassed reach), sampling for both resident fish spawning studies (Study 13, 15) will be conducted concurrently.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

As described in the PADs, the tessellated darter is a confirmed host for DWM (a federally listed as endangered freshwater mussel species) resident within the upper Connecticut River. As noted in the study requests, existing literature indicates that tessellated darters may be found in a variety of habitat types (Scott and Crossman, 1979; Hartel, 2002). Although tessellated darter has been confirmed both upstream and downstream of each project, previous fisheries sampling in those areas did not rely on collection techniques that specifically target small-bodied benthic fish species. Based on comments in the study requests, the resource agencies determined it is likely that results from previous investigations are biased and may have underrepresented the abundance.

PROJECT NEXUS

Operations at the Wilder, Bellows Falls, and Vernon Projects potentially affect the availability of instream habitat on which the tessellated darter and other lotic species depend. Habitat for tessellated darters may be related to the project operations in terms of flow (water depth and velocity, and their timing, duration, frequency, and rate of change), as well as the interactions of flow with other habitat variables such as substrate, vegetation, and cover. Operations both upstream (i.e., impoundment levels) and downstream (i.e., flow fluctuations) may affect habitat, which may consequently lead to changes in the distribution, abundance, and behavior of tessellated darter. Those changes could, in turn, potentially affect the federally listed as endangered DWM.

Results from this study will enhance the currently limited knowledge related to the distribution and abundance of tessellated darter in the project areas.

STUDY AREA AND STUDY SITES

The study area will encompass the upper extent of the Wilder impoundment to the Vernon tailrace. For sampling purposes, that portion of the Connecticut River will be broken down into six ~~study reaches~~sampling strata:

- Wilder impoundment (RM 262.4 - 217.4~~ – 262.4~~)
- Wilder tailrace and downstream riverine corridor (RM 217.4 – 199.7)
- Bellows Falls impoundment (RM 199.7 – 173.7)
- Bellows Falls tailrace and downstream riverine corridor (RM 173.7 – 167.9)
- Vernon impoundment (RM 167.9 – 141.9)
- Vernon tailrace (RM 141.9 - ~~~140.9~~140.4)

Prior to selection of sampling locations, each stratum will be delineated in 500 meter (m) segments using ArcGIS. These segments will be consistent with those established for both the baseline fish assemblage sampling (Study 10) and the American eel study (Study 11). Within each ~~strata~~stratum, 500 m segments will be randomly selected for tessellated darter sampling. Within the three strata representing project impoundments, a total of 30 randomly selected segments will be selected and the total number within any one ~~strata~~stratum will be proportional to the contribution of the total length of that impoundment to the entire impounded area. A total of 14 segments will be randomly selected in the Wilder impoundment, 8 in the Bellows Falls impoundment, and 8 within the Vernon impoundment. Within the three strata representing tailrace and riverine sections, a total of 15 randomly selected segments will be selected and the total number within any one strata will be approximately proportional to the contribution of the total length of that impoundment to the entire impounded area. A total of 9 segments will be randomly selected in the Wilder tailrace and downstream riverine corridor, 4 in the Bellows Falls tailrace and downstream riverine corridor, and 2 within the Vernon tailrace. ~~Sampling locations will be distributed throughout each of the six study reaches. Ten sample stations will be established in each impoundment study reach, and five sample stations will be established in each of the tailrace and downstream riverine corridor study reaches included in the study area. As noted in the study requests, existing literature indicates that tessellated darters may be found in a variety of habitat types. Study requests included evaluation of habitat use within project-affected areas because it is not certain if habitat use infers preference, or if habitat use will be consistent from basin to basin. To accommodate that request, final placement of sample stations within each study reach will be determined following review of the literature and results from aquatic habitat mapping (Study 7). Stations will be distributed throughout each of the six study reaches proportional to the distribution of dominant substrate types (e.g., if 50 percent of the study reach is dominated by sand substrate then 50 percent of the sample locations will be placed in that habitat type).~~ To ensure that a portion of tessellated darter sampling occurs in areas within the distribution of DWM, results from the population and habitat assessment for that species in the project areas downstream of Wilder and Bellows Falls (Study 24) will be used to place several sample stations.

METHODS

Collection techniques for tessellated darters were not specified in the study requests. Available peer-reviewed and gray literature dealing with the collection of small-bodied benthic fish species was reviewed, and several appropriate sampling techniques were identified.

- Electrified benthic trawl
- Snorkel survey
- Beach seine/backpack electrofish unit (where feasible)

An electrified benthic trawl (similar to that developed by Freedman et al., 2009) will be used at ~~all~~ each randomly selected non-wadeable sample station~~s~~ (i.e., those within the Wilder, Bellows Falls and Vernon impoundments). Should the field crew be unable to sample a particular segment due to bottom habitat conditions (e.g. boulders or submerged woody debris), a randomly selected alternate location will be selected. Each trawl sample will consist of a single 5-minute tow conducted within the 500 m segment and in the direction of and slightly faster than the river current. Sampling will take place during the daylight hours. ~~-~~Field crews will record the start and end coordinates and track information for each trawl sample. In addition, the date, start and end time, water depth, velocity, water quality (temperature, DO, pH, ~~and~~ conductivity, and turbidity), weather, and dominant substrate will be recorded.

Snorkel and beach seine/backpack electrofish sampling will be used at all randomly selected wadeable sample stations where boat access is limited or unavailable and the use of a deeper water trawl is inappropriate (i.e., likely in the Wilder, Bellows Falls and Vernon tailrace areas). Should the field crew be unable to sample a particular segment due to either safety or access issues, a randomly selected alternate location will be chosen. Snorkel and beach seine/backpack electrofish ~~These~~ techniques have been successfully employed for the detection of benthic darter species during FERC relicensing processes at other hydroelectric facilities (e.g., at the Conowingo Project, FERC No. 405).

The determination of the shallow-water sampling technique to be used will be made on a case-by-case basis at each sampling station. In general, snorkel surveys will consist of a team of 2 to 5 biologists spread across a selected reach. The survey team will move from downstream to upstream and record the abundance of species based on visual observation. Beach seine/backpack electrofish sampling will be conducted by anchoring a fine mesh seine at the downstream end of the sample station. A backpack electrofish unit and 2 to 3 biologists will move in a downstream direction towards the seine while actively kicking the substrate to drive stunned individuals towards the collection net. Sampling will take place during the daylight hours. Field crews will record the start and end coordinates for each snorkel or beach seine/backpack electrofish sample. In addition, the date, start and end time, water depth, velocity, water quality (temperature, DO, ~~and~~ pH, conductivity and turbidity), weather, and dominant substrate will be recorded. Factors such as the presence/absence of cover and proportion of available cover will also be recorded for shallow water samples. Effort will be made during the shallow water sample collections to record the presence and abundance of DWM and the presence of other freshwater mussel species.

Following completion of each electrified benthic trawl or beach seine/backpack sample collection, total catch will be identified to species and enumerated. Tessellated darters will be measured for total length. Representative photographs will be taken of each collected fish species.

During sampling associated with this study, care will be taken to avoid the disturbance of dwarf wedgemussels as well as other freshwater mussel species. Trawl samples will be conducted using a standard small-mesh benthic Missouri trawl similar to those used in other studies (e.g., Herzog et al. 2005, Bonar et al. 2009, Freedman et al. 2009. Paired tow ropes will lead down to otter boards located on each side of the trawl opening. The mouth of the trawl is formed by a head rope (with evenly spaced floats) connected between the tops of the two otter boards and a foot rope (and chain) connected between the bottoms of the two otter boards. A series of wire electrofishing cathodes will be connected to the tow ropes above the otter boards and a wire anode will be connected to the trawls head rope. During active trawling, the otter boards are pushed outward by the force of the water and pull on the head and foot ropes to open the net mouth. The foot rope runs over the bottom substrate and is kept in contact by the weight of the associated chain. Benthic fish will be stunned by the ~~electic~~electric field generated by the cathode and anode wires out ahead of the trawl mouth and will be captured in the trawl bag.

For proper operation of the trawl and to prevent significant gouging of bottom habitat, the length of the tow ropes need to be set at an appropriate length based on the depth of the water being sampled. A general rule of thumb is for 2.1 m of tow rope length for every 0.3 m of water depth (Bonar et al. 2009). To further reduce potential bycatch of DWM and other freshwater mussel species, an additional layer of exclusion netting can be ~~afixed~~affixed across the net opening. This approach has been used elsewhere to reduce the collection of rocks and other debris in trawl nets (Freedman et al. 2009). Alternatively, trawl sampling for tessellated darters and other small bodied benthic fish species could be conducted at locations away from known concentrations of DWM ~~indetified~~identified during Study 24.

Additional concern may be related to the potential impact of the electric field associated with electrofishing on mussel species, particularly DWM. Exposure of freshwater mussel species to electric current associated with electrofishing have been assessed in both field (Hastie and Boon 2001) and laboratory settings (Holliman et al. 2007). Results of both studies suggested that electrical exposure associated with typical electrofish sampling (i.e. standard 60 Hz pulsed ~~DC current~~DC current) poses little to no risk to freshwater mussels.

Prior to field sampling associated with this study, TransCanada will consult with the aquatics working group to determine the most appropriate sampling gears and placement of sampling locations to both minimize potential disturbance of DWM while maintaining a defensible and scientifically sound sampling procedure.

~~Sampling within each of the six study reaches will be conducted during a single year of study. A limited number of replicate samples may be conducted to provide estimates of species detection probability. Sample replicates may be gathered temporally, using different methods, by independent observers, by randomly sampled spatial replicates or by other means (MacKenzie et al., 2006).~~

ANALYSIS

Results of this study will be presented in graphical and tabular format and combined into a single report document with the results from the Fish Assemblage Study (Study 10). For each sample collected, date and time of sample, the specific location (coordinates), sampling effort (tow, electrofish or snorkel duration) and unique habitat and environmental variables at the time of collection will be presented in tabular format and in GIS attribute tables. Distribution data will be displayed as GIS maps of the six ~~sample~~ sampling strata~~reaches~~ overlaid with habitat mapping from other studies, and abundance data in the form of raw catch and catch-per-unit-of-effort will be presented in tabular format within the attribute tables and or hardcopy report for each station and sample reach. The GIS layer attribute table for each tessellated darter sampling location will include information on the length frequency data for tessellated darters at that location as well as operational and environmental conditions at the time of sampling.

An examination of the distribution and relative abundance of tessellated darters as it spatially relates to the ~~determined~~ distribution and relative abundance of DWM (from Study 24) will be conducted in GIS, and results will be presented in the report.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Electrified benthic trawl sampling has been shown to be highly effective for the capture of small-bodied benthic fish species when compared to conventional survey methods (boat electrofish and gill net) and standard trawling (Freedman et al., 2009). Previous relicensing efforts (at the Conowingo Project) have relied on a similar combination of snorkeling, electrified benthic trawling and beach seine/backpack electrofishing sampling to describe the presence of benthic darter species.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014), following completion of aquatic habitat mapping (Study 7). Sampling locations will be identified by May 2014 and shared with the fisheries interest community for discussion and review. The primary field effort associated with tessellated darter surveys within the six defined ~~study reaches~~sampling strata will be conducted during the late-summer months (August-September, 2014). This will ensure that young-of-year individuals are large enough to recruit to the sampling gears and be represented in collected samples. Prior to any field sampling TransCanada will obtain the appropriate scientific collection permits from both NHFG and VANR. It is anticipated that ~~5~~ 7 to ~~7~~ 10 days of trawl sampling will be necessary to complete the number of proposed samples within the three impounded study reaches. An additional several days will be required to conduct tessellated darter sampling within the tailraces and downstream riverine corridor study reaches.

LEVEL OF EFFORT AND COST

The expected cost for survey work is $~~75~~85,000.

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Updated Study 13

Tributary and Backwater Fish Access and Habitats Study

RELEVANT STUDY REQUESTS

FWS-18; NHDES-17; NHFG-17; VANR-19; CRWC-19

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC identified issues related to water level fluctuations caused by Wilder, Bellows Falls, and Vernon Project operations that may impede fish movement in and out of tributaries and backwater areas in the project impoundments and riverine reaches.

The goals of this study are to:

- determine if water level fluctuations from project operations cause impediments to fish movement into and out of tributaries and backwater areas within the project-affected areas; and
- determine if water level fluctuations caused by project operations effect available fish habitat and water quality in the tributaries and backwater areas within the project-affected areas.

The objectives for this study are to:

- conduct a field study of tributaries and backwaters in the project-affected areas to assess potential effects of water level fluctuations on fish access to these areas in the impoundments and riverine reaches below the Wilder and Bellows Falls dams; and
- conduct a field study to examine potential effects of water level fluctuations on available habitat and water quality in tributaries and backwaters.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats;

providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998) including two SGCN unidentified in the study request.
VANR	•	State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
	•	General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
	•	VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
	•	VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
	•	Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

This study depends on the results of the Aquatic Habitat Mapping Study (Study 7). The bathymetry data from that study will help identify tributaries and backwaters that may have access problems such as shallow areas in the inlets to backwaters or shallow areas in and around the tributary mouths that may impede fish movements in and out of these areas when water levels are low. For the riverine reaches, preliminary data will be collected on the tributaries and backwaters, including identifying those that may be affected by fluctuating water levels. These data will help in screening potential tributaries and backwaters that may need further investigation in this study.

Concurrent studies that will provide additional data are the Instream Flow Study (Study 9), Hydraulic Modeling Study (Study 4), and Operations Modeling Study (Study 5). Those studies will provide water level elevation data that can be incorporated into this study's analysis through the operations model.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

All five requestors stated that to their knowledge, no information exists related to effects on tributary and backwater area access and habitat due to project operations.

PROJECT NEXUS

In their study requests, stakeholders expressed concern that water level fluctuations due to project operations have the potential to create conditions that could impede the movement of fish between the Connecticut River and its tributaries and backwaters. These conditions, if present, could limit access to spawning habitat and growth opportunities. Additionally, water level changes have the potential to alter water quality and quantity in these areas, which could decrease productivity.

STUDY AREA AND STUDY SITES

The study area includes all tributaries and backwaters from the upper extent of the Wilder impoundment to Vernon dam and up to a point in tributaries and backwaters where project operations no longer have any effect under normal operating conditions.

METHODS

During Study 7's habitat mapping of riverine reaches and bathymetry and habitat mapping in the impoundments, all tributaries and backwater areas in project-affected areas will be inspected and preliminary data collected to assess their potential for impeding fish movements during fluctuating water levels. This preliminary data will be collected during the summer of 2013 (July-Sept). The inlets to backwaters and the tributary mouths will be photographed and water depths at selected points will be collected to gather baseline data on the depth of the inlets to backwater areas and tributaries. Backwater sites and tributary mouths that have shallow inlets and shoal areas with the greatest chance of impeding fish movement during fluctuating water levels will be documented and shared with aquatics working group during December 2013. Water level recorders placed at selected sites (both tributary and inlet mouths) in all three project-affected areas during the summer of 2013 will also be used to collect preliminary data on the extent of water level fluctuations in shoal areas. These preliminary data will be used in consultation with the aquatics working group to select sites that are most likely to impede fish movement (1 ft or less water depth during low impoundment water levels) and will be the focus of field efforts in 2014 to assess effects on habitat, water quality, and access.

During the first study year (2014), selected sites will be studied further. Water level recorders will be placed in selected backwaters and tributary areas and will operate for an entire year to collect hourly depth changes and water temperature. Additional water quality data will be collected in these areas (temperature, DO, pH, conductivity, and turbidity) if it is found that access to the main river is impeded.

When low flow measurements are being collected for the Instream Flow Study (Study 9), these selected locations will be inspected, photographed and data collected on water depths at the backwater inlets and tributaries to document the conditions found during low flows. These areas will also be inspected during the fish spawning field work in Resident Fish Spawning in Impoundments (Study 14) and Resident Fish Spawning in Riverine Sections (Study 15) studies and during the Fish Assemblage Study (Study 10). Data collected at the tributary and backwater sites during these field efforts will include water quality data (temperature, DO, pH, conductivity and turbidity), photographs, downloading of water level recorders and field notes on access conditions.

ANALYSIS

Water level recorders will be downloaded every few weeks during spring through late fall when field crews are in the area, but they will not be downloaded during the winter months. They will be retrieved after 1 year of data collection. Water level data will be analyzed to develop a relationship between project operations and effects at the selected sites. Using the operations model (Study 5), project related effects on the habitat in these areas, including whether they become an impediment to fish access due to water level fluctuations will be assessed. Water quality data collected during the study in the selected backwaters and tributary mouths will also be analyzed to see if water fluctuations affect water quality at the study sites.

Data from the water level recorders, bathymetry mapping, habitat mapping (both riverine and impoundment), and periodic field surveys for the instream flow and resident fish spawning assessments (Studies 9, 14, and 15) will assist in determining potential effects of project operations on fish access and habitat during water level fluctuations.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Brassua Hydroelectric Project.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. An interim study report will be prepared after the first year of study is complete. The report will be provided to stakeholders for review and comment. A draft final study report will be prepared after the study and analysis is complete in study year two. Stakeholder comments on the draft final report will be included in the final study report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014). Based on the results of the 2013 Aquatic Habitat Mapping Study (Study 7) tributary and backwater sites will be selected for detailed survey in 2014. Water level recorders will be deployed in select locations in early spring 2014, and data will be collected at the sites selected during the related studies through spring of 2015.

LEVEL OF EFFORT AND COST

The preliminary estimated cost of this study is $50,000 including an estimated 30 Onset water level recorders @$15,000.

REFERENCES

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

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Updated Study 14

Resident Fish Spawning in Impoundments Study

RELEVANT STUDY REQUESTS

FWS-17; NHDES-16; NHFG-16; VANR-18; CRWC-17

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC identified issues regarding the potential effects of impoundment fluctuation on resident fish spawning success in the Wilder, Bellows Falls, and Vernon Project impoundments.

The goal of this study is to assess whether project related water level fluctuation in the impoundments effect resident fish spawning. The target species identified for this study by VANR, NHDES, NHFG, and CRWC include smallmouth bass, largemouth bass, yellow perch, black crappie, pumpkinseed, bluegill, chain pickerel, northern pike, golden shiner, white sucker, spottail shiner, walleye, and fallfish. FWS did not specify the fish species that should be included in the analysis.

The objectives of this study are to:

- delineate, quantitatively describe (e.g., substrate composition, vegetation type and abundance) and map shallow water aquatic habitat types subject to inundation and exposure due to normal project operations, noting and describing additional areas where water depths at the lowest operational range are wetted to a depth less than one foot, such as flats, near shoal areas, and gravel bars with very slight bathymetric change;

- conduct analysis of the effects of the normal operation and the maximum licensed impoundment fluctuation range on the suitability of littoral zone habitats for all life stages of target species likely to inhabit these areas;

- conduct field studies to assess timing and location of fish spawning under existing conditions; and

- conduct field studies to assess potential effects of impoundment fluctuation on nest abandonment, spawning fish displacement, and egg dewatering.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects. • General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat. • VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005). • VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. • Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

The Aquatic Habitat Mapping Study (Study 7) will be completed prior to this study. Data collected in that study will be used to identify preferred spawning habitat types and depths of the targeted fish species.

Data collected concurrently about fish spawning in the riverine sections (Resident Fish Spawning in Riverine Sections, Study 15) includes some of the same fish species being investigated in the impoundments and will provide data on spawning times for walleye, smallmouth bass, fallfish, and white sucker. The Fish Assemblage Study (Study 10) will also inform this study because collections made during the spring/early summer spawning period will provide potential location data for target species spawning grounds and nesting sites for this study. The Tributary and Backwater Fish Access and HabitatsStudy (Study 13) will provide information on potential projects effects on spawning in those areas. The Operations Model (Study 5) will provide information on impoundment elevations and project flows in relation to identified impoundment spawning habitat.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

All five requestors stated that, to their knowledge, no information exists related to the effects of project operations on resident fish spawning. This study, in conjunction with the referenced related studies, will provide information on resident fish spawning activity in relation to project operations.

PROJECT NEXUS

Project operations, specifically fluctuating water levels in the three impoundments, have the potential to affect fish spawning success and spawning habitat quality and quantity. The potential exists for either fish eggs or quality spawning habitat to be dewatered, and/or for some species of fish to abandon nests containing eggs. Data collected during this study will assist in determining whether spawning fish in the project impoundments are affected by fluctuating water levels due to project operations.

STUDY AREA AND STUDY SITES

The study area includes all impounded waters of the Wilder, Bellows Falls, and Vernon Projects including portions of tributaries and backwaters within the impoundments that are affected by project operations.

METHODS

To effectively delineate and map the shallow water habitat types and analyze the potential effects of fluctuating water levels on these areas, detailed bathymetry and side-scan sonar habitat mapping from the Aquatic Habitat Mapping Study (Study 7) will need to be conducted before this study can begin. The bathymetry mapping will be used to identify shallow water habitats that may be affected by fluctuating water levels in the impoundments. The side-scan sonar habitat mapping will provide the habitat types that occur in all three impoundments, including substrate types (sand/mud, gravel/cobble, boulder, riprap), woody cover and submerged vegetation. The habitat mapping will be post-processed to delineate and quantify the amount of the different habitat types found in each impoundment and the depths they occur. The substrate types and locations will assist in identifying potential target fish spawning locations based on spawning habitat preferences, such as gravel or cobble areas. These data will help focus the field effort for the first year of this study to locate fish spawning sites based on habitat characteristics such as substrate and depth.

Water level in each of the impoundments during normal operations will be quantified using Onset HOBO water level data loggers (vertical accuracy of +/- 0.1 in). Data loggers will be placed in selected locations along the length of each impoundment, including backwater areas, potential spawning locations, in shoal areas and other sensitive locations to determine how, in terms of depth, frequency and duration, daily water level changes affect these locations. The data loggers will also collect water temperature data every ~~30~~ 15 minutes, and field crews will download the data anytime they are in the area sampling or checking on the nest sites, which will occur at least twice per week at the spawning sites. Data will be compiled with corresponding project operational data from the downstream dam to create a dataset that can be used to analyze how project operations affect the spawning areas primarily in terms of elevation, frequency, and duration.

A literature review of spawning times, temperature, and habitat preferences with geographic relevance for the target fish species will be conducted. A field study will be conducted in each impoundment during each target species' spawning season to locate shallow water spawning areas and record spawning times for the target species. Five of the 13 target fish species spawn in the early spring, including walleye, yellow perch, white suckers, northern pike, and chain pickerel when water temperatures are 42-52°F. None of these fish are nest builders (they broadcast their eggs) but they prefer specific habitat types for spawning and this will help in locating their spawn sites. For instance, northern pike and chain pickerel require vegetated areas for spawning, so searches will focus on submerged aquatic beds in shoal water. Yellow perch spawn near rooted vegetation but also like to spawn near submerged brush, fallen trees, and sometimes over sand and gravel areas. Walleye spawn in rocky areas in white water, so we are not expecting to find them spawning in the impoundments. However, they could move up to the tailraces (riverine habitat) or in the tributaries in the faster water. Walleye egg traps will be set in the tailraces of the projects to locate their spawning sites; that effort is detailed in the Resident Fish Spawning in Riverine Sections Study (Study 15).

Additional egg traps will be set in tributaries that enter the three impoundments, if they have the right conditions (e.g., moderate to high current, rocky bottom), to determine if walleye are spawning in those sites. Egg traps will be constructed of standard 8x16 inch concrete blocks wrapped in hog's hair synthetic filter media that forms an ideal surface to collect the broadcasted white sucker and walleye eggs. Four individually wrapped blocks will be attached at equally spaced intervals (5-10 feet) along a line and a buoy will be connected to one end. White sucker typically move into tributary streams to spawn in shallow water with a gravel bottom, sometimes spawning in rapids. Egg traps will be set in some of the lower tributaries with the proper habitat that are influenced by project operations to attempt to locate their spawning sites. Using the habitat and bathymetry data collected from the Aquatic Habitat Mapping Study (Study 7), these preferred habitat types can be identified before going into the field, enabling the field crew to focus their efforts in the correct habitats. The time of spawning can also be narrowed down using literature-based water temperature preferences for each fish species. Field efforts to look for spawning sites for the five fish listed above will begin in April and will likely be completed by early May (dependent upon water temperatures).

The other eight target fish species (smallmouth bass, largemouth bass, pumpkinseed, black crappie, bluegill, spottail shiner fallfish, and golden shiner) spawn later in the season when water temperatures range from 61 to 68°F (late spring/early summer). Most of these fish build nests and guard the eggs, with the exception of golden shiner and spottail shiner, which scatter their eggs. The preferred habitats, depth and temperature ranges of these fish will be used to locate the spawning sites/nests.

Sampling during the Fish Assemblage Study (Study 10) will assist with locating spawning sites and nest locations. Fish in spawning condition will be reported by the crew and all nest/spawning sites will be recorded with GPS. Sampling for the early spawners (April) will be conducted prior to the general fisheries surveys. This early sampling will include electrofishing in key habitat areas, such as off channel locations for chain pickerel, yellow perch and northern pike and in the tributary mouths for walleye and white suckers. Fish captured will be checked for spawning condition, released back to the water and their locations recorded with GPS. If targeted fish are found and they are spawning, a water level recorder will be set up to document water levels in the spawning sites to record depth and water temperature every ~~30~~ 15 minutes. These data will determine if the area is dewatered during the spawning period, and if so, the time that it occurred so it can be ~~determined~~ assessed if the fluctuating water levels may have been due to project operations. Data on the depth of the nesting site, fish species, water quality data (temperature, DO, pH, conductivity, turbidity) and habitat type (i.e., aquatic weed bed, gravel bar) will be recorded. Field crews will return to the spawning sites during the season to conduct visual observations on the spawning nests/sites and record instances of abandoned or dewatered nests.

ANALYSIS

Using data from the Aquatic Habitat Mapping Study (Study 7), water level recorders and field surveys, an analysis of the effects of project operations on spawning of target resident fish species will be conducted. The analysis will include data on fish spawning sites and fish species located during the field study and potential effects that may have occurred due to project operations, such as dewatered nests or spawning sites from peaking operations. This will be performed using the outputs from the Hydraulic Modeling and Operations Modeling studies (Study 4 and 5) in order to assess the full range of current project operating conditions.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Brassua Hydroelectric Project (FERC No. 2615). The side-scan sonar habitat mapping will follow the methods and analysis techniques developed by Kaeser and Litts, 2010.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. Given the similarity between studies, results for this study will be combined into a single report along with results from Study 15 (Resident Fish Spawning in Riverine Sections) to provide a more complete picture of the potential project impacts on resident fish spawning. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The study will be conducted in the first study year (2014). Field work to locate spawning fish in the impoundments will be begin in late March/April 2014 and will continue into the summer months until all the targeted fish have completed spawning. The water level recorder data will be analyzed and correlated with project operations to ~~determine if~~assess if effects on surveyed spawning fish were due to fluctuating water levels in the impoundments.

LEVEL OF EFFORT AND COST

This preliminary estimated cost for this study is $80,000.

REFERENCES

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

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NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

Updated Study 15

Resident Fish Spawning in Riverine Sections Study

RELEVANT STUDY REQUESTS

NHDES-11; NHFG-11; VANR-14; CRWC-18

STUDY GOALS AND OBJECTIVES

In their study requests, NHDES, NHFG, VANR, and CRWC identified issues related to potential effects of water level fluctuations on resident fish spawning in downstream riverine reaches of the Wilder, Bellows Falls, and Vernon Projects.

The goal of this study is to ~~determine if~~assess whether project related water level fluctuations in the affected areas downstream of Wilder, ~~and~~ Bellows Falls, and Vernon dams negatively affect resident fish spawning.

Based on the study requests, the resident target species included in this analysis are smallmouth bass, white sucker, walleye, and fallfish.

Objectives for this study are to:

- conduct field studies in the project-affected areas downstream of the Wilder, ~~and~~ Bellows Falls, and Vernon dams. Nesting locations and spawning sites will be GIS located and mapped; and
- conduct field studies in the project-affected areas below Wilder, ~~and~~ Bellows Falls, and Vernon dams to assess potential effects of operational flows and water level fluctuations on nest abandonment, spawning fish displacement and egg dewatering.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including fish SGCN.

ASSOCIATION WITH OTHER STUDIES

Aquatic Habitat Mapping (Study 7) is a prerequisite study that should be completed prior to beginning this study, and is anticipated to be completed in 2013. The riverine habitat mapping that is included in Study 7 for the reaches below the Wilder, ~~and~~ Bellows Falls, and Vernon Projects (for the purpose of this study plan, referred to as the projects) will assist in identifying and focusing the field efforts on potential spawning locations that may be used by the four target fish species. The Fish Assemblage Study (Study 10) is associated with this study since the electrofishing field work in the riverine reaches in that study will be used to help locate spawning smallmouth bass and fallfish nest sites; it will not help locate walleye and white sucker spawning locations since they spawn early, prior to the electrofishing surveys.

Data collected concurrently ~~about~~on fish spawning in the project impoundments (Resident Fish Spawning in Impoundments, Study 14) includes some of the same fish species being investigated in the riverine sections. Study 14 will provide data on impoundment spawning times for a total of 13 resident fish species including the four assessed in this study. The Operations Model (Study 5) will provide information on project flows in relation to identified spawning habitat.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

All four requestors stated that to their knowledge, no information exists related to the effects of the project related water level fluctuations on spawning fish downstream of the projects. This study, in conjunction with the referenced related studies, will provide information on resident fish spawning activity in relation to project related water level fluctuations.

PROJECT NEXUS

Project related water level fluctuations downstream of the projects have the potential to affect resident fish spawning success and spawning habitat quality and quantity. Fish eggs or quality spawning habitat could potentially be dewatered, and/or some species of fish could abandon nests containing eggs. Data collected during this study will assist in determining whether fish spawning downstream of the Wilder, Bellows Falls, and Vernon Projects are affected by fluctuating water levels caused by project operations.

STUDY AREA AND STUDY SITES

The study area includes locations in the project-affected riverine areas downstream of the Wilder, Bellows Falls, and Vernon dams (approximately 1.5 miles downstream of Vernon dam) where the target fish species are likely to spawn.

METHODS

Data from the Aquatic Habitat Mapping Study (Study 7) will be analyzed to identify possible spawning sites for walleye, white sucker, fallfish, and smallmouth bass. If identified as representing a significant portion of the riverine fish communities during the fish assemblage study (Study 10), spawning success of additional fish such as longnose dace and trout may also be monitored. A literature search and field surveys will be conducted to assess timing and location of fish spawning for the target species below each project. ~~Smallmouth bass and fallfish are nest spawners, nest locations will be GIS located and mapped.~~

Egg traps will be deployed to assist in the identification of spawning sites for the walleye and white ~~sucker,~~sucker; two riverine fish species which broadcast spawn their eggs. Egg traps will be constructed of standard 8x16 inch concrete blocks wrapped in hog's hair synthetic filter media that forms an ideal surface to collect the broadcasted white sucker and walleye eggs. Four individually wrapped blocks will be attached at equally spaced intervals (5-10 feet) along a line and a buoy will be connected to one end. Both species generally spawn at night in moderate to high current over rocky substrates during early spring when high flows and turbidity can make it difficult to locate them visually. The timing of initial egg trap deployment will be driven by temperature and a range of 7-10 °C will be targeted as it represents the onset of the spawning period for walleye and white sucker spawning. Egg traps will be deployed downstream of areas with suitable substrate (as identified during aquatic habitat mapping – Study 7) and flow velocities for both species. Traps will be checked every 48-72 hours and eggs will be collected and preserved for identification in the laboratory. Once spawning locations (walleye and white sucker) are identified and confirmed through egg trap catches, the egg traps will be removed and field surveys will be conducted in those spawning areas.

Field surveys will be conducted to assess effects of water fluctuations on potential spawning fish displacement and egg dewatering. Following the detection of walleye and/or white sucker eggs, an Onset HOBO water level data logger (vertical accuracy of +/- 0.1 in) will be deployed at selected spawning areas to monitor water levels during the period of egg development (approximately 3 weeks). The number of monitored spawning areas will be dependent on the total number of areas identified during the initial egg trap sampling. Shallow water shoal habitat where white sucker and walleye eggs are detected will be given priority over deeper water areas as it is more likely that potential impacts from project operations will be observed there. Water level loggers will be programmed to record water depth and temperature at 15 minute intervals. In addition to the continuously operating water level data loggers, identified spawning locations will be visited once every 1-3 days. During site visits, the identified spawning locations will be photographed and water quality data (DO, pH, conductivity, and turbidity) will be recorded.

~~Field surveys will also be conducted to assess effects of water fluctuations on potential spawning fish displacement and egg dewatering. This will include photographing the sites and monitoring water levels (water level recorders) to determine if eggs in these selected spawning locations are being dewatered.~~

For the two nesting species, smallmouth bass and fallfish, nest sites will be located during targeted field surveys and during the electrofishing surveys conducted under the Fish Assemblage Study (Study 10). Nest locations for both species will be georeferenced using GPS. Similar to field surveys conducted for walleye and white sucker, detailed assessment of riverine conditions will be conducted at selected nesting sites during the spawning season to determine if fluctuating water levels are causing nests to become dewatered. Onset HOBO water level data loggers (vertical accuracy of +/- 0.1 in) will be deployed at selected nesting areas to monitor water levels during the period of egg development (approximately 2 weeks). The number of monitored nesting areas will be dependent on the total number of areas identified during the initial survey work. Areas with multiple nests in shallow water areas will be given priority over deeper water nests as it is more likely that potential impacts from project operations will be observed there. Water level loggers will be programmed to record water depth and temperature at 15 minute intervals. In addition to the continuously operating water level data loggers, identified nesting locations will be visited once every 1-3 days. During site visits, the identified nesting locations will be photographed and water quality data (DO, pH, conductivity, and turbidity) will be recorded.

~~Water level recorders set in proximity to the nests along with field observations will be used to determine effects. Water quality data will be collected at the spawning sites during all field visits (for nesting and broadcast spawners) and will include DO, pH, and turbidity. Temperature data will be collected by the water level recorders every 30 minutes during the spawning season.~~

ANALYSIS

Data on the timing and location of fish spawning collected during field efforts will be summarized. The potential effects of project related water fluctuations on nesting and spawning fish, such as nest abandonment, egg dewatering and spawning fish displacement will be analyzed. This will include comparing water level fluctuation data from the recorders placed near the nesting sites to project operations data where spawning fish are documented. Data will include GPS mapped locations of fish nests (smallmouth bass, fallfish) and the location of the water level recorders. The walleye and white sucker spawning locations from egg trap data that were located during field surveys will be mapped with GPS along with the water level recorders set nearby. All egg trapping sites will be mapped, including those where no eggs are collected.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Brassua Hydroelectric Project (FERC No. 2615).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. Given the similarity between studies, results for this study will be combined into a single report along with results from Study 14 (Resident Fish Spawning in Impoundments) to provide a more complete picture of the potential project impacts on resident fish spawning. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be done in the first study year (2014). Field work to locate spawning fish downstream of the dams will be dependent on water temperature and ice conditions, and could begin in late March/early April 2014 when egg traps will be set for walleye and white suckers. Field work will continue into June to capture the fallfish and smallmouth bass spawning periods. The final study report will be prepared after the field season and the lab effort to identify fish eggs collected is completed.

LEVEL OF EFFORT AND COST

The estimated cost of this study is $60,000.

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

Updated Study 16

Sea Lamprey Spawning Assessment

RELEVANT STUDY REQUESTS

FWS-12, NHDES-19, NHFG-19, VANR-17, CRWC-29

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHDFG, VANR, and CRWC identified issues related to potential effects of operation of the Wilder, Bellows Falls, and Vernon Projects on sea lamprey spawning habitat and activity in the Connecticut River.

The goal of this study is to assess the level of spawning activity by sea lamprey (*Petromyzon marinus*) in the project-affected areas and to determine whether project operations are affecting the success (i.e., survival to emergence) of lamprey spawning. New Hampshire and Vermont have classified sea lamprey as an SGCN, thus, as stated in Vermont's Wildlife Action Plan (Kart et al., 2005), "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." New Hampshire has listed the conservation status of sea lamprey as "vulnerable."

The objectives of this study are to:

- identify areas within the Wilder, Bellows Falls, and Vernon Project-affected areas and riverine reaches where suitable spawning habitat exists for sea lamprey;
- conduct a telemetry study of sea lamprey during their upstream migration period in the spring, focusing on areas of suitable spawning habitat, and areas of known spawning;
- conduct spawning ground surveys to observe the use of this habitat for spawning purposes, and hence, confirm suitability;
- obtain data on redd characteristics including location, size, substrate, depth and velocity; and
- ~~determine if~~assess whether the operations at the Wilder, Bellows Falls, or Vernon Projects are adversely affecting these spawning areas, specifically if flow alterations are causing dewatering and/or scouring of sea lamprey redds.

Results of the study will provide information on sea lamprey spawning locations within the three project-affected areas, lamprey redds will be characterized and spawning success will be assessed. An analysis of the effects of project operations on spawning success, potential habitat degradation and larval viability will be presented.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects. • General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• Sea Lamprey is a state SGCN. • General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat. • VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species and the ecological processes that support them; and providing fish and wildlife-based

activities including viewing, harvesting and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish, and wildlife recreation and use, and human health and safety.
- Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATIONWITH OTHER STUDIES

Analysis of data and conclusions in this study will be informed by data collected in several other studies, including: Instream Flow (Study 9), Aquatic Habitat Mapping (Study 7), Tributary and Backwater Fish Access and Habitats (Study 13), Operations Modeling (Study 5), Upstream Passage of Riverine Fish (Study 17), and Fish Assemblage (Study 10).

Studies 7, 9, and 13 will provide additional information on the availability or lack, of sea lamprey spawning habitat within the project-affected areas, and where suitable habitat is found (i.e., backwater areas, tributaries). The Operations Modeling Study (Study 5), which will help discriminate between the effects associated with project and non-project flows, and Studies 10 and 17 will allow for a closer evaluation of the results of this study. For example, the upstream fish passage study and fish assemblage study will provide relative abundance data on sea lamprey and therefore, perspective relative to the quantity of spawning sites identified in the project area and their rated success. If some nests are not successful, river flow modeling will help to ~~determine if~~assess whether project or non-project flows were a factor.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The sea lamprey is known to spawn in the Connecticut River as far upstream as Wilder dam and in tributaries such as the West, Williams, Black, and White rivers (Kart et al., 2005). Sea lamprey typically spawn in areas of shallow rapid water conducive to their redds, and near sandy bottom, quiet water being preferred by larvae (Bigelow and Schroeder, 1953). FWS (2012) lists the current upstream extent of sea lamprey range as Bellows Falls dam, noting, however, that reproduction has been documented as far north as the White River, Vermont, in the Wilder Project area. In certain years hundreds to thousands of sea lamprey have been recorded passing upstream of Bellow Falls dam, and in at least one year (2008) sea lamprey were documented passing upstream via the Wilder dam fish ladder. In 2008 surveys, Yoder et al. (2009) documented sea lamprey just downstream of the confluence of the White River.

As reported in the project PADs, 99 lamprey passed Bellows Falls dam in 2012, and 696 passed Vernon dam in that year. They also state that they know of no studies to date that address the identification of sea lamprey spawning habitat and activity within the three project areas and no studies of the effects of project operations on those activities.

PROJECT NEXUS

Agencies contend that Wilder, Bellows Falls, and Vernon Project operations have the potential to cause direct effects on spawning habitat and activity downstream of the projects in riverine portions of the river, from water releases during routine operations. If lampreys are actively spawning during operational changes, such as decreased or increased generation, assessing whether these changes adversely affect spawning activity will assist resource agencies in the management of the species. Results of this study should identify whether project operations affect spawning activity of sea lamprey.

STUDY AREA AND STUDY SITES

The study area will encompass the Wilder, Bellows Falls, and Vernon Project-affected areas. Specific sites of interest are likely to be riverine sections of the river downstream of Wilder dam, the stretch of river from Bellows Falls tailrace to about 6 miles downstream, an approximately 1.5 miles downstream of Vernon dam to the downstream end of Stebbins Island.

Sea lamprey typically spawn in areas of shallow rapid water with cobble/gravel substrate for their redds and sandy/muddy bottom quiet water for their larvae (Bigelow and Schroeder, 1953). Other areas of the projects, i.e., impoundments, will most likely not be suitable for lamprey spawning. Specific lamprey spawning sites within the study area will be ~~determined~~ identified via radio telemetry of individuals. Lamprey will be trapped at the Vernon fishladder, radio tagged, and released just upstream of Vernon dam. If suitable numbers of lamprey arrive and pass the Bellows Falls fishladder, they will be trapped, radio tagged, and released above Bellows Falls dam for migration upstream towards the Wilder Project. No lamprey will be double tagged. Tagged lamprey will be followed throughout the project impoundments, riverine sections and into project-affected tributary areas until they exhibit stationary behavior implying spawning activity.

METHODS

Methods to be used in this study generally follow those requested by stakeholders in their study requests, and are as described below.

If present, up to 20 sea lamprey will be collected at each of the Vernon and Bellows Falls fish ladders. It is expected that tracking tagged lamprey will reveal spawning locations and that these spawning locations, if suitable, will be inhabited by non-tagged lamprey as well. Lamprey will be collected and tagged as they enter and traverse the ladder, and released just upstream of the dam. Lamprey will be selected and tagged to reflect the breadth of the migration period. At Vernon, six lamprey will be tagged during the early arrivals, seven at the projected mid-point and 7 tagged during the latter portion of the run. The same methods will be used at Bellows Falls Project. Records of lamprey passage at Vernon and Bellows Falls Projects will be analyzed to gage when the migration period may near peak and when it may end in order to select specimens to radio tag. If during the migration period it appears few lamprey are arriving, and fewer than 20 fish are collected at the Bellows Falls fish ladder as the ambient water temperature approaches 15°C (since lamprey spawn between 10 and 20°C) additional fish may be taken from Vernon, tagged, and transported to above Bellows Falls dam for release to expedite arrival at spawning areas.

In the event that FirstLight conducts a similar study in the Turners Falls Project area, TransCanada will share radio frequency information with FirstLight, and expects FirstLight will share its frequencies as well, so that tagged fish that move from the Turners Falls Project upstream into the Vernon Project vicinity could be monitored.

Lamprey will be radio tagged by techniques described in Hanson and Mathur (2002). These techniques are very similar to those described in Noyes et al. (2011) and Mosher et al. (2002).Briefly, sea lamprey will be anesthetized, weighed, and measured for total length and girth and surgically implanted with a radio transmitter. Tagged lamprey will be allowed to recover in a flow through water bath for 4 to 5 hours before release. They will be placed in a truck mounted transport tank or live well on a boat for release mid-channel just upstream of Vernon dam, and just upstream of Bellows Falls dam. Releases will be made after sunset in adherence to widely accepted methodology.

Each transmitter will be of suitable size, weight not to exceed 3 percent of lamprey weight, and most likely all transmitters will operate on at least 20 different frequencies. Lamprey will be manually tracked by boat, car, or possibly aircraft if lamprey cannot be located otherwise, and locations recorded for each tracking event. Once tagged lamprey have reached suspected spawning grounds within the project-affected areas, the area in the immediate proximity of tagged fish will be visually inspected by scuba, snorkeling, and/or boat-mounted observation gear to discern if the habitat is suitable for spawning (i.e., shallow rapid water, sandy/ muddy bottom areas nearby). Fish that move outside of the project-affected areas will be noted as having left, followed until they exhibit stationary behavior indicating potential spawning, and will not be tracked further into non project-affected waters. If all radio tagged individuals are not located by boat or motor vehicle, efforts will be made to survey all tributaries as feasible via airplane to locate those lamprey. All tagged lamprey found outside the project-affected areas will be reported to the FWS, and state agencies.

Once an area within project-affected areas is deemed suitable for lamprey spawning activity, it will be characterized for substrate, depth, and GPS location and monitored frequently, approximately once every 2 or 3 days, dependent upon how many spawning areas are found. Water quality (temperature, DO, turbidity, pH, and conductivity), water velocity, embeddedness, and depth will be measured over the range of normal project operations. Once redds are established within the project-affected areas and spawning activity commences, these redds will be monitored daily and a sub-sample will be randomly capped and emerging larvae enumerated following methods by Fox et al. (2010). All redds found within project-affected areas, whether located via radio telemetry or during studies 7, 9 and 13 will be enumerated and monitored if feasible. Efforts will be made to accurately monitor, photograph and measure variables near the redds without disturbing spawning and rearing.

All spawning grounds within project-affected areas will be observed from the time of lamprey arrival to the time of larval lamprey departure, or until water temperature exceeds 22°C since lamprey spawn between 10 and 20°C (Bigelow and Schroder, 1953). All redds will be enumerated and a sub-sample of redds(to include as much habitat variability as possible) will be chosen to monitor daily. Number of redds monitored will be dependent upon density (number of redds/acre). As many redds as possible in each project area, up to a maximum of 25, will be monitored extensively. Environmental variables including water velocity, depth, temperature, exposure, and relative condition of redds/area will be measured; and the grounds photographed if possible, over the range of normal ,project discharges in order to characterize operational effects. Preliminary information from the Hydraulic and Operations Models (Studies 4 and 5) will help to correlate project operations during spawning. Any changes to the habitat and/or redds will be described and recorded. Embeddedness, ratio of sand and sediment in gravel, will be characterized and monitored over the life of the active redd, for each redd monitored. A selected number of redds which may be in jeopardy of becoming de-watered during project operations will be monitored with depth calibrated pressure transducers.

We expect that some radio tagged sea lamprey will migrate to areas not affected by project operations, such as into the White or West rivers. In that event, individuals will be monitored to a much lesser extent and gross observations (from shoreline or wading) of their activity will be conducted. Tagged lamprey may also move to locations in some tributaries that may be affected by project operations, such as near the confluence or just within the tributary in a location that may be affected by operations (e.g., just within the Saxtons River or the Cold River). In cases such as these, where tributary inflows or other non project-related variables may be a factor in lamprey behavior, all possible environmental variables will be measured and recorded, i.e., water depth, velocity, temperature, etc., so that normal project operations and other contributing effects might be isolated.

ANALYSIS

All radio transmitters will have a unique frequency or code, thus allowing discrimination by individual. All radio telemetry data will be compiled, reduced, and sorted by individual lamprey. Data from any related FirstLight study will be incorporated into this dataset, if available. Locations of each tagged lamprey will be presented spatial-temporally in tabular and graphic form. Coordinates of spawning locations for all tagged fish that participate in spawning within project-affected areas will be identified graphically on maps. The last known location of each tagged fish that moves out of the project areas will also be identified. Congregation areas of radio tagged sea lamprey will be compiled and presented graphically on maps and with aerial photography. Additional non-tagged lamprey and their redds, as well as redds identified during studies 7, 9 and 13, will be enumerated and included within the redd monitoring for project operational effects. Areas within the project-affected areas will be classified as follows:

1) non-suitable spawning habitat

2) suitable spawning habitat – no observed spawning

3) active spawning area

4) active spawning area with larval sampling

These classified areas will be described as to substrate composition, and for classes 2, 3, and 4, range and average depth, range and average temperature, range and average water velocity, and range and relative clarity over the course of spawning and rearing activity. Project operations, turbine discharge, spill discharge, and water elevation, are recorded hourly and these data will be correlated to changes observed and water level measurements taken at the lamprey redds.

Success of spawning by sea lamprey within the project-affected areas will be characterized by emergence of larvae from capped redds, if larvae emerge, spawning was successful. If eggs do not hatch, and no larvae emerge, spawning was not successful. Emerging larvae will be enumerated and timing of emergence relative to redd construction will be documented. Redds will be characterized as to location, range and average depth, general surrounding substrate, and range and average water velocity.

In order to gage the effects of project operations on the physical spawning habitat and success of spawning by sea lamprey within project-affected areas, all collected data will be analyzed (by colony/grouping in each habitat area to the extent possible based on identified spawning), and compared to project operations. The date and time of all observed activities, water measurements, and any visual variations of the structural spawning habitat and redd characteristics will be related to the operational data (i.e., total generation, turbine operating, spill, etc.) of the particular project in question. Effects of the projects will be classified per operational regime observed as:

1) No effect - no observable difference to habitat/redd structure or lamprey activity – successful spawning documented.

2) Moderate effect – observable difference to habitat/redd structure and/or behavior noticeable but not enough to preclude normal spawning activity - successful spawning documented.

3) Large effect – observable structural differences to habitat/redds and observable decreased spawning activity – minimal to no successful spawning documented.

4) Severe effect – noticeable habitat/redd degradation, i.e. de-watered, scoured out, and conditions, depth, water velocity, preclude normal spawning activity – no successful spawning documented.

If radio tagged sea lamprey migrate to areas not affected by project operations, gross observations of their activity may reveal whether they spawned in those areas. These data will be presented as ancillary observations. If tagged lamprey move into locations in tributaries that may be affected by project operations, all data will be analyzed and to the extent possible, non-project effects will be compared to project operational effects to ~~determine~~ identify the extent of each contributing factor.

Other related studies (5, 7, 9, and 13) should provide additional information on available sea lamprey spawning habitat and flows within the project-affected areas. Results of these studies will supplement and possibly support the analyses of this study when the results of those studies are available.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. Radio telemetry of both Pacific and sea lampreys has been conducted and accepted for many years. Habitat descriptions and measurement of environmental variables as described above have also been widely conducted for years.

DELIVERABLES

A final study report will be prepared after the first year field season. This reporting period depends on analyses and reporting of related habitat studies. In addition, if project operations were not reasonably typical during the study year, a second year of study may be warranted.

Results and conclusions will be reported in either the PLP or draft license applications for the projects. Exhibit E of the final license applications will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license applications.

SCHEDULE

This study will be conducted in the first study year (2014). Lamprey collection and tagging would likely commence at the Vernon fishladder between mid-April and early May dependent upon water temperature. Specimens will be tagged over the extent of the projected run. All specimens should be tagged and released by the end of May or mid -June. Lamprey will be monitored during May and early June and, once all lamprey have arrived at suspected spawning sites in mid- to late-June, field observations will commence. The field observations will most likely end by mid- to late-July. Data compilation, reduction, and analysis will be conducted directly after the field season. A final report including relevant data from related studies will be prepared after data from those studies are available, analyzed, and incorporated into this study's dataset.

LEVEL OF EFFORT AND COST

The estimated cost for this study is $150,000 for one field season.

REFERENCES

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Updated Study 17

Upstream Passage of Riverine Fish Species Assessment

RELEVANT STUDY REQUESTS

FWS-16; NHDES-20; NHFG-20; VANR-24; CRWC-20

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, and CRWC identified issues related to upstream passage of riverine fish species at the Wilder, Bellows Falls, and Vernon Projects. Specifically, requesters indicated that no information exists to assess existing year-round fishway use by resident fish species, nor whether existing upstream passage at the projects is adequate for riverine and diadromous fish species. Due to the logistical difficulties of operating project fishways during the winter months because of icing and potential damage to the facilities, monitoring at the TransCanada projects will be limited to the open water season (from ice-out until freezing temperatures make it infeasible). The goals of this study are to determine the use and temporal distribution of riverine fish passing upstream in the existing Wilder, Bellows Falls, and Vernon fish ladders during the open water period and to determine the appropriate operation period for these fishways to pass riverine and diadromous fish.

The objectives of this study are to:

- identify the use and temporal distribution of upstream passage through the Wilder, Bellows Falls, and Vernon fishways by riverine and diadromous fish species;
- operate and monitor the fishways during the open water period (ice-out until freezing temperatures make it infeasible) to assess fishway use over a longer period than the existing May-July time period;
- identify potential appropriate operating windows during the open water period for the fishways for riverine species; and
- identify potential appropriate operating windows during the open water period for diadromous species such as American eel and sea lamprey.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats; providing instream flows to meet the requirements of diadromous and resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
- Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

This study relates to two other requested studies. Data collected from the Sea Lamprey Spawning Assessment (Study 16) and American Shad Telemetry Study (Study 21) that will provide additional information on upstream fishway usage by these species. In those studies, adult sea lamprey and adult American shad will be monitored as they approach and potentially attempt to pass the Bellows Falls and Wilder fishways, American shad will also be monitored at the Vernon fishway.

We expect that radio tagged shad and sea lamprey tagged downstream by FirstLight will also be monitored if they attempt upstream passage at any of the three project fishways. Continuous temperature monitoring in the fishways in this study will also supplement water quality data collected in the Water Quality Study (Study 6).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No information exists that will allow for a comprehensive assessment of existing year-round fishway use by resident fish species. The requesters provided some summary data in their study requests on passage numbers of resident fish at Vernon dam in 2012, but noted that those analyses were conducted during one year and did not include any monitoring outside of the May through July period. In their PADs for the Wilder and Bellows Falls Projects, TransCanada identified resident fish species recorded using the Wilder and Bellows Falls fishways and indicated that the data are available from VFWD. They also noted that VFWD has several years (2007-2012) of seasonal fish passage data not yet analyzed for the May through July period.

This study will fill the data gaps about potential upstream passage usage of the project fishways by resident and diadromous fish during the other open water periods ~~9 months~~ of the year ~~(August through April)~~.

PROJECT NEXUS

The Wilder, Bellows Falls, and Vernon dams are a physical impediment to upstream fish passage for both resident and diadromous fish. The three dams have a direct effect on fish species attempting to move upstream and may prevent some fish from accessing aquatic habitat upstream of the dams. Operating the fishways beyond the normal May-July time period and documenting the usage by resident and diadromous fish species will provide the data needed to determine the level of riverine fish passage through the existing fishways. The data from this study will also provide information on the temporal distribution of riverine and diadromous fish passage.

STUDY AREA AND STUDY SITES

The study sites include the fish ladders at the Wilder, Bellows Falls, and Vernon Projects.

METHODS

Salmonsoft FishTick/FishRev digital video counting systems will be set up and maintained in the fishway windows of each of the three fish ladders. TransCanada intends to make use of three Salmonsoft software licenses offered by VANR to assist with this study. Three laptop computers meeting the minimum requirements for the Salmonsoft software will be purchased by TransCanada and used during this study. Fishways will be monitored using Salmonsoft24 hours a day during the open water period (ice-out until freezing temperatures make it infeasible) to evaluate fishway use by resident and diadromous fish. TransCanada will coordinate with FWS and CRASC to ensure that fishway inspections are conducted in a timely fashion so installation of cameras and monitoring of passage is not delayed.

Salmonsoft counting systems will be checked weekly to ensure proper operation and to retrieve video files for analysis. The Salmonsoft counting systems will be quality control checked during the study to determine the accuracy of the counts. This will be accomplished by operating a second video camera on randomly selected days that is not using Salmonsoft and comparing the results. Previous use of the Salmonsoft counting systems by VANR and FirstLight have noted that turbidity can limit the effectiveness of the programs ability to detect and record fish. As a result, TransCanada will rely on the operation of a second in-air video camera (non Salmonsoft) recording in the counting window following rain events and high flow periods. In addition, TransCanada will consult with both VANR and FirstLight to ensure that Salmonsoft equipment is properly installed to account for the effects of both sunlight (i.e. install proper shade screening) and night time (i.e. install directed lights). Care will also be taken to adapt methods previously used at Connecticut River projects to obtain a net count of fish, accounting for movements upstream and downstream of individuals.

Video files will be processed and reviewed throughout the study by trained personnel. TransCanada intends to make use of 2013 Salmonsoft data collected by VANR for the purposes of training project staff on the correct identification of unique fish species. Monthly tables will be created that detail hourly fish passage results at each fishway. Data will include number of fish, species, water flow through the project (generation, spill, attraction and fishway flows), water temperature, and time of passage.

Fishways will be visited on a weekly basis and video files will be downloaded at that time. TransCanada will internally coordinate with project personnel to conduct an initial inspection after the 2013 passage season to determine the of debris accumulation during an operating season. Ladders will be cleaned prior to the study year, and a protocol for weekly inspections at each fishway will be developed to evaluate potential blockages to passage during the study year. Should these weekly checks indicate that a significant blockage or obstacle to upstream passage is present, a post season shut down may be implemented (i.e. following spring passage season and/or following the summer season). In addition to monitoring passage obstacles, temperature monitors will be placed in each fishway to record hourly temperatures throughout the study period. Operational parameters for the ladder (e.g. attraction flow, tailrace and headpond elevations, etc.) will be recorded for the period of operation.

TransCanada will regularly confer with the aquatics working group regarding equipment operation and monitoring. If for unforeseen reasons, use of the

Salmonsoft counting system or 24-hour monitoring become problematic, TransCanada will investigate alternate methods of monitoring.

ANALYSIS

Results of this study will be presented in graphical and tabular format. The usage and temporal distribution of riverine and diadromous fish passage at each of the three fish ladders during the open water season (from ice-out until freezing temperatures make it infeasible)will be documented after reviewing all the recorded digital files collected during the study.

Radio telemetry data on upstream migrating shad and sea lamprey attempting upstream passage at any of the three fishways gleaned from the related sea lamprey and shad studies (Studies 16 and 21) will also be analyzed and summarized as part of this study.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The use of cameras to record upstream fishway use by resident and diadromous fish has been used at the Merrimack Hydroelectric Project (FERC No. 1893) and at other locations in the Northeast, including the fishway monitoring conducted annually by Vermont DFW since 1985.

DELIVERABLES

A report will be prepared that presents methods, analysis and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted during the first study year (2014). Cameras and recording equipment will be setup in the count windows at each of the three fishways as soon as feasible during late winter or early spring 2014 and will be operated until icing in the fishways makes sampling prohibitive during the winter of 2014/2015. A final report will be prepared after the study field season and data analysis is completed.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is approximately $~~40~~46,000 per fishway, or $~~120~~138,000 total.

REFERENCES

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

Updated Study 18

American Eel Upstream Passage Assessment

RELEVANT STUDY REQUESTS

FWS-09, NHDES-24, NHFG-24, VANR-22, CRWC-27, TU-08

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified potential issues related to upstream American eel passage at the Wilder, Bellows Falls, and Vernon Projects. TU only requested upstream eel studies for the Bellows Falls and Vernon Projects; the other five requestors also included the Wilder Project. Specifically, requesters indicated that the dams may increase residency time of upstream migrating American eels trying to access historical rearing habitat and information is needed on where and at what concentrations American eels are congregating downstream of the projects.

The goal of this study is to provide baseline data on the presence of American eels attempting to move upstream of the projects and the locations where they congregate while attempting upstream passage.

The objectives of this study are to:

- conduct systematic surveys of eel presence/abundance at tailrace and spillway locations at the Wilder, Bellows Falls, and Vernon Projects to identify areas of concentration of eels staging in pools or attempting to ascend wetted structures (study year one); and
- collect eels with temporary trap/pass devices from areas identified from the surveys at locations of eel concentrations to assess whether eels can be collected and passed in substantial numbers (study year two).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American eel include minimizing project effects that could hinder management goals; and minimizing project effects on upstream passage, injury, and stress to facilitate access to historical rearing habitat. Goals reference ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008); and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the

		Connecticut River Basin (CRASC, 2005).
	•	General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
NHDES	•	State water quality standards and designated uses for Class B waters, including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	American eel is a state SGCN. Specific goals include minimizing project effects on upstream passage, injury, and stress to facilitate access to historical rearing habitat. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	•	American eel is a state SGCN. Specific goals include minimizing project effects that could hinder management goals; and minimizing project effects on upstream passage, injury, and stress to facilitate access to historical rearing habitat. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
	•	General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
	•	VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish- and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN.
	•	VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
	•	Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD,

2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

This study is part of a group of studies related to American eel in the project areas. Related studies include the American Eel Survey (Study 11), American Eel Downstream Passage Assessment (Study 19), and American Eel Downstream Migration Timing Assessment (Study 20). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river in project-affected areas and the potential project effects.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No information currently exists about where upstream migrating American eels might be concentrating below the three dams as they seek upstream passage, or the annual numbers of eels attempting to ascend the dams.

While eels have been documented ascending the Bellows Falls and Vernon fishways, fishway efficiency for passing eels is also unknown. The existing upstream fishways were designed to pass Atlantic salmon and American shad, the primary species of concern when fishery agencies were considering fish passage at the projects. Although some eels ascend the fishways, agencies are concerned that smaller eels may encounter velocity barriers within the fishways that increase their residency time below the dams.

PROJECT NEXUS

The three project dams create impediments to upstream migrating eels. The dams directly affect some of the eels' ability to pass upstream due to dam height; the existing fishways were not designed for eel passage and may present a velocity barrier for some smaller eels. The results from this study will provide information on specific locations where eels attempting to move upstream may concentrate downstream of project facilities.

STUDY AREA AND STUDY SITES

The study area includes the tailrace and spillway locations at the Wilder, Bellows Falls, and Vernon dams and the Bellows Falls bypassed reach. During the first year of study, systematic surveys will be conducted at each site to document the presence and relative abundance of eels. Surveys will be conducted in the spillway areas, especially where there is significant spill or leakage flow where eels may attempt to climb. Visual searches and eel pot trapping will also be conducted around the fish ladders and in the Bellows Falls bypassed reach during the first year of study. During the second year of study, temporary eel trap passes will be installed in areas downstream of project spillways, fish ladders and/or bypassed reaches where concentrations of eels were identified during systematic surveys.

METHODS

Systematic Surveys (Year One)

During the first year of study, visual surveys will be conducted at night, once per week, downstream of each dam on foot (wading) or from a boat from May 1 through October 15 (or when water temperature exceeds 50°F). Visual surveys will be done in areas where eels are likely to congregate below each dam, such as spillways, places where there is significant leakage or overflow points along the dams, the Bellow Falls bypassed reach, and in areas near the upstream fish ladders. Data collected will include location (GPS coordinates), observation of eels (presence, absence, numbers, estimated sizes), time and date of observation, field notes on weather conditions, and moon phase. Other data that will be recorded include notes on project operations during sampling such as spill gates that may be open and/or spill conditions during high flows.

A minimum of 10 baited eel pots per project will be fished once per week (overnight sets) from May 1 through October 15 downstream of the Wilder, Bellows Falls and Vernon projects. Areas to be sampled include below the spillways, Bellows Falls bypassed reach, near fish ladders, and in locations that upstream migrating eels may congregate. Eel pots will consist of standard double-entry, 1/8" galvanized wire mesh cylinders approximately 1.5-feet long. Eel traps will be weighted to remain on station for the duration of their soak time and will be retrievable via a float line. Traps will be baited using dead herring or other appropriate bait (e.g. chicken liver, catfood, canned fish). Data collected will include location, number captured (or recorded as none captured), relative sizes, and time and date of observation. Each eel will be assigned a length class (0 to 6 inches, 6 to 12 inches, 12 to 18 inches, and >18 inches). The first 10 individuals within each length class will be individually measured for total length (nearest mm) and wet weight (nearest gram). The first 10 individual eels in the >18-inch length class will also have eye diameter measurements recorded. To facilitate collection of length and weight data as well as prevent unnecessary injuries to the eels, it may be necessary to anesthetize individuals using an appropriate anesthetic for the species (i.e., ice, clove oil, or MS-222).

All eels collected from baited eel pots will be transported and released into the impoundment upstream of where they were collected. This will reduce the likelihood of overestimating eel concentrations through multiple recaptures of the same individuals. Eel pots will be moved to different locations below the dams if no eels are captured in a particular location after 3 weeks of fishing. GPS coordinates will be taken for all eel pot locations.

Temporary/Portable Eel Trap Passes (Year Two)

Should adequate concentrations of eels be identified during the systematic surveys conducted during the first year of study, temporary eel trap passes will be installed and operated at each of the three projects during the second year of study. If concentrations of eels are not located due to low abundance below a project, then eel trap passes will not be fished at that site. Prior to the installation of any temporary eel trap passes during year one, TransCanada will consult with the aquatics working group to review results from the year one systematic surveys. During that consultation, TransCanada will seek to reach agreement on appropriate locations for installation of eel trap passes during year two.

If eel concentrations are located below a project during the systematic surveys, then up to two portable, temporary eel trap passes will be set below each of those dams in the locations where the eels congregated. These eel trap passes will be operated throughout the upstream migration season for eels (May 1 to October 15, or when river temperature exceeds 50°F). The eel trap passes will be operated daily, with catches quantified every 2 to 3 days. GPS coordinates will be taken at all the locations the eel trap passes are fished.

One of the temporary eel trap passes may be installed in the lower sections of fishways supplied with minimal attraction flow (0.5 to 1.0 cfs);however, this will only occur if the fishway is dewatered. In another study, Upstream Passage of Riverine Fish Species Assessment (Study 17), the three fish ladders will be operated during the open water period. Study 17 is planned for year one, which would not conflict with eel trap pass placement in the fish ladders during year two.

Data recorded from the temporary eel trap passes will include location, trapping interval, number of eels trapped, length, weight, and hydrologic and environmental conditions (water temperature, DO, pH and conductivity, weather conditions, and moon phase) encountered during trapping. Project operations data for any spill events during the study period, including gates that may be open, will also be recorded. Each eel will be assigned a length class (0 to 6 inches, 6 to 12inches, 12 to 18 inches, >18 inches). The first 10 individuals within each length class will be individually measured for total length (nearest mm) and wet weight (nearest grams). The first 10 individual eels in the >18-inch length class will also have eye diameter measurements recorded. All eels collected from the eel trap passes will be transported and released into the impoundment upstream of where they were collected.

ANALYSIS

Study results will include an analysis of where eels congregate during the visual night surveys and eel pot survey, including GPS coordinates of places where eels were captured or visually seen during night surveys and photos of the locations and eels found during the surveys, if possible. Additional data will include the number of eels captured (in traps); number (or relative number) of eels observed during night surveys; relative sizes, weight, behaviors noted during the survey (visual surveys); and the time, date, and environmental and hydrologic conditions (as described above) encountered during the surveys.

For the eel trap/pass collections, recorded data will include location, trapping interval, number of eels trapped, relative sizes, weights, and hydrologic and environmental conditions (as described above) encountered during the trapping period.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, including the Merrimack River Hydroelectric Project (FERC No.1893).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Systematic surveys will begin at all three dams during the first study year (2014) on May 1 and continue through October 15, including weekly eel pot trapping and visual night surveys. Following consultation with the aquatics working group regarding results of the systematic surveys, temporary eel trap passes will be installed during the second study year (2015) below the dams if concentrations of eels are found during the first study year. Two eel trap passes will be set in locations where eels were found congregating by May 1, and traps will be fished through October 15. The field effort will cover 22 weeks of sampling during both years one and two, with the traps being fished every 2 to 3 days during that time period. The study report will be prepared after all field work and data analysis is completed.

LEVEL OF EFFORT AND COST

The estimated cost of this study is approximately $~~65~~70,000 per dam or $~~195~~210,000 total.

LITERATURE CITED

ASMFC (Atlantic States Marine Fisheries Commission). 2000. Interstate Fishery Management Plan for American Eel.

ASMFC. 2008. Addendum II to the Fishery Management Plan for American Eel. Approved October 23, 2008.8pp.

CRASC (Connecticut River Atlantic Salmon Commission). 2005. A Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin. Draft.

Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

NHFG (New Hampshire Fish and Game Department). 1998. New Hampshire Fish and Game Department Strategic Plan (1998–2010). Concord, NH.

VFWD (Vermont Fish and Wildlife Department). 2006. Vermont Fish and Wildlife Strategic Plan.

Updated Study 19

American Eel Downstream Passage Assessment

RELEVANT STUDY REQUESTS

FWS-11, NHDES-09, NHFG-09, VANR-21, CRWC-28, TU-06

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified a potential issue related to potential effects of operations of the Wilder, Bellows, and Vernon Projects on American eel during the silver phase. Specifically, the issue is whether project operations negatively affect emigration of American eels.

The study goals are to identify project-related effects on downstream passage timing, injury, stress, and survival in order to maximize the number of American eels migrating to their spawning grounds.

The specific objectives of this study are to:

- quantify the movement rates and timing, and relative proportion of silver eels passing via various routes at the projects including through the turbines, the Bellows Falls bypassed reach, downstream passage facilities, and spillways; and
- assess instantaneous and latent mortality and injury of silver eels passed through turbines, and (only if appropriate, based on route selection results and consultation), via the non-turbine routes.

This study will assess whether project operations are adversely affecting American eel migration timing and survival.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American eel include minimizing project effects that could hinder management goals; and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008) and CRASC Management Plan for American Eel (*Anguilla*

rostrata) in the Connecticut River Basin (CRASC, 2005).

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- American eel is a state SGCN. Specific goals include minimizing project effects on eel passage, injury, stress, and mortality to maximize the number of silver eels migrating. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- American eel is a state SGCN. Specific goals include minimizing project effects that could hinder management goals; and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including

SGCN.

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety.
- Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

This study is part of a group of studies related to American eel in the project areas. Related studies include the American Eel Survey (Study 11), American Eel Upstream Passage Assessment (Study 18), and American Eel Downstream Migration Timing Assessment (Study 20). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river and project areas, and potential project effects.

EXISTING INFORMATION

American eels have been collected both upstream and downstream of the Vernon Project and also have been counted passing the upstream fishladder. Eels have been documented upstream of the Bellows Falls Project by NHFG (unpublished data) and Yoder et al. (2009), and although passage into the Wilder Project area is conceivable (based on their presence upstream of Bellows Falls), American eels were not documented in the Wilder Project area during the most recent survey (Yoder et al., 2009).To date, no directed studies of eel entrainment or mortality have been conducted at any of the projects.

Within the past 7years, FWS has received two petitions to list the American eel under the Endangered Species Act. The first petition was received on November 18, 2004. On July 6, 2005, FWS issued a substantial 90-day finding on the petition and initiated a 12-month status review that concluded on February 2, 2007, with a finding that listing was not warranted. The second petition was filed on April 30, 2010, by the Council for Endangered Species Act Reliability. On September 29, 2011, FWS issued a substantial 90-day finding and initiated a 12-month status review. FWS is still accepting new American eel information for the ongoing status review. The date for completion of the 12-month finding on the latest petition is uncertain.

PROJECT NEXUS

The Wilder, Bellows Falls, and Vernon Projects operate as daily peaking facilities, except during periods when inflow exceeds the hydraulic capacities of generation. Silver phase American eels emigrate during the mid-summer through late fall, a time of year when flows are generally within the operating capacities of the projects except during periodic high water events. Therefore, eels would likely pass the projects through the turbines, open fish passage facilities or spill gates if open.

Since little information exists and eels are known to be present upstream of Vernon and Bellows Falls projects, and potentially in the Wilder Project, it is necessary to understand how eels move downstream through the projects and to assess what level of injury or mortality caused by passage during emigration may occur.

STUDY AREA AND STUDY SITES

The study areas associated with assessing movement rates and passage through the dams encompass the Wilder, Bellows Falls, and Vernon Project forebays, tailraces, turbines, downstream fish bypass routes, and spillways.

METHODS

American eel downstream passage will be assessed by radio tagging and systematically monitoring fish movements and passage through each of the routes through the projects. The methods in this study incorporate the use of radio telemetry and balloon tag methodology as requested by the agencies, but do not include the use of passive-integrated transponder (PIT) tags because PIT tags would provide little additional information for determining passage route selection or passage survival, and only the open fish passage facilities would be conducive to installing PIT tag readers so the remaining potential passage routes would not be monitored by that method. PIT tag monitoring would require a confined limited range antenna for each potential passage route (i.e. individual turbine intakes, bypasses, etc.). Although it is theoretically possible to monitor the turbine intakes for PIT tag fish, the spillways and Bellows Falls bypassed reach could not be monitored at all with this methodology.

American eel downstream passage survival will be assessed by using HI-Z Turb'N Tag mark/recapture methodology. In their study requests, resource agencies proposed evaluating survival at all potential passage routes at each project; however, TransCanada believes that passage survival through the fish passage facilities and through spill gates and structures is likely to be high since most primary spill gates open from the bottom of the gate rather than at the top (tainter gates at Wilder and Vernon, and roller gates at Bellows Falls) and these gates pass a large volume of water due to their large size. Therefore, the focus of the survival study is on turbine passage alone. This portion of the study will use the total number of silver eels (150) requested by the resource agencies. However, rather then testing 50 eels at each of the three projects as requested by stakeholders, this study will proportionally allocate the number of eels tested at each project by the number of different turbine types (two at Wilder, one at Bellows Falls and three at Vernon). This approach will provide more reliable survival estimates because the sample size for each test will be increased.

If the route selection portion of the study indicates that a significant proportion of fish use the spillways and/or passage facilities and result in low survival, TransCanada will consult with the aquatics working group on any potential changes to the scope of the survival portion of the study and consider options to assess those specific routes that appear to be preferred.

Route Selection

American eel downstream passage will be assessed by radio tagging and systematically monitoring their movements and passage through each of the projects from ~~mid-September~~late August through mid-October.

Silver phase American eels for the study will be collected at either the Turners Falls or Holyoke bypass samplers, or as suggested by the resource agencies, from out-of–basin if needed to meet the sample size requirements. All collections will occur from late August to mid-October to coincide with the expected natural emigration period. Following collections or acquisition, eels will be transported and retained in appropriate holding facilities in a secure location at the Vernon Project.

Only eels that meet the morphometric criteria (eye diameter relative to body size as described in Pankhurst, 1982) will be used to ensure they are silver phased migrants. It is expected that any eels obtained from an out-of-basin source will be of similar size to those collected at the Turners Falls or Holyoke bypass samplers.

Remote telemetry monitoring will occur at the project forebays, log booms, fish passage routes, turbines, tailraces, and spillways. Additionally, monitoring will occur in the power canal at Bellows Falls and the fishway attraction water intake at Vernon if it is operational during the course of this study.

Radio receivers and/or Digital Spectrum Processors capable of monitoring multiple radio channels simultaneously at each location will be coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites to be monitored while minimizing overlap between the sites. It is expected that at a minimum, 18 monitoring sites will be installed. Data collection from the remote telemetry monitoring stations will occur at a minimum of three times per week. Periodic manual monitoring by vehicle or boat will also occur at least two times per week to assist in data collection and analysis.

Radio transmitters of a suitable size and weight and having a minimum calculated life of 90 days will be used. Each transmitter will contain a unique pulse code to allow for individual fish identification and be compatible with Digital Spectrum Processors. The radio tag channel/code set will be designed to ensure tagged eels released upstream of Wilder and Bellows Falls will subsequently be able to be monitored at the TransCanada facilities downstream, thus increasing the sample size at those facilities.

In the event that FirstLight conducts a similar study within the Turners Falls Project area, TransCanada will share radio frequency information, and expects that FirstLight will share its frequencies as well, to ensure that tagged fish that may move from the Turners Falls Project upstream into the Vernon Project or vice versa, will be monitored. TransCanada will also share tag information with agencies for agency tracking of eels outside of the project-affected areas.

For testing, 50 silver phase eels will be radio tagged following procedures established in Welsh et. al. (2009) and released approximately 5 kilometers (3 miles) upstream of each project in five separate groups of 10 fish each, for a total of 150 eels. If possible, releases will occur during spill and non-spill conditions and under low, moderate, and high generation conditions. If spillage from the Bellows Falls dam occurs, an additional 50 eels will be released directly into the power canal so an adequate number of eels are exposed to the turbines and fish passage facilities.

During the course of the study, air temperature, water temperature, turbidity, rainfall, river flow, and project operations will be continually collected and retained. Lunar phase will also be noted.

Survival/Injury Studies

American eel passage survival will be assessed by using HI-Z Turb'N Tag mark/recapture methodology at the powerhouse turbines at each of the three projects.

Silver phase eels for this portion of the study will be collected at either the Turners Falls or Holyoke bypass samplers or (as suggested by the resource agencies) out-of–basin if needed to meet the sample size requirements. Collections will occur from late August to mid-October as needed to achieve collection numbers and to coincide with the expected natural outmigration period. Following collections or acquisition, eels will be transported and retained in appropriate holding facilities in a secure location at the Vernon Project.

Only eels that meet the morphometric criteria (eye diameter relative to body size as described in Pankhurst, 1982) will be utilized to ensure they are silver phased migrants. It is expected that eels that may come from an out-of-basin source will be of similar size to those collected at the Turners Falls or Holyoke bypasses.

A minimum 50 HI-Z Turb'N Tagged eels will be released for testing at each of the three projects using methodologies outlined in Normandeau (2010). The exact breakdown of the number of eels released at each turbine type at each project and the number of control eels released will be determined following working group consultation. Turbine survival tests will be conducted at each project as each group of fish has been collected and tagged by injecting tagged eels into turbines at or near full generation. Following release through each turbine tested, the eels recovered alive downstream will be held for 48 hours for observation of injury and latent mortality. Unrecovered balloon tagged eels will be censored from the sample for survival analysis.

During the course of the study, air temperature, water temperature, turbidity, rainfall, river flow, and project operations will be continually collected.

ANALYSIS

Route Selection

The radio telemetry data will be analyzed to determine the number and timing of eels using each passage route at each of the three projects. A comparative analysis of passage routes with environmental and physical variables that occur during the study period will be conducted. The analysis will include 2-D maps of movement and passage for each individual eel. If during spill events the passage route analysis indicates significant preference for spill routes and downstream radio tag detection suggests poor survival, additional consultation with the working group will be undertaken to discuss the merits for additional survival estimates and studies for specific spill passage routes.

Survival /Injury Studies

Immediate and latent survival and classification of injuries will be estimated for the turbines at each project using generally accepted practices (Normandeau, 2010). The results will be assessed in conjunction with the physical and environmental conditions that occur during the study. At Wilder and Vernon where multiple turbine types are tested, a survival estimate will be derived individually for each turbine type as well as a composite survival estimate for the project. As noted above, if it is deemed necessary to conduct survival tests or evaluate survival through desktop analysis at non-turbine routes, details related to methodology and analysis will be developed in consultation with the working group.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology, data collection, and analysis techniques to complete this study are consistent with generally accepted practices (Normandeau and FPLE, 2007a, b; Normandeau, 2010, 2011a, b; Normandeau and Gomez and Sullivan, 2012).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license applications for the projects. Exhibit E of the final license applications will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license applications.

SCHEDULE

This study will occur in the first study year (2014). The exact timing of both the route selection and turbine testing portions of the study will depend upon the ease of fish collections earlier in the season (e.g., August/September timeframe). If environmental conditions (i.e., continual high flows and/or spill events during the emigration season) compromise the route selection study findings, a second year of the route selection portion of the study may be warranted; however, the timing of a second year study in the fall of 2015 may preclude filing of a final study report by the current ILP study report deadline.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this one-year study is ~~$200,000~~ $250,000 but is dependent on the effort required to obtain test specimens through field collections.

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Updated Study 20

American Eel Downstream Migration Timing Assessment

RELEVANT STUDY REQUESTS

FWS-10; NHDES-03; NHFG-03; VANR-20; CRWC-26; TU-04

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified a potential issue related to the lack of understanding about the outmigration timing of silver phase American eels in relation to environmental factors and operations of mainstem hydropower projects on the Connecticut River, including the Wilder, Bellows Falls, and Vernon Projects, although the TU study request only included the Bellows Falls and Vernon Projects.

The goal of the requested studies was to assess the timing of American eels migrating from the Connecticut River to their spawning grounds. The specific objective is to characterize the general migratory timing and presence of silver phase American eels in the Connecticut River compared to environmental factors including air and water temperature, turbidity, rainfall, river flow, lunar phase and flow-related operations of mainstem river hydroelectric projects.

TransCanada is interested and willing to contribute to a more in-depth understanding of the timing and cues that initiate the downstream migration of American eel in the Connecticut River. However, it finds that a field study is premature at this time. There are few American eel upstream of the TransCanada projects, as indicated by annual electrofishing conducted in the lower portion of Vernon impoundment by Entergy Nuclear Vermont Yankee and as summarized in the Vernon PAD, and collections made by Yoder et al. (2009) above the Bellows Falls and Wilder dams. A robust evaluation of the timing of downstream migration necessarily requires collecting fish through the migration period, as they emigrate. The effort required to catch a reasonable proportion of the few eels that currently emigrate through the projects would be cost prohibitive. Even then, the number of eels collected would likely be too small to draw reasonable conclusions. Therefore, TransCanada proposes to conduct a thorough review of existing eel downstream migration literature. It appears that such a review has not been completed, particularly with an emphasis on the Connecticut River watershed. The review would augment any field data collected at Cabot Station by FirstLight if such a study is conducted.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- Specific goals related to American eel include minimizing project effects that could hinder management goals and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC Interstate Fishery Management Plan for American Eel (ASMFC, 2000); ASMFC Addendum II to the Fishery Management Plan for American Eel (ASMFC, 2008) and CRASC Management Plan for American Eel (*Anguilla rostrata*) in the Connecticut River Basin (CRASC, 2005).

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- American eel is a state SGCN. Specific goals include minimizing project effects on eel passage, injury, stress, and mortality to maximize the number of silver eels migrating. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005).

- General goals related to sustainable fish populations, habitats, recreational fishing and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR	• American eel is a state SGCN. Specific goals include minimizing project effects that could hinder management goals and minimizing project effects on passage timing, injury, stress, and mortality to maximize the number of silver eels migrating to spawning grounds. Goals reference ASMFC (2000), ASMFC (2008), and CRASC (2005). • State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat. • VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting, and use of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN. • VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. • Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006), including SGCN.

ASSOCIATION WITH OTHER STUDIES

This study (Study 20) is part of a group of studies related to American eel in the project areas. Studies related to this study include American Eel Upstream Passage Assessment (Study 18), American Eel Survey (Study 11), and American Eel Downstream Passage Assessment (Study 19). Together, these four studies will provide a more complete picture of American eel usage of the mainstem river and project areas and potential project effects. In addition, other concurrent studies may provide supplemental information for this study, including the Fish Assemblage Study (Study 10), Upstream Passage of Riverine Fish Species Assessment (Study 17), and Aquatic Habitat Mapping (Study 7).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Some information is available about the timing of downstream migration of American eel in the Connecticut River watershed and in other basins. Monitoring of the downstream bypass at the Holyoke dam (canal louver array) was performed in 2004 and 2005 (Kleinschmidt, Inc., 2005, 2006; Normandeau, 2007).

Results of the 2004 study indicated outmigration occurred at night, between the hours of 1700 to 0400 with peak activity (70 percent) between the hours of 1900 to 2100. Most eels were collected between October 13 and November 7. In 2005, sampling occurred almost every night from October 5 through November 9. The nightly emigration activity occurred between the hours of 1900 and 2400.

PROJECT NEXUS

Currently the TransCanada projects have little, if any, direct effect on the overall outmigration of Connecticut River American eel because so few eels exist upstream of the TransCanada projects. With increased passage at the Turners Falls Project, a greater number of American eels may penetrate farther up the basin, and ultimately, there may be a need to consider specific downstream passage effects at one or more of the TransCanada projects. Because of the potential for a significant number of eels at some time in the future, TransCanada recognizes that there is a nexus between the projects and the American eel resource.

As stated above, an understanding of the dynamics and triggers for downstream migration would be helpful in developing reasonable plans to address safe downstream passage. Results of this study will be used to contribute to the overall knowledge about the American eel downstream migration in the basin. This approach differs from those requested by the resource agencies. The agencies requested continual systematic monitoring of the Holyoke or the Turners Falls bypass facilities via video or DIDSON surveys and a hydroacoustics survey in the Turners Falls intake canal. Because the same request for study has been made to FirstLight, it is not plausible for TransCanada to conduct a field study at the FirstLight Project. If FirstLight conducts a field study at Cabot Station, the field data request to characterize run timing will be fulfilled, obviating the need for TransCanada to request permission of Holyoke Gas & Electric to conduct a study related to TransCanada’s projects at the Holyoke Project.

STUDY AREA AND STUDY SITES

The literature review will focus on existing Connecticut River Basin primary publications, reports, and data (as made available). In addition, existing information from basins in the Northeast will be included to compare and contrast with specific information for the Connecticut River Basin. A broader search for information specific to cues that instigate migration will be included. Regardless of basin or even region, such information on migratory cues may be helpful for developing downstream passage plans in the Connecticut River Basin.

METHODS

The method to be used for this study is to conduct a thorough review of currently available literature for the Connecticut River Basin and other rivers in the Northeast to characterize the general timing of the Connecticut River American eel downstream migration.

Specifically, a review of both peer-reviewed and grey literature related to American eel downstream migration on the Connecticut River and other river systems in the Northeast and general eel migration biology will be conducted to quantify and characterize the expected outmigration of silver phase American eels with a particular focus on environmental cues that stimulate migration.

ANALYSIS

Results of the literature review along with results of related studies and any field surveys that may be conducted at Turners Falls and shared by FirstLight within this study's report timeline will be compiled, summarized, and presented to the agencies and FERC for review and comment.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study.

If FirstLight conducts field studies at Turners Falls in study year one, it is assumed those results will be available to be incorporated into the review (or a report supplement for study year two if field study results are not available prior to the due date of TransCanada's report). Additionally, observations of eels from the American Eel Survey (Study 11), Upstream Passage of Riverine Species Assessment (Study 17) and American Eel Upstream Passage Assessment (Study 18) will be included in this analysis.

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will occur in early 2014, the first study year.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $30,000.

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Updated Study 21

American Shad Telemetry Study - Vernon

RELEVANT STUDY REQUESTS

FERC-09; FWS-04, -05; NHDES-02, -04; NHFG-02, -04; VANR-11, -12; CRWC-22, -23; TU-02, -03

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, FWS, NHDES, NHFG, VANR, CRWC, and TU identified two issues related to potential project effects relative to adult American shad (*Alosa sapidissima*). One issue concerned upstream and downstream adult American shad passage success on the Connecticut River, leading agencies and NGOs to request a study of shad migration from FirstLight's Cabot Station to upstream of Vernon dam. The second issue pertains to American shad spawning behavior, spawning habitat use, areal extent and quality of those spawning areas, and spawning activity in terms of egg deposition in those areas.

Additionally, agencies and NGOs included a request for TransCanada and FirstLight to complete analyses of data collected by USGS on the migration of radio-tagged shad from Turners Falls Project to Vernon dam and passage efficiency of the Vernon fish ladder. They have requested the analyses be completed as soon as possible so that these analyses can be used as a basis to design subsequent field studies.

This study will include analyses of the USGS and FWS 2012 data and an assessment of migration and spawning of shad between Bellows Falls dam and the tailwaters below Vernon dam.

The goals of this study are to:

- Characterize effects, if any, of project operations on behavior, approach routes, passage success, survival, and residency time by adult American shad as they move through the Vernon Project during both upstream and downstream migrations; and
- characterize whether project operations affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches downstream and upstream of Vernon dam and in the area downstream of the Bellows Falls Project.

The objectives of the study are to:

- assess near field attraction to, and entrance efficiency of the Vernon fish ladder;
- assess internal efficiency of the Vernon fish ladder;

- assess upstream passage past Vermont Yankee's thermal discharge located on the west bank of the river 0.45 mile upstream of the Vernon fishladder exit;

- assess upstream migration beyond Vernon dam up to the Bellows Falls Project~~ in relation to the peaking generation operations of the Bellows Falls Project~~;

- characterize project operations effects on post-spawn downstream migration route selection, passage efficiency, downstream passage timing/residence and survival related to the Vernon Project~~, including evaluation of the effect of the Vermont Yankee's heated water discharge plume on downstream passage route, migrant residence/timing of migration, efficiency, and survival~~;

- identify areas that American shad use for spawning;

- assess effects (e.g., water velocity, depths, inundation, and exposure of habitats) of project operations on identified spawning areas; and

- quantify spawning activity.

This study will provide information about American shad route selection, efficiency, and survival during upstream and downstream passage at the Vernon Project. In addition, American shad spawning areas between the Bellows Falls and Vernon dams will be identified and spawning activity will be determined. The effects of project operations on upstream passage, spawning, and downstream passage of American shad will be assessed.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	•	Specific goals related to American shad include minimizing project effects on shad spawning and recruitment, and shad passage effectiveness and survival. Goals reference ASMFC Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (ASMFC, 2010) and CRASC Management Plan for American Shad in the Connecticut River (CRASC, 1992).
	•	General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
NHDES	•	State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	•	Specific goals related to American shad include minimizing project effects on shad spawning and recruitment; and shad migration, false attraction, entrainment, impingement, and survival. Goals reference ASMFC (2010) and CRASC (1992).
	•	General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR	• VFWD specific goals related to American shad include minimizing project effects on shad spawning and recruitment, and shad passage effectiveness and survival. Goals reference ASMFC (2010) and CRASC (1992). • State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat. • General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects. • VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting, and use of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005). • VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

The Aquatic Habitat Mapping Study (Study 7) may assist in identifying suitable spawning areas. The Hydraulic Model and Operations Model (Studies 4 and 5) will provide information for this study in terms of water levels, velocities and flows in relation to shad movement and spawning sites. In addition, this study may relate directly to similar shad studies requested of FirstLight. The resource agencies requested shad migration studies related to the Turners Falls and Northfield

Projects. Part of those studies, specifically, migration of radio-tagged shad past the Northfield Project to Vernon dam, may directly add to the sample size of this study, and this study may inform any FirstLight study conducted.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

American shad are known to migrate upstream in the Connecticut River as far as the Bellows Falls Project. In 2011, FWS and USGS began a whole-river study of radio-tagged shad migration. This study continued through 2012 but the plethora of data has precluded analyses of overall performance of the fish ladder to pass shad. The 2011 study identified problems with the Vernon fish ladder that prevented efficient upstream passage (Castro-Santos, 2011). Subsequently TransCanada repaired the fish ladder, and passage in 2012 was vastly improved in terms of numbers passed and efficiency of the ladder (personal communication, Melissa Belcher, Vermont Fish and Wildlife Department, and Ted Castro-Santos, USGS).

The study conducted in 2012 was a broad scale monitoring of tagged shad in the tailwaters of the Vernon Project with near-field monitoring of the fishladder entrance. Via PIT tags, the efficiency of the ladder to pass shad upstream was observed. Detection of post-spawned tagged shad (both PIT and radio) and perhaps downstream passage at Vernon may have been recorded. While we believe there is valuable and critical existing information from the 2012 study, it has yet to be analyzed. Therefore as a component of this study, a review of the 2012 data will be performed and used to fine tune the design of this study in consultation with the aquatics working group as described in the methods section below.

Resource agencies and NGOs state in their requests that they know of no studies or data available to identify or describe shad spawning areas downstream of Bellows Falls dam or in the vicinity of the Vernon Project. Results of this study combined with the 2012 study results should provide a good representation of American shad migration to and past Vernon, up to the Bellows Falls Project, and emigration of the tagged individuals downstream past Vernon to the Turners Falls impoundment after spawning.

PROJECT NEXUS

Vernon Project operations have the potential to affect water velocity and depth in the shad migration corridors of the Connecticut River. Project flow releases at Vernon dam could affect passage route selection and entry into fishways, increasing tailrace residence time. Inefficient downstream bypasses could increase forebay residence times and possibly result in higher turbine passage. If normal project operational changes, such as decreased or increased generation, occur during active shad spawning, it is important to determine if these changes adversely affect the spawning activity. Results of this study should identify effects of project operations on upstream and downstream passage of shad at Vernon and spawning activity in the project-affected areas.

STUDY AREA AND STUDY SITES

The upstream passage efficiency portion of the study area will encompass the immediate near-field area of Vernon dam for passage evaluations, specifically the immediate Vernon tailrace, fish ladder entrance, and fish ladder proper.

The Connecticut River from about 0.75 river miles upstream of Vernon dam to the Bellows Falls tailrace will be monitored to assess upstream passage timing through the Vernon impoundment and the riverine section downstream of Bellows Falls.

During the downstream passage of post-spawned shad phase, the immediate Vernon forebay area, turbine intakes, bypass fishpipe entrance and exit, and spillway areas will be monitored. An area of the Connecticut River approximately 10 miles downstream of Vernon dam near Northfield, MA, will be monitored for survival of downstream passage. This site was used during the USGS shad study and is a relatively secure site for the monitoring equipment.

Specific sites of interest for the spawning phase of the study will be areas identified as potential spawning sites between Bellows Falls dam and approximately 1.5 miles downstream of Vernon dam. Specific shad spawning sites will be determined via radio telemetry of individuals, and because this determination is a result of the study, it is not specifically known yet. Some shad will also be trapped at the Vernon fish ladder, radio tagged, and released just upstream of Vernon dam for the spawning phase of the study.

METHODS

It is expected that once the 2012 data have been analyzed in 2013, those data may indicate timing of the shad run from Turners Falls to the Vernon Project, residency of tagged shad at the Vernon Project prior to passing upstream, efficiency of shad passage through the fishladder, and perhaps numbers of post-spawned shad returning downstream through the Vernon Project. Another variable the 2012 study may assist with is selection of radio frequencies for this study. Analysis of those data may provide insight into which frequencies may be noisier, thus avoided, in the vicinity of the project. Timing of migration through the Turners Falls impoundment and residence time of tagged shad in the Vernon tailwaters during 2012 will help determine sample size for this study. Analysis of the 2012 data will be discussed with the aquatics working group. Critical modifications to the field work described below for the upstream passage assessment in this study will be discussed based upon this consultation.

TransCanada will monitor the timing of shad migration through the upper portion of the Turners Falls impoundment as the 2012 study did, and monitor shad behavior and movement near-field to the Vernon turbine discharges and the spillway areas. This behavior will be correlated to turbine discharge regimes and effects determined. Success of tagged shad to locate the fishladder entrance will be assessed and related to project operations. Once in the fishladder, efficiency of passage will be determined similarly to the 2012 study. PIT readers throughout the fishway, as well as one radio monitoring station will record shad passage. After passage at Vernon, timing of the shad migration as far upstream as the Bellows Falls Project will be determined. Tagged shad will be manually tracked and spawning areas located. Spawning will be observed and egg collections should yield measurable success evaluations. Emigration of post-spawned tagged shad will be evaluated and downstream passage routes as well as expediency of passage at Vernon Project identified. Survival of passage at the project will determined with the use of motion sensor/temperature radio tags.

Methods used for this study will generally follow those requested by the agencies and NGOs and are provided below with the level of detail requested. Using methods similar to those used in the 2011 and 2012 whole-river shad migration studies for this study will aid in making comparisons between years and enhance the overall dataset. Use of radio telemetry with PIT telemetry, which is widely accepted as the best method to assess fish migratory behavior and passage success, has been used extensively to assess migration and passage issues at Connecticut River projects.

Monitoring Stations and Receivers

Prior to any releases of tagged individuals, radio-monitoring equipment and PIT readers will be set up at the Vernon Project. Similar to the prior USGS radio telemetry study, monitoring stations will be installed to monitor the fish ladder entrance, the immediate tailrace area, and a location just downstream of the tailrace (approximately 1.5 miles downstream of Vernon dam). In addition, two monitoring stations will be deployed to monitor the dam spillway and turbine discharge areas of the tailrace.

In the immediate vicinity of Vernon dam, monitor stations will be configured to monitor tagged individuals to within 30 feet of the fish ladder entrance, in areas of the turbine discharges within 50 feet downstream, in the spillway within 100 feet downstream, and within the entire tailrace area to approximately 800 feet downstream of the dam (Figure 21-1).

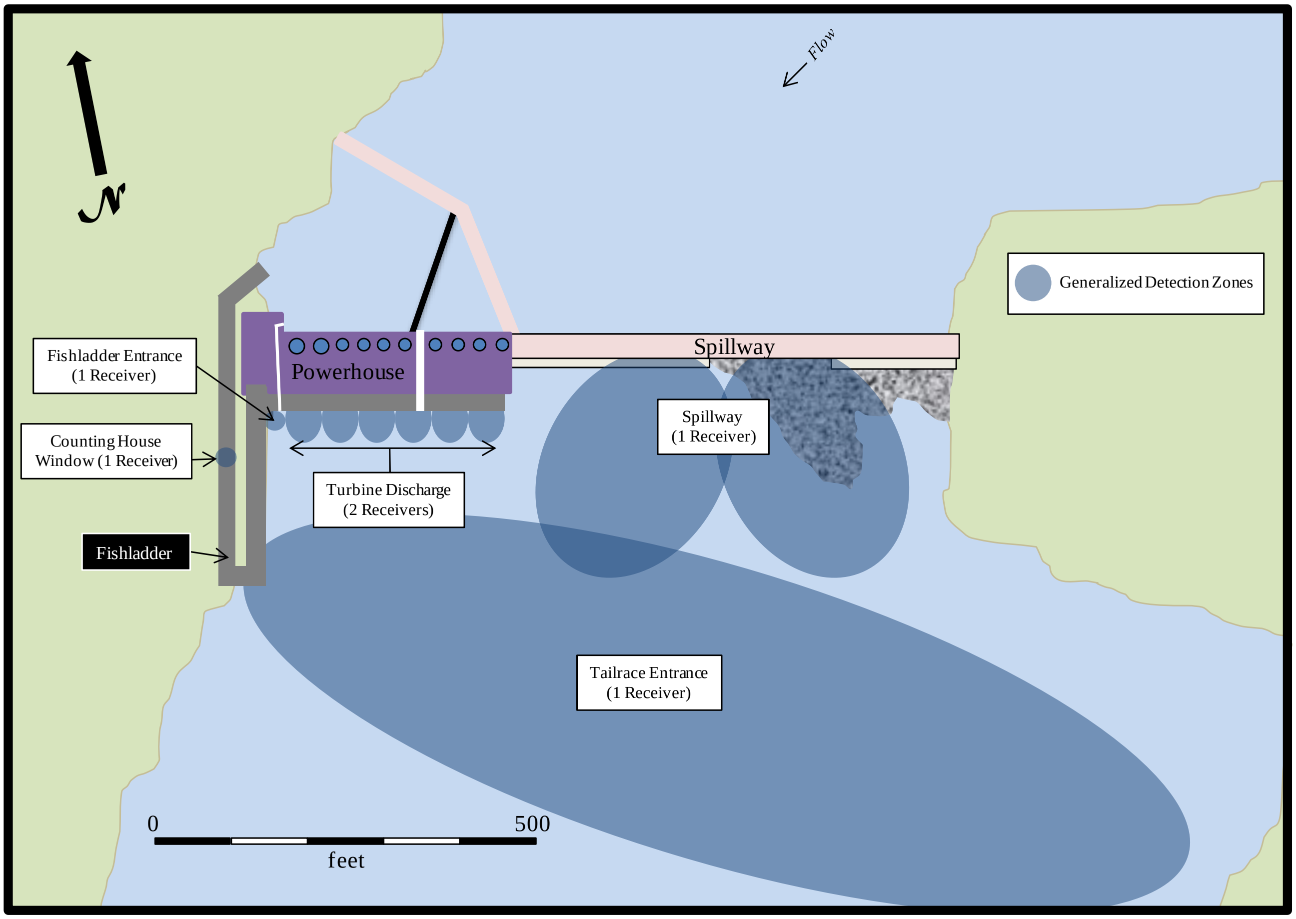

Figure 21-1. Detection zones for monitoring stations used to evaluate upstream movement of radio tagged shad at the Vernon Project.

One receiver connected to an underwater stripped coaxial cable antenna (dropper) will be configured to detect the presence of radio tagged shad to within 30 feet of the fishladder entrance. Within the ladder, another receiver and dropper near the counting room window will detect tagged shad passing upstream. The turbine discharge area will be monitored with two receivers connected through switchboxes to three aerial 4-element Yagi antennas each. Reception of these antennas will be configured to detect tagged shad within 50 feet downstream of the dam and approximately 25 feet in either direction along the dam from each Yagi antenna. The spillway area will be monitored with one receiver connected through a switchbox to two 4-element Yagi antennas to differentiate if and where within proximity to the spillway tagged shad reside. Entrance into the tailrace area will be monitored with one receiver coupled to a 9-element Yagi antenna. Coverage will include a large portion of the tailwaters and the entire width of the river.

The monitor station located 1.5 miles downstream of the dam will be configured to detect tagged individuals within 400 feet downstream and upstream of that station over the entire width of the river (Figure 21-2). An additional receiver will be installed in the counting house of the Vernon fish ladder to confirm presence within the ladder via radio telemetry. A monitor station will also be installed approximately 0.75 miles upstream of Vernon dam to monitor continued upstream migration.

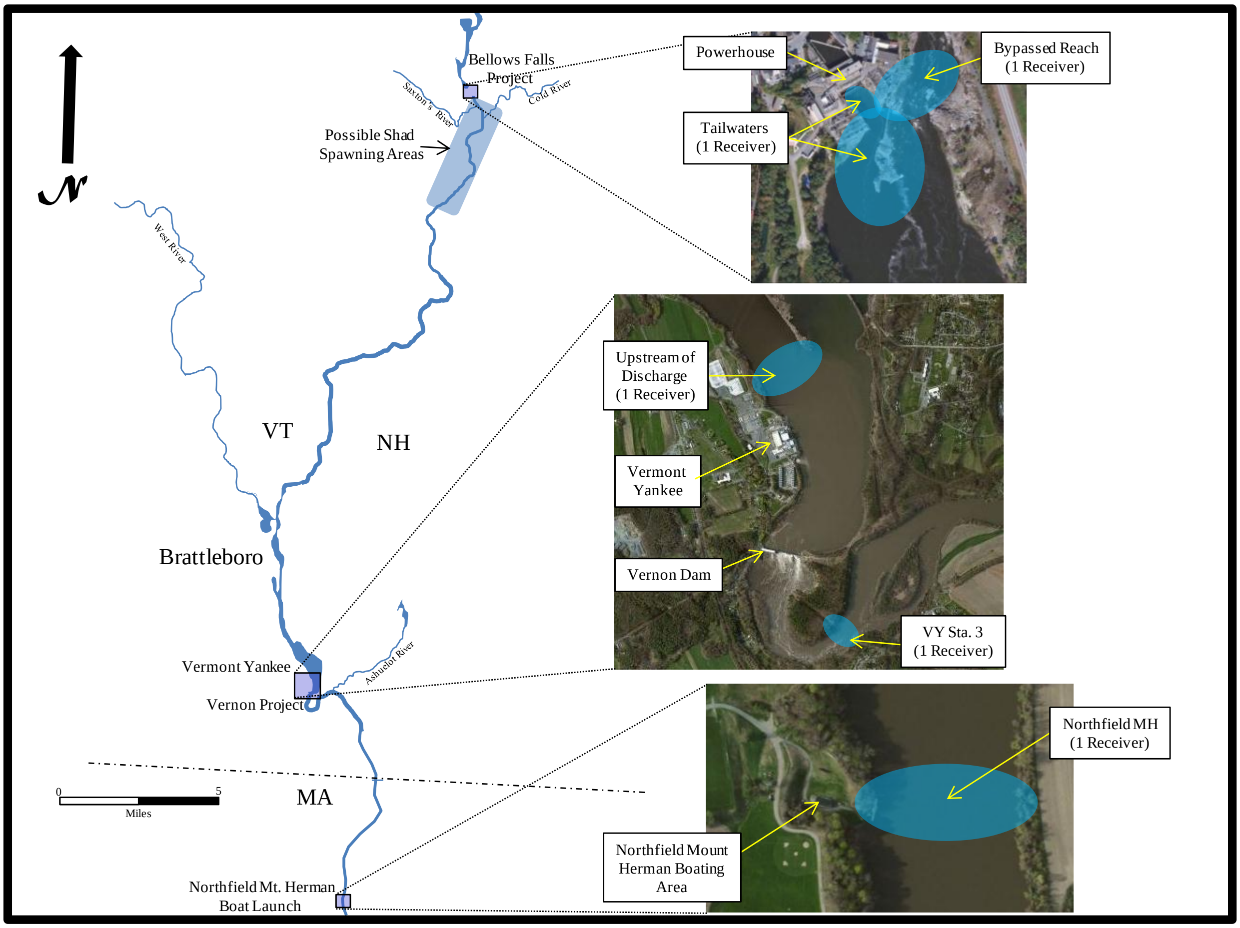

Figure 21-2. Diagram depicting detection zones of monitoring stations upstream and downstream of the Vernon Project.

PIT readers will be installed at five locations within the fish ladder. An antenna will be installed in the first bay of the ladder to denote the entrance of an individual. Other antennas will be deployed at the first bend of the ladder, near the counting house window, just upstream of the window where the ladder becomes vertical slot, and at the exit.

Two monitoring stations will be deployed at the Bellows Falls Project to detect radio tagged shad which may arrive in the tailwaters (Figure 21-2). One receiver with one 6-element Yagi antenna will survey the area of the bypassed reach of the river where it flows into the tailrace of the project. Another receiver combined through a switchbox with two 4-element Yagi antennas will monitor the near-field tailrace and the far-field tailwaters of the project.

The immediate upstream area of Vernon dam will be monitored with three dedicated receivers and the fish bypass routes monitored with a Digital Spectrum Processor (DSP) (Figure 21-3). They will be configured to discretely monitor the intakes, the fish bypasses, and the spillway area of the dam. One receiver connected through a switchbox to four 4-element Yagi antennas will monitor the area just upstream of the spillway. . The immediate area in front of the turbine intakes will be surveyed with two receivers with one 4-element Yagi antenna each. One will monitor presence in front of the six Kaplan unit intakes (Units 5 through 10 – to the west of the louver) and one will detect presence near the four Francis unit intakes (Units 1 through 4). The fish bypass routes will be monitored with stripped coaxial cable antennas strung differing distances within the fishtube and fishpipe. These antennas will be connected to a DSP capable of detecting multiple signal frequencies simultaneously. Post-spawned, radio-tagged shad will be monitored emigrating past the dam and route selection will be determined. A PIT antenna will be installed on the bypass fishpipe exit to monitor PIT-tagged (nonradio-tagged) shad that may exit.

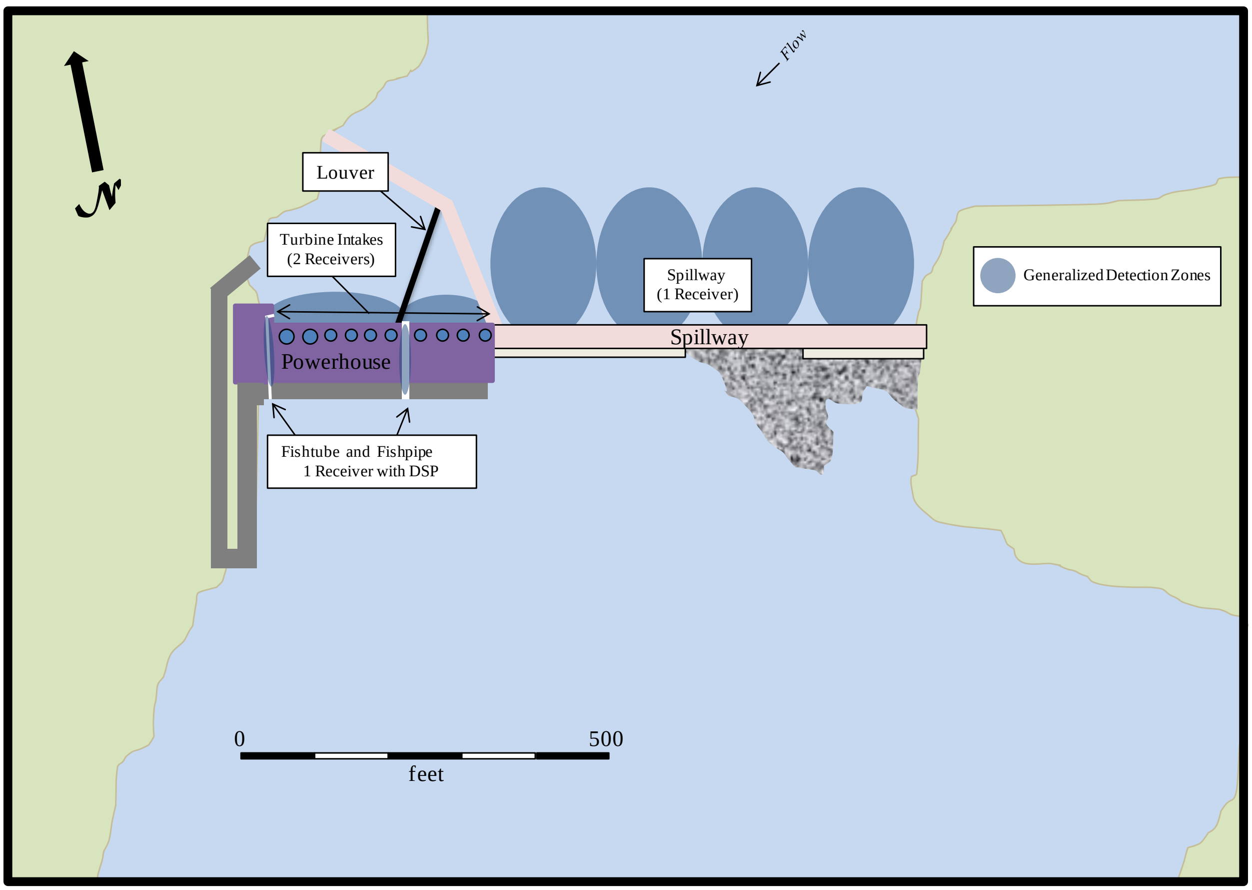

Figure 21-3. Detection zones for monitoring stations used to evaluate downstream movement of radio tagged shad at the Vernon Project.

Radio receivers will be Lotek Wireless, Inc. (Lotek) SRX_400 and SRX_600 units and a Digital Spectrum Processor datalogging unit. Radio transmitters will be coded VHF transmitters supplied by Lotek, Newmarket, Ontario, Canada. The radio tags (model number MCFT-3EM) are digitally encoded and will transmit signals on two to four frequencies (channels), yet to be determined, within the 150- to 151-megahertz band. Each radio tag will contain a unique pulse train to allow for individual fish identification (codes). Each cylindrical radio tag measures 11 mm in diameter, 49 mm in length, weighs 4.3 g in water, and has a 455-mm-long whip antenna. The radio tags will propagate signals at varying rates between 2.0 to 3.0 seconds and will have a minimum battery life of approximately 206 days. Each tag will incorporate motion and temperature sensing capabilities. If a specimen becomes stationary or regurgitates its transmitter, detection of that signal will verify via pulse code that the transmitter is stationary. In addition, every detection event of radio tagged shad will record its temperature within the data log. Temperature and motion data are transmitted via pulse codes, thus, they are only discerned during detection of the radio signals.

PIT readers to be used will be half-duplex units identical to those used for the 2012 USGS study. PIT tags will be 32 mm half-duplex Model RI-TRP-WR2B-30 read/write, Texas Instruments, Austin, TX.

Tagging

American shad will be collected at the Holyoke fishlift and Vernon fish ladder for radio tagging. ~~Twenty~~ Fifty specimens will be taken at Holyoke, radio and PIT tagged, and transported to an area of the Connecticut River approximately 10 miles downstream of Vernon dam for release. The release site is located outside of the Vernon Project area, but it was selected to give radio-tagged shad sufficient area in which to recover from handling and continue volitional upstream migration.

Specimens will be tagged by inserting the radio tag through the mouth and esophagus and placing it in the stomach. They will be PIT tagged by placing the tag through a small incision made on the lower flank of the fish. Another 50 shad will be PIT tagged at the Holyoke fishlift, transported upriver, and released at the same area of the Connecticut River 10 miles down from Vernon dam. Fifty fish should be sufficient to monitor fish ladder efficiency, and this sample size may be supplemented with radio-tagged shad released by First Light under a similar study. Fallback is an issue inherent with American shad tagging studies. Handling of fish to tag induces stress and some proportion of the sample may move downstream after release, prior to moving back upstream; some may not move upstream at all. Castro-Santros (2011) noted 90% of his radio tagged shad arrived at VY Station 3 (lower boundary of study area) from Turners Gatehouse in 2011. TransCanada proposes to tag shad with methods similar to Castro-Santos.

Another ~~20~~ fifty shad (not previously PIT or radio tagged) will be taken from the Vernon fish ladder, radio tagged, and released just upstream of Vernon dam.

In the event that FirstLight conducts a similar study in the Turners Falls Project area, TransCanada will share radio-frequency information with FirstLight and expects that FirstLight will share its frequencies to ensure that tagged fish that move from the Turners Falls Project upstream into the Vernon Project or vice versa will be monitored.

Tracking

Radio-tagged American shad upstream and downstream (if present) of Vernon dam will be manually tracked using a boat, car, and/or aircraft if shad cannot be located otherwise, and their locations will be recorded for each tracking event. Once the tagged fish appear to be congregating and holding around areas that appear suitable for spawning and once water temperatures are conducive, nighttime observation periods will commence.

Observation trips will take place every night, alternating between the downstream areas of Bellows Falls dam and the downstream areas of Vernon dam (i.e., one night below Vernon dam and the next night below Bellows Falls dam). Nighttime visual observation of spawning activity will include identifying and defining areas geospatially and obtaining data about physical habitat conditions and project operations (e.g., water depth, velocity, discharge, substrate, exposure, and inundation of habitats). If observations suggest that shad are spawning, ichthyoplankton nets will be set and towed downstream of the suspected spawning activity to collect eggs. All sampling events will be documented with date/time, location, water temperature, substrate type, average depth, water velocity, and pertinent comments.

ANALYSIS

After all telemetry data (radio and PIT) collected by USGS and/or FWS during their studies in 2012 that is pertinent to the Vernon Project are made available to TransCanada, the data will be compiled, reduced, sorted by individual, and analyzed to provide, to the extent the agency data allows, a concise representation of migrating shad movement and behavior in the tailrace area of Vernon dam. Depending on the quality of the data, migration routes, residency times, ladder efficiencies, and effects of project operations on passage efficiency will be ascertained if the data allow. If data are conducive to determining downstream passage of post-spawned shad, they will be analyzed to discern success of downstream passage.

All radio transmitters for the study will have a unique frequency or code, thus allowing discrimination by individual. In addition, temperature sensors incorporated within the transmitters will allow the fish's ambient temperature to be recorded when individual is being detected. The motion sensing ability of the transmitters will be an instantaneous measure of the transmitter's (i.e. in the fish or not) mobility status. All radio-telemetry data from each monitor station at Vernon dam will be combined, compiled, reduced, and sorted by individual shad. Pertinent data from any related FirstLight study will be incorporated into the TransCanada dataset associated with this study.

Resultant refined data will illustrate individual shad movement about Vernon dam tailwater areas and indicate holding areas, if any, and timing of upstream passage. PIT readers within the fish ladder will supply information as to the efficiency of the ladder to pass shad. Locations of each tagged shad will be presented spatial-temporally in tabular and graphic form, both in and around Vernon dam and upstream in the Vernon impoundment and Bellows Falls downstream reach. Project operational data will be presented and compared to shad movement to determine effects on shad movement and passage at the dam. The spawning location of each fish within the study area, if applicable, will be identified.

Congregation and spawning areas of radio-tagged American shad will be compiled and presented graphically on maps and possibly with aerial photography. Quantification and qualification of shad egg collections will be presented in tabular form. Density of eggs collected per sample will be determined by enumerating a sub-sample and relating that to volume of water filtered. Spawning activity and fervor will be described subjectively and relatively to other spawning activities observed. Factors affecting egg collection, i.e. water turbulence, high velocities, shallow depth, will be noted.

Emigration timing, residence time, passage route selection, and survival of passage for each post-spawned shad will be presented in tabular form. Shad presence and timing of passage will be related to project operations data to characterize what project effects, if any, on downstream passage can be discerned. Temperature sensors will indicate water temperatures each tagged shad occupy as they migrate about the forebay area prior to downstream passage. Motion sensors will immediately identify the status of each transmitter, whether it is mobile or stationary, after passage. Attempts will be made to discern whether the fish regurgitated the tag or whether it suffered mortality after downstream passage.

In order to gauge the effects of project operations on shad spawning, collected data will be analyzed and compared to project operational data. The times and dates of all observed spawning activities, substrate description, water measurements (i.e., velocity, temperature, dissolved oxygen, pH, conductivity, and turbidity), and observational characteristics or anomalies (e.g., extensive water roiling or turbulence) will be recorded and related to the operational data (e.g., total generation, turbine(s) operating, and spill of the particular project in question—Bellows Falls or Vernon).

Observed effects of the projects will be classified per operational regime observed as:

1. no effect –no observable effect on spawning, viable eggs were collected;

2. moderate effect – observable possible effect on normal spawning activity; spawning may have been hindered but viable eggs were collected; and

3. adverse effect – project operations likely to have prevented successful spawning of shad; no viable eggs collected.

Effects classified as 2 or 3 will be correlated to data in the HEC-RAS model in the Hydraulic Modeling Study (Study 4) specific to that location in an attempt to characterize the relative level of project effects from non-project effects that contribute to potential adverse effects on the specific sites. To the extent possible and based on the assessment of the entire spawning dataset, attempts will be made to identify and characterize if any of these effects are likely to be persistent throughout available shad spawning habitats.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology is consistent with generally accepted practices. The radio telemetry of American shad has been conducted and accepted for many years. Shad spawning observations and egg collections during and after spawning follow acceptable practices and also have been widely conducted for years.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study, as well as results of passage efficiency at Vernon fish ladder and an assessment of project operational flows and elevations on spawning activity. A final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report, and an explanation of any stakeholder comments not incorporated will be provided.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Analyses of all data from FWS and USGS American shad migration study conducted in 2012 and related to the Vernon Project is expected to be completed by the end of 2013, prior to the first year of study.

Field work for this study will occur in the first study year (2014). American shad collection and tagging would likely commence at the Holyoke fishlift from mid-April to early May, depending on water temperature. All specimens should be tagged and released by the end of May. Shad will be monitored at Vernon dam and tailwaters during May and early June, and once most specimens have passed upstream and have arrived at spawning sites, as determined by monitoring, by mid- to late-June, field observations and egg collections will commence. The field observations will likely end in early to mid–July when specimens should begin to emigrate. Most post-spawned shad can be expected to pass downstream of Vernon dam by late July. Data compilation, reduction, analyses, and report preparation will be conducted after the end of the field season.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $~~150~~208,000.

REFERENCES

ASMFC (Atlantic States Marine Fisheries Commission).2010. Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring(American Shad Management). ASMFC, Washington, D.C.

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Kart, J., R. Regan, S.R. Darling, C. Alexander, K. Cox, M. Ferguson, S. Parren, K. Royar, and B. Popp (editors). 2005. Vermont's Wildlife Action Plan. Vermont Fish and Wildlife Department, Waterbury, VT.

NHFG (New Hampshire Fish and Game Department).1998. New Hampshire Fish and Game Department Strategic Plan(1998–2010). Concord, NH.

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Updated Study 22

Downstream Migration of Juvenile Shad Study - Vernon

RELEVANT STUDY REQUESTS

FWS-06; NHDES-26; NHFG-26; VANR-09; CRWC-24; TU-09

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TU identified a potential issue related to the Vernon Project's operations on downstream passage of juvenile shad. The issue identified is whether or not project operations affect juvenile shad outmigration and production.

The study goal is to assess whether project operations affect the safe and timely passage of emigrating juvenile American shad ~~outmigration, survival, production, and recruitment~~.

The specific objectives of this study are to:

- assess project operation effects on the timing, route selection, migration rates, and survival of juvenile shad migrating past the project;
- d~~etermine~~ characterize the proportion of juvenile shad using all possible passage routes at Vernon over the period of downstream migration under normal operational conditions; and
- d~~etermine develop~~conduct controlled turbine passage survival tests for juvenile shad passed through one of the older Francis units (Unit Nos. 1 - 4) and one of the new Kaplan units (Unit Nos. 5 - 8) to estimate the relative survival specific to those unit types.

This study, in conjunction with a previous juvenile American shad turbine survival study of Unit 10 (Normandeau, 1996), will provide the information to evaluate whether ~~project operations~~turbine passage adversely affects juvenile survival and also provide information to evaluate migration timing and forebay residency time.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Specific goals related to American shad including minimizing project effects on juvenile shad survival, production, and recruitment. Goals reference ASMFC Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (ASMFC, 2010) and CRASC Management Plan for American Shad in the Connecticut River (CRASC, 1992). • General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• NHFG specific goals related to American shad including minimizing project effects on juvenile shad survival, production, and recruitment. Goals reference ASMFC (2010) and CRASC (1992). • General goals related to healthy ecosystems to support fish and wildlife. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- VFWD specific goals related to American shad including minimizing project effects on juvenile shad survival, production, and recruitment. Goals reference ASMFC (2010) and CRASC (1992).

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.

- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

This study does is not directly associated with any other studies.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Adult shad are counted annually as they pass above Vernon dam. Juvenile American shad production has been monitored upstream and within approximately 0.5 mi downstream of Vernon dam by Vermont Yankee as part of an annual monitoring program, using both boat electrofishing (since 1991) (Normandeau, 2012) and beach seining (since 2000) (Normandeau, 2013). A seasonal average annual index of juvenile American shad standing crop in the portion of the lower

Vernon impoundment (from river mile 141.9 at Vernon dam to the West River confluence at river mile 149.3) has been calculated since 2000 (Normandeau, 2013). Estimates of juvenile shad growth rates have varied from 0.26 to 0.79 mm per day (Normandeau, 2013). Additionally in a study conducted in 1995 (Smith and Downey, 1995) in the Vernon reservoir and upper Turners Falls impoundment, the combined average growth rate observed was 0.75 mm per day.

Studies of American shad passage were conducted in 1991 and 1992 with tests of a high frequency sound field to guide fish to the fish pipe, the primary downstream fishway (RMC Environmental Services, Inc., 1993). Although the high-frequency sound studies were deemed inconclusive, in some tests a behavioral response by juvenile shad to the sound pulses was observed.

In 2009 following the replacement of Units 5 through 8, a feasibility study to evaluate the use of a fixed aspect hydroacoustic array to evaluate passage routes selection by juvenile shad was conducted (Normandeau, 2010). The study included the deployment of transducers on the downstream face of the trashracks, 'looking' into the turbine intakes, and a limited collection of data. The configuration of the turbine units intake bays limited the volume that could be sampled and there were significant amounts of entrained air that confounded juvenile shad target detection. Due to these limiting factors it was concluded that an adequate assessment with this tool was not feasible.

Passage survival of juvenile shad through Vernon's Unit 10 (a Francis turbine) was estimated in a study conducted in the fall of 1995. All recaptured fish were alive, and the immediate (1-hour after passage) estimate of relative survival was 94.73%. The latent survival estimate was 94.61%. The precision on the estimates was within ±10% for 95% of the time (Normandeau, 1996).

PROJECT NEXUS

The falls at Bellows Falls, Vermont is recognized as the historical upstream limit of migration for American shad in the Connecticut River (Scarola, 1973). Spawning in between Vernon dam and Bellows Falls dam is known to be based on the production of juvenile shad in Vernon Pool (e.g., Normandeau, 2013). Limited information is available regarding the total effect of the Vernon Project on downstream migration of juvenile shad. Project operations may influence the downstream passage route selection, forebay residency time, and predation and mortality of juveniles during passage under varying flow conditions.

STUDY AREA AND STUDY SITES

The study area encompasses the Vernon Project forebay, tailrace, turbines, bypass fishways, and dam.

METHODS

Due to the configuration and specifications of the Vernon Project and due to potential limitations inherent in working with juvenile American shad, no single monitoring tool will provide the information needed to make the assessments needed for this study. Each of the available tools (e.g., underwater video recording, telemetry of tagged fish, various acoustic tools) has limitations. Therefore multiple tools are proposed to better assure that objectives are met. While the use of all available tools may be the ideal, there is some overlap in the information provided by some of the tools, and the use of each tool adds significant cost. At some point there is diminishing value as additional tools are included because of some redundancy in the information that can be collected.

The methods proposed for this study include underwater video monitoring, radio telemetry, and HI-Z Turb'N tag methodology as requested by the agencies, but they do not include the use of PIT tags or passive hydroacoustics. Underwater video monitoring is the most cost effective approach to evaluate the timing of outmigration. Its effectiveness is reduced during periods of high turbidity but even if there are occurrences of high turbidity they are typically of short duration and thus the intent of characterizing the timing of the juvenile shad outmigration should be met.

Radio telemetry of juvenile shad will provide information on forebay residency time and proportional passage route selection. Radio tag size has become smaller in recent years and is now suitable for juvenile American shad. This tool has been used with juvenile American shad for several other studies (e.g., recently on the Susquehanna River). One potential limitation is that the tagged fish should be at least 110 mm in length so that the fish is able to continue its migration with the tag attached and with little or no behavioral effect.

The HI-Z Turb'N tag methodology (Heisey et al., 1996) is the most effective approach to estimate the direct survival of fishes that pass through hydro turbines or spill structures. The methodology was developed in the early 1990's in large part to evaluate turbine passage survival of juvenile American shad at Susquehanna River projects. Due to the relatively large size of the river and the hydro projects, no other conventional tool was effective at the time for juvenile American shad (due to the small size and fragile nature). The use of these three tools should provide the information needed to evaluate whether juvenile shad pass Vernon dam safely and timely.

Because the turbine units, and possibly other routes could not be set up with PIT tag antennas that would sample with high detection probabilities, the use of PIT tags would provide little additional information for determining passage route selection, survival, or overall run timing. At best, only the fish bypasses (and possibly the sluice) would be conducive to installing a PIT-tag reader, and because the fish pipe is of steel construction and tagged fish would be moving through them at very high velocities, the installation of effective PIT tag antennas may also be problematic in these routes.

As noted above, the use of fixed aspect hydroacoustics to estimate the relative use of the turbine units for downstream passage is not feasible (Normandeau, 2010).

Other hydroacoustic tools (e.g., scanning sonar, DIDSON, transducers oriented to monitor across the water column (rather than 'up-looking' or 'down-looking') may supplement the information that will be obtained with the proposed tools but likely not provide substantially different information that would not otherwise be available. Due to the size and depth of the forebay and the various structures (e.g., louvers, piers, log boom) there are limitations to the deployment of a hydroacoustic system that could sample large volumes and thus provide robust information. A single transducer system would likely not provide much useful information; a complex hydroacoustic deployment would likely provide additional information but at significant cost (and questionable value). DIDSON units can provide useful information for a specific location if conditions are conducive for sampling (e.g., little entrained air and noise). These units are relatively expensive to purchase or rent and in this case would provide little additional information. A rough estimate of a range of cost to add a single transducer system up through a complex system may be $50,000 - $400,000, and likely not provide substantially more or unique information over what is proposed herein.

Run Timing and Route Selection

The duration and timing of the juvenile shad downstream migration will be characterized through monitoring the bypass with under-water video cameras. The cameras will be capable of observing shad during both day and night. It is understood that this technique may have some draw backs under extremely turbid conditions during high flow events. However, in the fall those events are typically of short duration (and thus the objective can still be met), and if spill occurs during those conditions shad will likely pass the project via spill. Monitoring will occur from approximately early September through approximately the end of October. Monitoring will be triggered when the ambient river temperature decreases to 19 degrees Celsius (O'Leary and Kynard, 1986) and be terminated when juvenile shad are no longer observed or the river temperature reaches 5 degrees Celsius, whichever occurs first.

The proportional route selection and forebay residency time for juvenile shad downstream passage will be assessed by radio tagging and systematically monitoring tagged shad movement and passage through the project. Because fish for tagging should be at least 110 mm in length, and purported availability of test fish from a regional hatchery, that is the preferred source of fish for tagging portions of this study. Periodic monitoring of shad growth rates and, if necessary, supplemental feeding to increase growth can be facilitated in a hatchery environment and thus better assure that study objectives are met. If hatchery fish are not available, juvenile shad for this study will be collected at one or more of the following locations: via seining in a backwater area in Vernon Pool known as Cersosimo Pond (approximately 4.7 miles upstream of Vernon Dam); Turners Falls Cabot Station bypass sampler; via seining upstream of Turners Falls dam near Barton Cove; or via seining in the Oxbow in Northampton, Massachusetts. Test fish procurement is expected to occur in late September to early October to coincide with the expected natural downstream migration period. Following collections, shad will be transported and retained in appropriate holding facilities in a secure location at the Vernon Project.

Remote telemetry monitoring will occur at the Vernon forebay, log boom and diversion boom, bypass fish tube, turbines, tailrace, and spillway. Radio receivers and/or digital spectrum processors (DSP) capable of monitoring multiple radio channels simultaneously at each location will be coupled with appropriate antennas and calibrated to ensure adequate coverage of the individual sites to be monitored while minimizing overlap between the sites. It is expected that at a minimum, seven monitoring sites will be installed. Data downloading from the remote telemetry monitoring stations will occur at a minimum of three times per week. Periodic manual monitoring by boat will also occur ~~at least twice per week~~ to assist in data collection and analysis.

Radio transmitters for this study will be no more than 5 mm wide x 3 mm high x 14 mm long in size, weigh≤0.5 g in air, have a calculated life of 8days, and will propagate a signal via a flexible whip antenna. Each transmitter will contain a unique pulse code to allow for individual fish identification and be DSP compatible. The transmitters will be constructed or modified to allow for reliable secure external attachment to the back of each fish. For testing, 10 groups of 10 shad will be externally radio tagged, transported by boat, and released approximately 1.5 miles upstream of Vernon dam over the course of the downstream migration season. It is expected that this release scenario will allow for monitoring over a range of environmental and project operating conditions. Only shad >~~100~~110-mm total length will be used for the study. Additionally, each group of tagged shad will be released with a group of untagged shad to encourage schooling behavior.

~~During the course of the study,~~ air temperature, water temperature, turbidity, rainfall, river flow, and project operations information will be collected and reported. Lunar phase will also be noted.

To evaluate the potential for tagging effects, a simultaneous controlled experiment will be conducted (either simultaneously to the study or in the fall of 2013) by holding groups of tagged and untagged juvenile shad in tanks and making formal observations on their relative behavior. The objective of this experiment is to evaluate whether the tagging process and tag itself affect the behavior of shad relative to untagged fish. If behavior of tagged fish is affected by tagging, the results of the field tests could be biased. A dummy tag of the same specifications as the radio tags will be used on shad at least 110 mm in length. The tagged fish will be mixed with untagged fish. At least 20 tagged fish in each of two holding tanks will be mixed with at least 20 untagged fish in each of two holding tanks. Water temperature and dissolved oxygen will be continuously monitored in the tanks. Representative video recordings will be made to document the behavior of the fish in the experiment. In addition, 15 minute observation periods during late afternoon and evening periods will be randomly selected so that close observation and data recording can be conducted. At least twenty 15 minute observation periods per test tank will be conducted. Results will be compiled and included as an appendix to the report.

Turbine Survival/Injury

Turbine passage survival of juvenile shad will be assessed by using mark/recapture methodology at one of each of the two un-tested unit types (i.e., smaller Francis turbines in Units 1-4 and Kaplan turbines in Units 5-8). As discussed above, one of the two large Francis turbines (Unit 10) was previously studied for juvenile shad passage survival (Normandeau, 1996).

Selection of the test turbine units will be based in part on historic operations (being prepared as part of Study 5, Operations Model) and on an evaluation of the turbine specifications and priority of operation. As described in the Vernon PAD, Units No. 1 through 4 are single runner, vertical Francis turbines rated at 4,190 HP at 35 feet of head and 133.3 rpm with a maximum hydraulic capacity of 1,465 cfs. The new Units, No. 5 through 8, are vertical axial flow Kaplan turbines with a 3.1-meter diameter runner rated at 5,898 HP at 32 feet of head, and 144 rpm with a maximum hydraulic capacity of 1,800 cfs. Units No. 9 and 10 are vertical single runner Francis turbines rated at 6,000 HP at 34 feet of head with a maximum hydraulic capacity of 2,035 cfs. The turbine intake trashracks are 2-inch on center for Units 1 through 8, and 4-inch on center for Units 9 and 10. During fish ladder operation, unit priority is Unit 10, followed by 8, 7, 9, 6, 5, 4, 3, 2 and 1. Outside of the fish ladder operating season unit priority is Units 5-8 first, followed by Units 9 and 10, followed by Units 1-4.

A minimum of 150 HI-Z Turb'N tagged juvenile shad will be released into one of the small Francis units and 150 into one of the Kaplan units. An additional 150 HI-Z Turb'N tagged shad will be released into the tailrace to serve as control group for the turbine survival tests. Based on assumptions of 93% control group survival, 93% live recapture of fish, a sample size of 150 treatment group fish per test unit and 150 control group fish should yield a survival estimate with a precision of <u><=</u>10%, 95% of the time. Survival tests will be conducted by injecting tagged shad into a turbine at or near full generation. Following release of treatment and control groups fish, they will be recovered from the tailrace, examined for injuries, and held for 48 hours for observation and latent mortality. Unrecovered tagged shad will be censored from the data set.

ANALYSIS

Route Selection

The radio telemetry data will be analyzed to determine the number and timing of shad using each monitored downstream passage route at the Vernon Project. A comparative analysis of passage routes with operations and environmental variables that occur during the study period will then be conducted. The analysis will include two-dimensional (2-D) maps of movement and passage for each individual shad along with summarized data in tabular form. Forebay residency time by release group and for all release groups combined will be reported. An appendix will include all the relevant data for each individual fish.

Turbine Survival/Injury

Immediate (1h) and latent (24h) relative survival and classification of injuries will be estimated for each of the turbine types tested at the project using generally accepted practices (Normandeau, 1996). The results will be assessed in conjunction with the physical, environmental and operating conditions that occur during the study.

An estimate of passage survival for the project in total will be calculated using proportional route selection data collected during the radio telemetry portion of this study, and survival data from this study and the previous study of juvenile shad turbine survival through Unit 10 (Normandeau, 1996). In addition, the assessment will also take into account the unit preference and operating frequency or likelihood.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The study methodology, data collection, and analysis techniques to complete the study objectives are consistent with generally accepted practices (Normandeau, 1996,Normandeau and Gomez and Sullivan, 2012).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted in the fall of the first study year (2014). The study report will be prepared after all field work and data analyses are completed.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $~~125,000 to $150,000~~200,000 – 250,000 and is dependent on the effort required to obtain test specimens, based on the year-class success.

LITERATURE CITED

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Updated Study 23

Fish Impingement, Entrainment and Survival Study

RELEVANT STUDY REQUESTS

FERC-08; NHDES-18; NHFG-18; VANR-23

STUDY GOALS AND OBJECTIVES

In their study requests, FERC, NHDES, NHFG, and VANR identified potential issues related to Wilder, Bellows Falls, and Vernon Project operations on fish impingement, entrainment, and survival. The goal of this study is to assess the adequacy of the intakes at the projects to minimize fish mortality resulting from impingement and entrainment of fishes residing in the Connecticut River.

The objectives of this study are to:

- provide a description of physical characteristics of the Wilder, Bellows Falls, and Vernon Projects (including forebay characteristics, intake location and dimensions, approach velocities, and rack spacing);
- identify current routes of fish movement past each project and the risk of injury/mortality associated with each route (considering seasonality, flow direction and velocity, existing management regimes);
- analyze target species for factors that may influence vulnerability to entrainment and mortality;
- assess the potential for impingement and estimate survival rates for target species;
- ~~estimate entrainment rates and numbers of~~assess the potential for entrainment and estimate survival rates for target species;
- estimate turbine passage survival rates~~ and numbers~~;
- estimate total project survival considering all passage routes for American shad and river herring at the Vernon Project; and
- estimate total project survival considering all passage routes for American eel, Atlantic salmon, and sea lamprey at the Wilder, Bellows, and Vernon Projects.

As requested by FERC, these objectives will be accomplished through desktop analysis, not through field study as requested by other entities. This desktop analysis is not intended to quantify the contribution of project-related mortality to a calculated population estimate for individuals of a specific fish species, but rather, to provide a qualitative assessment of the potential for impingement or entrainment. Supporting data for this desktop analysis will be obtained through review of previously conducted studies at these and other projects, and currently proposed species-specific passage and survival studies at the Vernon, Bellows Falls, and Wilder Projects.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• State water quality standards for designated uses of Class B waters relative to high levels of water quality that support healthy aquatic communities and associated uses such as fishing.
	• General goals relative to aquatic natural resources including providing for healthy, self-sustaining fish communities and minimizing potential effects of project operations on resident fish populations.

ASSOCIATION WITH OTHER STUDIES

This study will rely on fish community data collected during the Fish Assemblage Study (Study 10). Fish community data from that study will be used to identify the target species list that will be assessed to identify potential impingement and entrainment effects. In addition, findings from the two American shad studies at the Vernon Project (Studies 21 and 22) and from the two American eel downstream assessments (Studies 19 and 20) may provide useful insight into the determination of survival for these diadromous fish species.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

~~No information for rates of fish impingement or entrainment of resident species at the projects is available. However, n~~Numerous studies of passage route entrainment for anadromous fish are available (Hanson, 1999; Normandeau, 1995a, 1996a, 1996c, 1996d, 2009a; RMC, 1990, 1992b, 1993, 1994a). Previous mark-recapture balloon tag studies have assessed survival of Atlantic salmon smolts passing via downstream bypasses at the Wilder (RMC, 1992a), Bellows Falls (RMC, 1991) and Vernon (Normandeau, 1995b) Projects and through turbine units at the Wilder Project (RMC, 1994b) and Vernon Project (Normandeau, 1996b, 2009b). Exclusion and guidance of Atlantic salmon smolts by a fish diversion structure at Bellows Falls has also been assessed (Normandeau, 1995a). In addition, survival and injury rates have been assessed for turbine passed juvenile American shad at the Vernon Project (Normandeau, 1996a). With the existing information on passage survival and proposed studies related to passage survival, along with a characterization of the potential for entrainment of fishes in the three pools, a qualitative assessment of the effects of entrainment will be conducted.

PROJECT NEXUS

Potential effects of project operations and facilities include fish impingement on the trashracks and entrainment through the generating units. Fish moving downstream in the Connecticut River as part of their life cycle encounter the project dams and intakes. Similarly, fish species resident to the project impoundments may enter forebays and come into close proximity to the intakes. These actions may result in exposure of fish to impingement or entrainment.

This study will help establish a baseline condition to assist in evaluating ~~the number of fish entrained or impinged~~entrainment and impingement potential and the expected survival of those fish at each of the projects.

STUDY AREA AND STUDY SITES

This desktop assessment will examine fish impingement, entrainment, and passage through the Wilder, Bellows Falls, and Vernon dams and powerhouse structures, including spillways, downstream bypasses, and turbine units.

METHODS

The assessment of impingement, entrainment, and survival will be conducted as a desktop analysis. A list of target fish species representing species of conservation interest and all fish guilds will first be developed based in the baseline fish community data collected as part of the Fish Assemblage Study (Study 10).

The potential for impingement or entrainment will be ~~determined~~ characterized based on the relationship of site-specific intake characteristics along with swim speed and life history characteristics of target fish species and guilds. Site-specific factors likely to influence the potential for entrainment include intake location relative to shore and littoral habitat, prevalence of littoral species, clupeids and obligatory migrants in the source water body, depth of project intakes, degree of water level fluctuations, hydraulic capacity, water quality and intake velocities. Each project will be assessed for these site-specific intake characteristics. This assessment will rely on intake velocities calculated using the velocity equation $Q = V*A$ where Q = flow rate (cfs), V = velocity (feet per second) and A = area (square feet). Life history characteristics and species-specific swim speed information for target fish species will be obtained from peer-reviewed literature. The likelihood of impingement or entrainment for a particular species-life stage will be qualitatively assessed through the comparison of site-specific intake characteristics to literature-reported swim speeds, body dimensions and other life history characteristics.

A review of entrainment studies conducted at other hydroelectric projects (i.e., EPRI, 1997) will be conducted to derive entrainment rates for target fish species. EPRI (1997) summarized entrainment rate data for hydroelectric projects which relied on full-flow tailrace netting to sample the entire flow passing from one or more units at a project. Partial flow sampling was not included in that database due to the higher potential for sample contamination as a result of collection of resident tailrace fish or net avoidance. Each of the 43 projects contained in the EPRI (1997) data compilation will be reviewed for similarity in project characteristics to those in operation at Vernon, Bellows Falls and Wilder. Following determination of appropriate project(s) for use as surrogates, available entrainment rate data will be summarized for the fish species-life stages of interest at the TransCanada projects. Literature-obtained entrainment rates will be combined with project-specific discharge data to generate ~~quantitiative estimates~~qualitative assessments of potential of entrainment for target species at each of the projects.

Entrainment survival for target fish species will be estimated using data from survival studies conducted at the projects (Normandeau, 1995a, 1995b, 1996b, 1996e, 2009b; RMC, 1991, 1992a, 1994b), other hydroelectric facilities with similar characteristics (e.g., EPRI, 1997; Winchell et al., 2000) and the Franke blade strike probability equation (Franke et al., 1997). In addition to literature-based and calculated passage survival rates, results from studies conducted for this relicensing will be used, including concurrent site-specific mark-recapture studies—Downstream Migration of Juvenile American Shad at the Vernon Project (Study 22) and the American Eel Downstream Passage Assessment (Study 19). Where data is available, survival estimates obtained during the site-specific mark-recapture studies will be compared to literature-obtained and calculated passage survival rates to evaluate the precision of the three predictive methods. Survival rate estimates for target fish species will then be combined with estimated entrainment numbers to estimate fish survival through the turbine units at the projects.

Total project survival will be ~~determined~~ characterized for American eel, Atlantic salmon, and sea lamprey at the Wilder and Bellows Falls Projects and for American eel, American shad, Atlantic salmon, river herring, and sea lamprey at the Vernon Project. With the exception of species and life stages with known distributions among downstream passage routes (data to be collected from Studies 19 and 22), estimates of total project survival will be obtained based on the assumption that fish passage will be equal to the distribution of flow through all downstream passage routes at a particular project. Using available site-specific, literature-based, or calculated survival estimates for each downstream passage route, an estimate of total project survival for each applicable species-life stage combination will be calculated.

ANALYSIS

Results of this study, including probability of impingement, estimates of entrained fish survival through the project turbines and total project survival will be summarized in tabular format. All data used in the development of those estimates will be provided in an appendix to the study report.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

A desktop approach has been previously used and is a widely accepted technique for the assessment of impingement, entrainment and turbine survival as part of FERC relicensing. Examples include the Claytor Hydroelectric Project (FERC No. 739), Brassua Hydroelectric Project (FERC No. 2615), and the Santee Cooper Hydroelectric Project (FERC No. 199).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the project. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This desktop assessment of impingement, entrainment, and turbine survival will be conducted during the second study year in the spring of 2015. It will rely on results the Fish Assemblage Study (Study 10), which will be conducted during study year one and will allow for proper identification of the target fish species. In addition, findings from the associated studies referenced above (Studies 19, 20, 21, and 22) may provide useful insight into the determination of survival for diadromous fish species.

LEVEL OF EFFORT AND COST

The preliminary estimated cost this study is $65,000.

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Updated Study 24

Dwarf Wedgemussel and Co-Occurring Mussel Study

RELEVANT STUDY REQUESTS

FWS-13; NHDES-12; NHFG-12; VANR-27; CRWC-30; TNC-05

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, VANR, CRWC, and TNC requested a study of the effects of the Wilder and Bellows Falls Project operations on the dwarf wedgemussel (*Alasmidonta heterodon*). Five objectives were stated in each study request: three were related to baseline population studies and long-term monitoring and two were focused specifically on the potential effects of flow regime/water level fluctuations on mussel behavior or habitat. This study includes an adaptive, two-phase plan that meets the objectives of the study requests and will benefit from collaboration with resource agencies throughout the design and implementation of the study. The goals of this study are to:

Goal 1: Assess the distribution, population demographics, and habitat use of dwarf wedgemussels in the Wilder and Bellows Falls Project areas. This goal has three specific objectives:

- **Objective 1 (Phase 1):** Conduct an initial survey of the 17-mile-long reach of the Connecticut River from Wilder dam to the upstream end of the Bellows Falls impoundment to determine the distribution, relative abundance, and habitat of the dwarf wedgemussel;

- **Objective 2 (Phase 1):** Determine the best sites for quantitative mussel sampling in areas where dwarf wedgemussels are known to occur in the Wilder and Bellows Falls Project areas and the reach surveyed for Objective 1; and

- **Objective 3 (Phase 2):** At sites identified in Objective 2, collect statistically sound and repeatable data, using quantitative methods, to determine density, age-class structure, and habitat for dwarf wedgemussels and co-occurring mussel species.

Goal 2: Assess the influence of flow regime (which includes water-level fluctuations) on dwarf wedgemussels, co-occurring mussel species, and mussel habitat. This goal has two specific objectives:

- **Objective 4 (Phase 2):** Observe and record behavior of dwarf wedgemussels and co-occurring mussel species *in situ* during varying flow conditions; and

- **Objective 5 (Phase 2):** Assess the potential effects of flow regime on dwarf wedgemussels and their habitat.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS	• Dwarf wedgemussel is a federal endangered species. The goal is species recovery for removal under the Endangered Species Act in accordance with the U.S. Fish and Wildlife Service Dwarf Wedge Mussel Recovery Plan (FWS, 1993) and Five Year Review Summary and Evaluation (FWS, 2007).
NHDES	• State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.
NHFG	• General goals related to sustainable fish populations, habitats, recreational fishing and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).
VANR	• Dwarf wedgemussel is a state-listed endangered species. Specific goals for rare, threatened and endangered species include maintaining or increasing populations and maintaining, restoring, providing stewardship for, and conserving habitats and natural communities that support rare, threatened, and endangered species.

ASSOCIATION WITH OTHER STUDIES

Several other studies have objectives and methods that overlap with, or complement, this study. They will contribute toward a greater understanding of the effects of flow regime on aquatic resources in the study area. Related studies include the Tessellated Darter Study (Study 12), Aquatic Habitat Mapping (Study 7), Instream Flow Study (Study 9), Hydraulic Modeling (Study 4), and Operations Modeling (Study 5).

Phase 1 of this study can be completed independent of other studies. Phase 1 results may assist with site selection or the selection of which parameters to measure, map, analyze, or model for Studies 4, 5, 7, 9, and 12. Likewise, those studies may also provide important information regarding site selection, measured parameters, and analysis to meet Phase 2 objectives of this study.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The Connecticut River is thought to contain the largest populations of the dwarf wedgemussel in the world; they occur in three distinct areas of the river that have been referred to as the Southern, Middle, and Northern Macrosites (Nedeau, 2008, 2009). The Southern Macrosite is bounded by Bellows Falls dam to the south and Wilder dam to the north, a distance of approximately 42 miles within which dwarf wedgemussels are thought to occur in a 35-mile-long reach from Charlestown to Plainfield with one tributary population in the Black River. The Middle Macrosite occurs in the reach between the Wilder dam and Monroe, NH. Based on studies conducted from 1999 to 2011, it appears that no tributary populations exist along the Middle Macrosite and that dwarf wedgemussels are confined to a 16-mile-long reach from the Orford/Piermont line to Haverhill. The Northern Macrosite occurs in areas upstream from Moore dam to the now breached Wyoming dam.

In 2011, Biodrawversity conducted a freshwater mussel survey throughout the Wilder, Bellows Falls, and Vernon Project areas (Biodrawversity and LBG, 2012). This survey was semi-quantitative; the main goal was to assess the distribution, relative abundance, demographics, and habitat of the dwarf wedgemussel in the project areas. Dwarf wedgemussels were generally found in the same areas where they had been found during previous studies. The 2011 survey did not include the 17-mile-long reach of the Connecticut River downstream from Wilder dam, where dwarf wedgemussels have been documented to occur (Nedeau, 2008). This is the longest reach in the Connecticut River from the Holyoke dam (MA) to Fifteen Mile Falls (NH) that has not been surveyed in the last 15 years.

Most of the dwarf wedgemussel studies conducted in the last 20 years in the Connecticut River were either qualitative or semi-quantitative. Therefore, there is no basis for determining population estimates or trends. In addition, very little quantitative data exist about age-class structure, and therefore recruitment, of the population. Data on population distribution, size, density, age-class structure, and habitat use and availability are essential for determining the status and viability of the dwarf wedgemussel population. Resource agencies want to gain a better understanding of potential effects of hydropower operations on dwarf wedgemussels.

The biggest knowledge gaps include lack of a repeatable, quantitative mussel monitoring program that can allow for an assessment of population trends, and a general lack of understanding of how flow regime and water level fluctuations affect individual mussels, populations, and the quality and quantity of habitat.

PROJECT NEXUS

The federally endangered dwarf wedgemussel occurs in the Wilder and Bellows Falls Project areas, and the species may also occur in the 17-mile-long reach of the Connecticut River between the Wilder and Bellows Falls Projects. Project operations may influence dwarf wedgemussel population viability and habitat suitability in these areas. This study plan will document the distribution and status of dwarf wedgemussel populations in these areas and allow for a better understanding of how flow regime may influence dwarf wedgemussel distribution, density, behavior, and habitat use.

STUDY AREA AND STUDY SITES

The study area includes the Wilder Project, Bellows Falls Project, and the 17-mile-long reach from Wilder dam downstream to the upper end of the Bellows Falls impoundment (approximately to Chase Island). Survey sites in the Wilder impoundment will occur within the 14-mile-long reach (from 27 to 41 miles upstream from Wilder dam) where dwarf wedgemussels were documented in 2011. Survey sites in the Bellows Falls impoundment will occur within the upper 17 miles (approximately from the Black River confluence to Chase Island) where dwarf wedgemussels were documented in 2011. In the 17-mile-long reach from Wilder dam to Chase Island, a minimum of one site per mile will be surveyed; sites will be selected in the field as described in the Methods section.

METHODS

This study will use a two-phase, adaptive, and collaborative approach to achieve the same basic goals and objectives stated in each of the study requests. The study plan focuses on objectives that can be met within a 2-year period, but specific methods are described for 2013 fieldwork (Tasks 1 and 2, and a pilot study for Task 4). Details for Tasks 3–5 will be developed and discussed after evaluation of the field data collected in 2013. The primary reason for a two-phase approach is that additional surveys are needed to determine where dwarf wedgemussel densities are high enough to permit quantitative sampling, behavioral studies, or analyses that combined dwarf wedgemussel data with physical habitat modeling to assess potential effects of flow regimes. The goals and objectives of the dwarf wedgemussel study align with those of several other studies, and the planning and implementation of those studies would benefit by having better information on where, at what density, and in what habitat dwarf wedgemussels occur. The 2011 survey did provide some of these data, but only detected low-density populations where certain types of quantitative sampling and habitat analyses may not be effective.

- **Phase 1 (2013):** Addresses study objectives 1 and 2, which both relate to baseline mussel studies and an evaluation of potential areas where more intensive quantitative sampling and flow-related studies may be conducted. Specific methods for a Phase 1 study are outlined in this study plan, under Task 1 and Task 2. Phase 1 will also include a pilot study of *in situ* monitoring (Task 4) to begin to address study objective 4.

- **Phase 2 (2014)**: Addresses study objectives 3 through 5 and will rely on Phase 1 data and agency input to determine where and how the necessary data may be collected. Therefore, aside from the pilot study for Task 4, this study plan provides only general details on methods for Phase 2 data collection or analyses, under Tasks 3 through 5.

Task 1. Semi-quantitative Survey from the Wilder Dam to Chase Island

Methods for this task are similar to those used in the 2011 survey of the Wilder, Bellows Falls, and Vernon Project areas (Biodrawversity and LBG, 2012) but with the flexibility to spend additional time in high-quality habitat to simultaneously accomplish Task 2 objectives.

A minimum of 17 sites will be surveyed in this reach. Survey sites will be selected based on prior mussel survey data and the presence of habitat conditions likely to support dwarf wedgemussels. Further, sites will be selected to ensure adequate spatial coverage of survey sites within the study reach.

Survey methods may vary according to habitat conditions at each survey site, but generally, surveys will be conducted by SCUBA diving. Snorkeling may be used in shallow areas. A minimum 1-hour, timed search will be conducted at all survey sites with more time spent in high-quality habitat where dwarf wedgemussels are found.

The following information will be recorded at each survey site:

- Species richness;
- Precise counts of target species (dwarf wedgemussel) and uncommon non-target species. These results will be reported as raw counts and catch-per-unit-effort (CPUE);
- Abundance estimates of non-target common species and size ranges of live animals;
- Shell lengths and shell condition (i.e., degree of shell erosion) for each dwarf wedgemussel and also for a subsample of other species;
- Microhabitat (water depth, substrate, flow conditions, submerged aquatic vegetation, woody debris, and distance to shore) for each dwarf wedgemussel;
- Incidental observations of tessellated darters;
- General habitat descriptions will be recorded for each survey site and also for the broader areas near each survey site (i.e., a reach or segment);
- GPS locations for each survey site; and
- Digital photographs of habitat, live animals or shells, and other features.

Task 2. Assess and Select Sites for Quantitative Mussel Surveys and Flow-Related Mussel Studies

This step will examine data collected during the 2011 surveys in the Bellows Falls and Wilder impoundments (Biodrawversity and LBG, 2012), data collected from 1990 to 2010 for these same reaches (Nedeau, 2008, and references therein), and the 2013 mussel survey from Wilder dam to Chase Island.

Based on these data, sites likely to have the largest dwarf wedgemussel populations and the most available suitable habitat will be determined and assessed as to the degree of flow regime alteration at each site.

These survey sites and/or nearby reaches will be revisited to gain a better understanding of the following: 1) spatial extent of the dwarf wedgemussel population, 2) population densities of dwarf wedgemussels and other species, 3) habitat use by dwarf wedgemussels, 4) habitat suitability for dwarf wedgemussels, 5) environmental conditions (especially sampling constraints), 6) accessibility (including potential property rights issues), and 7) any other factors that may influence whether a site could be used for further study.

Items 1–4 above will be determined by SCUBA diving or snorkeling both cross-channel and longitudinal transects; the number of transects will vary according to conditions at each site. For each transect, the following data will be recorded:

- Precise counts of target species (dwarf wedgemussel) and uncommon non-target species. These results will be reported as raw counts and catch-per-unit-effort (CPUE);
- Abundance estimates of non-target common species;
- Shell lengths and shell condition (i.e., degree of shell erosion) for each dwarf wedgemussel and also for a subsample of other species;
- Incidental observations of tessellated darters;
- Microhabitat (water depth, substrate, flow conditions, submerged aquatic vegetation, woody debris, and distance to shore) for each dwarf wedgemussel, and for the entire transect; and
- GPS locations for stopping and starting locations of each transect.

A written summary will include the following: 1) complete rationale for the initial screening process, 2) summary of mussel data and habitat data gathered at each of the sites, 3) summary of environmental and logistical constraints to accessing or surveying each site, and 4) recommendations for monitoring sites.

Task 3. Quantitative Mussel Sampling at Selected Sites

Quantitative sampling using a statistically sound and repeatable study design, with the goal of estimating mussel density and population size with a measure of variance, was an objective of all six study requests. A mussel study should be guided by five considerations: 1) what are the objectives, 2) what is the target population, 3) what resources are available, 4) what is known about the study site, and 5) what is known about the mussel population (Strayer and Smith, 2003). Objectives should be defined in quantitative terms to help inform specific details of methods, such as sampling size.

Based on currently available information, it is premature to propose a specific study design or methods for quantitative monitoring. First, objectives need to be more explicit and quantitative. The target population (e.g., where, when, and what) needs to be better defined. Currently, there is no way to select study sites because the qualitative and semi-quantitative studies performed to date have not provided adequate data. In fact, based on currently available data, dwarf wedgemussel population densities in the project areas may be too low for some types of quantitative monitoring (Gabriel 1995, Strayer and Smith 2003). Lastly, environmental conditions and other sampling or access constraints need to be assessed before survey sites can be selected. TransCanada will work with resource agencies to address these considerations after Task 1 and Task 2 results have been summarized and submitted for review. The goal will be to establish three sites where quantitative sampling and behavioral studies may be most effective: one in the Wilder impoundment, one in the Bellows Falls impoundment, and one in the 17-mile-long reach between the Wilder and Bellows Falls Project areas.

A variety of quantitative study designs have been proposed and tested on dwarf wedgemussel populations and other riverine mussel species (Strayer and Smith, 2003). Study requests specifically mentioned systematic quadrat sampling with multiple random starts and double sampling (i.e., substrate excavation); this was described in Strayer and Smith (2003) and used in the Ashuelot River (NH) for long-term monitoring of dwarf wedgemussel populations (Nedeau, 2004, 2006; Biodrawversity, 2012, 2013a). Variations of this approach have also been used in lakes (Biodrawversity 2009) and large rivers (Biodrawversity 2013b) in the Northeast. It is very likely that some variation of this study design will be most appropriate for Task 3. This study design is also effective at determining spatial distribution and microhabitat of target species, particularly when key location and habitat parameters (e.g., water depth, flow velocity, substrate, etc) are recorded concurrently with the mussel data (Nedeau 2004, 2006; Biodrawversity 2012, 2013a-b). Shell length, age estimates, shell condition (degree of shell erosion), and gender of mussels would also be recorded during quantitative sampling to document age/size structure, recruitment success, individual condition, and sex ratios.

In low density mussel populations, quantitative sampling using quadrats may be difficult to implement because detection probability is low and very large numbers of samples (i.e., quadrats) may be needed to achieve adequate statistical power

(Strayer and Smith 2003). In these cases, investigators have used less rigorous quantitative study designs such as transects, or semi-quantitative study designs such as timed searches (or some combination of the two). The pros and cons of these approaches were described specifically for the dwarf wedgemussel population in the Connecticut River in a 1995 report (Gabriel 1995). Though transects or timed searches are inferior to quadrat sampling from the standpoint of repeatability and precision, they do typically detect a higher number of animals and may provide better information on habitat use and population demographics. Gabriel (1995) recommended intensive timed searches of transects to provide comparable indices of dwarf wedgemussel population density, size class distribution, and possible changes in the locations of mussel beds.

Overall, this study plan aims to find areas where quantitative sampling using quadrats will be effective. If dwarf wedgemussels are not found, or if there population densities are too low for this design to be effective, some variation of the transect and timed search study design, as described in Gabriel (1995), will be developed. This is similar to what is described under Task 2, except with greater replication, and only in areas that are selected using the Task 1 and Task 2 results.

Task 4. Observe and Record Mussel Behavior *In Situ* at Varying Flow Levels

In situ observations of mussel behavior at varying flow levels were included in each of the study requests. As described in the study requests, biologists could "measure changes in shell position (open/closed), siphoning rate, lure display, horizontal migration (movement across the substrate), and vertical migration (burrowing) due to flow fluctuations" by observing individual mussels. There are myriad challenges to this type of monitoring. Very few case studies provide guidance on where and under what conditions *in situ* observations might be effective, how to collect data, how to minimize observer effects, how to separate natural behavior from behavior related to a stressor of interest, how to interpret the data, and what conclusions can be drawn about individual mussels or populations from short-term observations of behavior. Furthermore, there are no known locations in the project area where dwarf wedgemussel densities are high enough that multiple individuals could be observed in the field of view of a biologist or camera, raising concerns about level of effort to adequately replicate behavioral observations while controlling for confounded variables.

Due to these challenges, this study plan proposes a two-phase approach. First, a pilot study will be conducted in 2013 to observe mussel bed(s), preferably with dwarf wedgemussels present, during the rising and falling limbs of daily flow fluctuations. Behavior will be observed, and recorded with an underwater video camera. The mussel bed(s) will occur in relatively shallow water in area(s) of the river where peaking flows are more acute, probably in the upper Bellows Falls impoundment or the reach downstream from Wilder dam. A summary of observations, along with an assessment of whether this type of monitoring might be feasible at a larger scale, will be developed and shared with the aquatics working group. Based on results of the pilot study, a second phase may be developed, discussed with agencies, and implemented in 2014. The second phase would likely be an expansion of the pilot study, but done in a more repeatable way and in areas where mussel populations and habitat conditions are conducive to *in situ* monitoring. Task 1 and Task 2 results will be needed to determine final site selection for *in situ* monitoring.

Task 5. Assess the Effects of Flow Regime on Dwarf Wedgemussel and Their Habitat

All six study requests expressed interest in an assessment of potential effects of flow regime (which includes water-level fluctuations) on dwarf wedgemussel populations and on the availability of dwarf wedgemussel habitat. Study requests cited a publication on the effects of flow and substrate parameters on dwarf wedgemussel habitat persistence in the Delaware River (Maloney et al., 2012), suggesting that this could be a model for the Connecticut River studies. Several other studies might also help to guide study plan development and offer alternate analyses (Hardison and Layzer, 2001; Howard and Cuffey, 2003; Morales et al., 2006; Gangloff and Feminella, 2007; Allen and Vaughn, 2010; Daraio et al., 2010). All of these studies involve physical habitat modeling with varying levels of complexity in terms of the habitat parameters that are measured or modeled, the types of analyses, and the degree to which field-collected, biological data are integrated into the model.

TransCanada is proposing to use the distribution, density, habitat, and behavioral data collected during Tasks 1-4, in combination with the data collection and analysis for Studies 4 (Hydraulic Modeling), 5 (Operations Modeling), 7 (Aquatic Habitat Mapping), and 9 (Instream Flow Study) to assess the effects of flow regime on dwarf wedgemussels and their habitat. Supporting information on dwarf wedgemussel habitat preference will come from other studies conducted in the Connecticut River watershed (Nedeau 2008 and references therein) and elsewhere in their range (e.g., Strayer 1993, Strayer and Ralley 1993, Maloney et al. 2012).

This assessment will benefit by first identifying where the largest dwarf wedgemussel populations occur in the project area and how this overlaps with areas of greatest flow fluctuations (Tasks 1 and 2), gathering quantitative population and habitat data at these sites (Task 3), and observing mussels and their habitat over a range of flows (Task 4). The data collection and analysis for the other studies (4, 5, 7, and 9) may focus specifically on those areas where these mussel data are collected to allow better integration of both physical and biological data in the resulting models.

Regardless of the analysis, TransCanada feels it is premature to plan this specific task until Phase 1 mussel studies are completed, and there has been an opportunity to consider potential biological limitations of the assessment (i.e., population size, spatial extent, habitat use). Once Phase 1 studies are complete, TransCanada will develop a study plan in consultation with the aquatics working group and file it with FERC for approval.

ANALYSIS

Task 1 will follow the same level of analysis and mapping used to develop the 2011 report. Task 2 will rely on descriptive statistics, written summaries, maps, photographs, and clearly presented data to convey how sites were assessed and why certain sites were selected for more detailed studies. Analyses are not yet defined for Tasks 3 through 5.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Overall, a two-phase approach is a widely accepted, highly recommended practice to refine key study considerations and provide preliminary data (i.e., Phase 1) to help plan more detailed studies (i.e., Phase 2). This approach will ensure that resource agency goals and objectives are adequately addressed, time is used efficiently, and studies serve their intended purpose. As recommended by resource agencies, methods for Task 1 match those used for the 2011 survey. Task 2 methods are widely accepted for evaluating populations and habitats and for informing the development of suitable study designs and methods. Aside from the pilot study for Task 4, methods and analyses are not yet defined for Tasks 3 through 5, but TransCanada feels that the best path forward is an open, collaborative approach with resource agencies with an awareness of the relevant publications and case studies to guide development of study plans.

DELIVERABLES

Task 1 results will be integrated into the 2012 mussel survey report, and an updated version of that report will be provided to resource agencies. Results from Task 2 and the pilot study for Task 3 will be compiled into a separate confidential report. Key topics for the Task 2 report will include the following: 1) complete rationale for the initial screening process, 2) maps and a summary of mussel data and habitat data gathered at each of the sites, 3) summary of environmental and logistical constraints to accessing or surveying each site, and 4) recommendations for monitoring sites. The confidential report for the Task 3 pilot study will include a summary of methods, parameters measured, maps of locations where observations were made, a summary of observations, underwater photographs, and underwater video (on DVD). Additional deliverables will depend on the outcomes of the Phase 1 studies and consultation with the aquatics working group on Phase 2 studies.

Results and non-confidential conclusions will be reported in either the PLP or draft license application for the project. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application. A stand-alone confidential report will be provided to FWS New Hampshire NHB, and Vermont NHIP, in which specific locations and details of individual populations will be provided.

SCHEDULE

Task 1, Task 2, and the pilot study for Task 3 will be completed in the 2013 field season, any time from ~~mid-May to early October~~June to September. Ideally, fieldwork would be completed early in that potential time frame, results will be summarized and provided to resource agencies, and a plan and timeline for Phase 2 studies can be developed.

LEVEL OF EFFORT AND COST

Phase 1

The preliminary estimated cost for Phase 1 is $30,000, and Phase 2 could range from $50,000 to $100,000, depending upon agency consultation.

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Updated Study 25

Dragonfly and Damselfly Inventory and Assessment

RELEVANT STUDY REQUESTS

VANR-29

STUDY GOALS AND OBJECTIVES

In its study request, VANR requested a baseline inventory of odonates (dragonflies and damselflies) and collection/synthesis of key life history, ecology, and habitat data to help assess the effects of current project operations on habitat and survival in the Wilder, Bellows Falls, and Vernon Project-affected areas. The study request emphasized SGCN but generally outlined objectives, methods, and analyses that would effectively target the all odonate species that use riverine habitat for larval stages.

This study plan has two related goals: 1) inventory the river-dependent odonate assemblages in the project-affected areas, including life history, ecology, and behavior information for each species; and 2) assess the potential influence of project operations on river-dependent odonate larval emergence/eclosion and habitat. The four specific objectives are to:

1. conduct a baseline inventory and habitat assessment that builds on prior surveys in the project areas;
2. collect field data on the emergence and eclosion behavior of river-dependent odonates in the project areas;
3. review and synthesize available information on the life history, ecology, and behavior of river-dependent odonates that occur in the project areas; and
4. use information gathered in Objectives 1–3, combined with data and analyses from other studies, to develop an overall assessment of the potential effects of project operations on odonate emergence/eclosion and habitat.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

VANR	• State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat. • General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including

invertebrates; and minimizing project effects on water quality and aquatic habitat.

- VFWD general goals related to conserving, enhancing and restoring natural communities, habitats, species and the ecological processes that support them and providing fish and wildlife-based activities including viewing, harvesting and utilization of fish, plant and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including three odonate SGCN.

ASSOCIATION WITH OTHER STUDIES

At least five other studies have objectives and methods that complement this study and that will contribute to a greater understanding of the effects of project operations on aquatic resources in the study area. The results from the Aquatic Habitat Mapping (Study 7), the 2012 Rare Species and Communities Survey (Normandeau 2013), and preliminary results from the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats (Study 27) will be used to assist in selection of sampling sites. The final results and analysis of this study will also incorporate findings from Instream Flow (Study 9); Hydraulic Modeling (Study 4); and Riverbank Erosion (Study 3). Because odonates use aquatic habitats as larvae, riverbanks and riparian habitats for emergence/eclosion, and upland habitats as adults, studies within and across these habitats will help provide a more comprehensive assessment of odonate usage in the study area.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Thirty-three species were found in the most recent odonate survey in the Connecticut River in New Hampshire and Vermont (Hunt et al., 2010); seven of the species are SGCN in Vermont, and an eighth species was newly reported in Vermont and possibly rare. All eight of these species are riverine dragonflies in the Family Gomphidae. These include:

- *Gomphus abbreviatus,*
- *Gomphusquadricolor,*
- *Gomphus vastus,*
- *Gomphus ventricosus,*
- *Ophiogomphusrupinsulensis,*
- *Stylurus amnicola,*

- *Stylurusscudderi,* and
- *Progomphusobscurus*.

Hunt et al. (2010) sampled 13 sites in the Connecticut River from Northumberland to Hinsdale, NH. Ten of these sites were in areas influenced by the Wilder, Bellows Falls, and Vernon Projects. Pfeiffer (2009) reported four Vermont SGCN species downstream from Vernon dam. These reports provide valuable baseline information on the odonate species that occur in the project-affected areas; however, site selection, species data, and habitat parameters collected at each survey site do not provide enough information to fully achieve the objectives of this study.

The effects of water-level fluctuations stemming from project operations on the emergence and eclosion success of odonates is not well understood. Aquatic larvae crawl out of the water (i.e., "emerge") when they are mature and ready to metamorphose into the adult phase of their lives. They crawl onto the riverbank, or onto emergent vegetation or woody debris, to find a suitable location to eclose, which is the process by which the adult sheds the larval exoskeleton before taking flight. For a short period after eclosion, the adult wings and exoskeleton are soft and the adults cannot yet fly, making them susceptible to fluctuating water levels and predators during this period. Species with a propensity to crawl farther up the streambank and gain a greater vertical distance from the water's surface are at lesser risk from fluctuating water levels. One of the key information gaps this study will address is how the magnitude and timing of project-related, water-level fluctuations may affect odonate species with different emergence and eclosure behaviors.

PROJECT NEXUS

Seven of Vermont's SGCN odonates occur in the Connecticut River in the Wilder, Bellows Falls, and Vernon Projects, yet the distribution and habitat of these and other odonate species is not well understood. Project operations may influence odonate assemblages in these areas, primarily via effects on habitat use/suitability, or survival during emergence/eclosion due to water-level fluctuations. This study will document the distribution, relative abundance, habitat, and behavior emerging and eclosing larvae of both SGCN odonates and the entire river-dependent odonate assemblage found in project areas and use these data and other studies to assess the potential effects of project operations, particularly water-level fluctuations.

STUDY AREA AND STUDY SITES

The study area includes the Wilder, Bellows Falls, and Vernon impoundments and the two riverine reaches downstream from the Wilder dam and Bellows Falls dam, as well as approximately 1.5 miles below Vernon dam. Seven of the sampling sites from Hunt et al. (2010) that occur within these areas will be used as study sites to maintain continuity with that study. These include two in the Wilder impoundment, one downstream from Wilder dam, two in the Bellows Falls impoundment, and two in the Vernon impoundment. ~~Three~~Four additional sites will be selected to provide wider geographic and habitat diversity. In general, the sites will be located to include one toward the middle of the Wilder impoundment, one additional site downstream of Wilder dam, one site downstream of Bellows Falls dam, and one site downstream of Vernon dam. Final site selection will be developed in consultation with the terrestrial working group and in consideration of results from Aquatic Habitat Mapping (Study 7). Overall, this approach results in a total of 1~~0~~1sampling sites: ~~three~~four in riverine reaches and seven in the impoundments.

In general, study sites will be 100 meters (m) in length, and will be selected primarily based on two considerations: 1) is habitat suitable for odonates, and 2) is habitat representative of conditions within that reach. Field reconnaissance and results of Aquatic Habitat Mapping (Study 7) and the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats (Study 27) will help with site selection.

METHODS

Timing

Each site will be surveyed three times during the summer: mid-June, mid-July, and early August. These times generally cover the peak emergence periods of most odonates, particularly SGCN species. Surveys will be conducted when weather and flow conditions are conducive to collecting larvae and exuviae and when larvae are more likely to be emerging. Optimal sampling conditions include warm, sunny days when river discharge is near or below average, during low water cycles. TransCanada operations staff will be consulted to help coordinate field work with low water opportunities, to the extent feasible.

Field Data Collection

Odonate sampling methods will target mature larvae, pre-flight adults (called tenerals), and exuviae. The focus will be on those individuals that have emerged from the water, but there will also be an effort to collect pre-emergent mature larvae by sampling in near shore shallow water. Basic methods will generally follow Morrison et al. (2006) and Hunt et al. (2010), but with a more quantitative approach. These methods briefly described below:

- Randomly placed transects will be established within each of the ~~ten~~ eleven 100-m-long survey sites. The long axis of each transect will be perpendicular to the shoreline with the lower end at the estimated low waterline and the upper end terminating 1 m into dense vegetation or at the top of the riverbank, whichever is less. The upper and lower ends of each transect will be recorded with GPS.

- Within each transect, biologists will thoroughly search for larvae, tenerals, and exuviae. Each individual that is found will be either identified in the field (if possible) or put into its own uniquely numbered vial. The following information will be recorded for each individual:

- Species;
- Exact time when collected;
- Surface from which it was collected;
- Horizontal, vertical, and straight-line distance from the waterline.

- For each transect sampled on each date, the following habitat information will also be collected:
  - Types and percent coverage of soil/substrate;
  - Types and percent coverage of vegetation;
  - Percent coverage of large woody debris or other types of cover;
  - The height, slope, and relative stability of the streambank;
  - Evidence of recent versus current water levels; and
  - Representative photos.
- In addition to the transect-specific data, biologists will also describe and photograph aquatic, riparian, and upland habitat along the entire length of the 100-m sampling sites.
- At each site and on each sampling date, an aquatic D-net will be used to capture larval odonates from a representative range of microhabitats, and the first 50 larvae captured will be preserved in alcohol. During D-net sampling, the relative abundance of larval odonate prey species captured incidentally, such as larval insects, crustaceans, and aquatic worms will be recorded.
- If larvae are observed in the process of emerging, their position, time, and distance walked from the first point of observation to the end of that survey period will be recorded.
- In the laboratory, all odonate specimens will be identified to species.

Literature Review

Existing books, manuals, peer-reviewed journal articles, unpublished technical reports, and other case studies will be reviewed to compile key life history, ecology, and behavior data for each of the odonate species found in the project areas, and particular emphasis will be placed on SGCN odonates.

ANALYSIS

Field data will allow for a quantitative analysis of odonate density (number per meter per transect) and abundance (total count by sample site) at each sampling site, an analysis of the variability in density and abundance within and among sampling sites and sampling dates, and an analysis of the influence of measured habitat parameters on odonate density and abundance. In addition, the field data will include key species-specific information such as emergence times, distances and heights that larvae travel before eclosion and preferred substrates for emergence and eclosion. These field data will be supplemented with the literature review to provide a database of when, in what conditions, and where odonates emerge and eclose, as well as the susceptibility of each species to water-level fluctuations.

Results of the Aquatic Habitat Mapping Study (Study 7), Hydraulic Modeling (Study 4), Operations Modeling (Study 5), Instream Flow (Study 9), Riverbank Erosion Study (Study 3) and Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27) will be used to assess the potential influence of project operations on river-dependent odonates.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods outlined for site selection, field data collection, and analysis are consistent with other studies that seek to understand the odonate assemblages in large rivers, habitat use, emergence and eclosion behavior, and potential effects of water-level fluctuations. VANR requested methods similar to Morrison et al. (2006), and this study plan uses these basic methods (minus the river bottom transects) but also uses methods that will allow for better quantitative analyses, which will be a more effective way of integrating results of the water-level fluctuation study, and expressing results in quantitative terms.

DELIVERABLES

A final study report will be prepared after the first year field season. The report will follow a standard scientific format and will include appendices for raw field data, field notes, and species information. Voucher specimens will be retained and made available to resource agencies.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will occur in the first study year (2014). Potential sampling sites may be assessed in late 2013 for planning purposes. In 2014, field studies will occur from June to August, laboratory identification of specimens will occur throughout the summer and fall, and a draft report will be prepared in late fall.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $~~96~~101,000.

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Updated Study 26

Cobblestone and Puritan Tiger Beetle Survey

RELEVANT STUDY REQUESTS

VANR-30

STUDY GOALS AND OBJECTIVES

In its study request, VANR identified potential issues associated with Wilder, Bellows Falls, and Vernon Project operations on two species of tiger beetle listed as Vermont SGCN. One of these species, the Puritan tiger beetle (*Cicindela puritana*), is listed as threatened federally and in Vermont. The cobblestone tiger beetle (*Cicindela marginipennis*) is listed as threatened in New Hampshire and Vermont. Specifically, potential habitat disturbance, alteration, and loss as well as sedimentation due to project operations could negatively affect these species.

The goal of this study is to conduct a survey to detect and gather information on known and new cobblestone tiger beetle and Puritan tiger beetle populations along the Connecticut River throughout the project-affected areas, including the impoundments and downstream on the riverine reaches, and to determine the potential effects of project operations on tiger beetles.

The objectives of this study are to:

- obtain baseline distributional and abundance data and map occurrences of cobblestone and Puritan tiger beetle populations along the Connecticut River throughout the three project-affected areas;
- define the particular habitat requirements of each species;
- assess the vulnerability of each species to disturbances such as siltation, flow fluctuations, and changes in shoreline composition and vegetation;
- identify areas where suitable habitat may exist for these tiger beetle species and the portions of those habitats affected by project operations; and
- determine if project operations are adversely affecting the survival success of adult and larval cobblestone and Puritan tiger beetles.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In its study request, VANR described various jurisdictional resource management goals for this study, as summarized below.

VANR

- Cobblestone tiger beetle is a state-listed threatened species. Specific goals for rare, threatened, and endangered species include maintaining or increasing populations; and maintaining, restoring, providing stewardship for, and conserving habitats and natural communities that support rare, threatened, and endangered species.
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities, including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including two beetle SGCN.

ASSOCIATION WITH OTHER STUDIES

Preliminary results from the Aquatic Habitat Mapping (Study 7) and the Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats (Study 27) will be used to assist in locating potential tiger beetle habitat and sampling site selection. The final results and analysis from this study will also incorporate findings from Instream Flow (Study 9); Channel Morphology and Benthic Habitat Study (Study 8); Hydraulic Modeling (Study 4); Riverbank Erosion (Study 3); and Operations Modeling Study (Study 5). Habitat identification, field work and analysis for this study may be conducted in conjunction with the Dragonfly and Damselfly Inventory and Assessment (Study 25), Fowler's toad Survey (Study 28), or with other surveys conducted during the same timeframe.

EXISTING INFORMATION

The Puritan tiger beetle is listed as a threatened species federally and in Vermont. It is only known historically in the project-affected areas from several New Hampshire sites and a single Vermont site in Hartland, VT, within the Bellows Falls Project. The historical distribution of Puritan tiger beetles included locations in the Connecticut River that extended from Claremont, NH, to Cromwell, CT. Nine of these populations were extirpated in the early 1900s, with the latest collection records in the 1930s (Knisley, 1987, cited in Hill and Knisley, 1993).

The distribution of Puritan tiger beetle, both historical and current, is restricted to two disjunct regions, Chesapeake Bay in Maryland and the Connecticut River in New England. Vogler et al. (1993) performed a genetic analysis of individuals from the two regions and concluded that the occurrences on the Connecticut River "have to be considered as independent units." Historically, there are records of Puritan tiger beetles from New Hampshire and Vermont but despite intense searching by tiger beetle experts over the last 25 years, no occurrences have been found upstream of Hadley, MA.

Impoundments along the Connecticut River are believed to have contributed to the extirpation of this species. Riverside recreational use has had a significant effect on populations at other New England sites, although in some cases recreational activity provides surrogate disturbance that delays vegetative succession. Historically found along the Connecticut River in Hartland, VT, and nearby New Hampshire sites, larval density of this species is highest along big rivers in sparsely vegetated patches of fine to medium sand (particles predominantly 0.125 to 0.5 mm [Omland, 2002]); in some instances, suitable habitat may be embedded in wide beaches (e.g., Northampton, MA) but in other instances, the beach may be quite narrow (e.g., 4 to 6 m in Cromwell, CT). Given their genetic distinctness, the species' association with clay banks in Maryland may not be relevant to habitat preferences in New England.

The cobblestone tiger beetle is listed as threatened in both Vermont and New Hampshire. It has been studied in Vermont to a greater degree than other *Cicindela* species. According to VANR in its study request, habitat losses along the Connecticut River and possibly along other rivers have been significant due to impoundments. The cobblestone tiger beetle is found in the vicinity of the projects on the Connecticut River including one at least one island, the West River, and the White River. This species has an extremely restricted habitat and is found on cobble and gravel beaches on medium and large rivers. Adults inhabit areas of cobble, gravel, and sand where vegetation is sparse. Larvae are thought to occupy burrows in the sand along the edges of or interspersed with cobblestones.

PROJECT NEXUS

Project operations and land uses have the potential to cause direct adverse effects on tiger beetle populations through effects on the egg, larval, and pupal stages; direct effects on adult beetles are unlikely. Threats to larval habitat are primarily due to vegetative succession mediated by diminished erosion dynamics. Inundation per se is unlikely to affect buried life stages because tiger beetles have adapted to tolerate frequent and/or prolonged submersion (Brust and Hoback, 2009), and it is likely that larvae dwell higher on banks than the daily inundation zone (Omland, 2002). However, if the daily inundation cycle or recreational activity on the riverbanks causes larval burrows to collapse frequently, then there may be an energetic cost of re-excavating burrows, which would divert resources from growth and reproduction. Knowing whether larvae of the two focal species are present in the project-affected areas and how they may be affected by vegetative succession, inundation, or recreational activity will enable us to assess whether project operations are having adverse effects on the populations.

STUDY AREA AND STUDY SITES

The study area encompasses the Wilder, Bellows Falls, and Vernon impoundments and riverine reaches below Wilder and Bellows Falls dams that are identified to be likely habitat for tiger beetles, as described below, including three islands below Wilder dam, islands in the Lebanon area, an area with slowly moving water at the mouth of Mascoma River, and Hart's Island. Vernon dam discharges into a reach that has limited riverine habitat due to impoundment fluctuations associated with a combined operational effect from Turners Falls Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project FERC No. 2485). While no known habitat for the listed tiger beetles is known to occur in this section, TransCanada will review the shorelines of the river and Stebbins Island for approximately 1.5 miles below Vernon Dam for potential tiger beetle habitat. .Having identified likely habitat patches from historical records and inspection of orthophotos, only specific patches will be included in this study.

Cobblestone tiger beetles and Puritan tiger beetles occupy distinct habitats along the Connecticut River as larvae and adults. Larval habitat is more specific than adult habitat. Puritan tiger beetle larvae are found at highest density in fine to medium sand, which is associated with slow-moving water. Adults may be found foraging near larval habitat on a variety of substrates ranging from mud to coarse sand. Puritan tiger beetles inhabit fine-to-medium sand beaches along bends of big rivers. For instance, the beach in Massachusetts where they have been found is dry, wide, free of vegetation, and located on a bend of the river (MA NHESP, 2010), while the beaches in Connecticut where they have been found are wet, narrow, and sparsely vegetated and located on a straight reach. Larvae live in burrows along the upper margin of the beaches.

In contrast, cobblestone tiger beetles are associated with cobble and gravel bars and beaches that have a mixture of coarse sand. Larval biology of cobblestone tiger beetles is poorly known but it is presumed they dig burrows in sand in such places. Cobblestone tiger beetles are found on the edges and islands of small to medium sized rivers with swiftly flowing water. They are restricted to scour areas along these rivers where the substrate is composed of wet pebbles, cobblestone, sand, and sparse vegetation. The larvae dig burrows in wet sand found interspersed among cobblestones (Pearson et al., 2006).

METHODS

Aerial photography and data from preliminary aquatic and terrestrial habitat mapping (Studies 7 and 27) ~~taken in summer low flow conditions (if available)~~ will be examined for patches of potentially suitable habitats for cobblestone and Puritan tiger beetles based on lack of vegetation and substrate composition. Areas of apparently suitable habitat will be visited by boat or on foot during low water cycles (to the extent possible and in consultation with TransCanada operations staff) to confirm habitat suitability. Areas with high quality habitat seen during sampling site selection will also be examined. In addition, historical areas where cobblestone and Puritan tiger beetles were found will be examined for larval burrows and adult specimens. Areas where these tiger beetle species were found during previous studies (Dunn, 1978; Dunn, 1986; Omland, 2004) will be searched in each project. Coordinates of previous records will be requested from the Vermont and New Hampshire natural heritage programs. Three separate searches (Hudgins, 2012) will be conducted during the adult flight period in ~~early July~~mid June, ~~late~~mid July, and early August.

Prior to conducting the field surveys, endangered species collection permits will be obtained from the Vermont DFW and the New Hampshire DFG for the cobblestone tiger beetle. The U.S. Fish and Wildlife Service and Vermont DFW will also be contacted for a permit to search for Puritan tiger beetle, if necessary. Searches will be conducted by walking along each beach or cobble bar from access point to end in a serpentine pattern until the area has been completely searched (Hudgins et al., 2011). Searches will be conducted under sunny, humid conditions during low water cycles when adult tiger beetles are most active. The searchers will primarily look for adults; however, since it may be possible for adults and larvae of tiger beetle species to overlap, locations of larval burrows observed during the adult surveys will be flagged.

Two biologists equipped with close-focus binoculars and aerial nets will search each survey location for a minimum of 30 minutes. Survey time will be recorded to calculate an index of relative abundance for each species. At most sites, representative photographs of adult tiger beetles will be taken to document identification. Occasional individuals of the listed species may be netted to confirm and document identification. In addition to the two target species, the common shore tiger beetle (*Cicindela repanda*) and other tiger beetles may also occur on the beaches. If observed, counts of common species will be estimated. Clasping pairs or individuals probing the sand with the tip of the abdomen will be noted as possible evidence of reproduction. If Puritan tiger beetles are observed during the survey, the FWS will be notified immediately. ~~The field biologists will attempt to net any individuals seen probing the sand with the abdomen to determine sex; males exhibiting such behaviors will not be construed as evidence of reproduction.~~These individuals will not be disturbed but may be photographed.

Following the active search for adult beetles the biologists will search the survey location for larval burrows for 30 minutes. Tiger beetle larval burrows may be recognized as neat, nearly perfectly round holes often with a distinct pile of excavated soil pellets nearby (burrows of wasps, spiders, and other arthropods are not like that). Grass stems will be used to probe any larval tiger beetle burrows found. Depth of burrows will be recorded, and angle relative to vertical will be noted. Larval burrows of the common shore tiger beetle are expected to be numerous; they may be recognized by being 5 to 10 cm deep and angled. In contrast, burrows of Puritan tiger beetle larvae are vertical and deep (50 to 100 cm). Larval biology of cobblestone tiger beetles is poorly known but it is likely that they are different than those of the common shore tiger beetle either in being deeper or vertical. If a distinct class of tiger beetle burrows is found at a site where adult cobblestone tiger beetles are known, their locations relative to the water level during the survey will be recorded; if at least 10 such burrows are found, then ~~only~~ one ~~or two of those~~ larvae will be excavated, preserved in alcohol, and sent to a taxonomic expert for identification. However, if the burrows are similar to those described for Puritan tiger beetles in Connecticut (50 to 100 cm deep, vertical; Omland, 2002), then FWS personnel will be notified of the possible presence of the listed species, and no specimens will be collected.

Substrate, vegetative cover, land use and other pertinent habitat information will be recorded on field data sheets. Field staff will use professional judgment to take 3 to 5 representative samples for particle size classification screening sand through sieves and estimating the b-axis of gravel or cobble particles typical of the site. The limits of apparent suitable habitat will be delimited using a GPS capable of sub-meter accuracy. The elevation relative to operational flows will be estimated by field survey of the center of the site relative to water levels. By noting the time of survey and comparing that time to river discharge records, the approximate elevation of the water can be estimated.

The field data will be supplemented with a literature review to provide a comprehensive database on when and under what conditions the listed tiger beetles are vulnerable to to water-level fluctuations.

ANALYSIS

Data collected will be used to qualitatively assess the distribution of cobblestone and Puritan tiger beetles in the study area. Survey results will include presence, relative abundance, evidence of reproduction, and information on habitat used for these species, including potential habitat. Incidental observations of other beetles will also be summarized. The location of survey areas will be identified on a map of each project as well as a description of habitat conditions at each location. A list of all adult tiger beetles identified from each survey location and their relative abundance for each location and sample trip will be developed.

Project operations schedules, results from Aquatic Habitat Mapping (Study 7); Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats (Study 27); Instream Flow (Study 9); Channel Morphology and Benthic Habitat Study (Study 8); Hydraulic Modeling (Study 4); Riverbank Erosion (Study 3); and Operations Modeling Study (Study 5), and river discharge data will be compared to determine river discharge levels that may affect cobblestone and Puritan tiger beetle populations. The portion of the habitat that is affected by project operations will be determined to develop an estimated frequency of inundation of each survey location.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Larval sampling will follow one of several methods described by Leonard and Bell (1999) including the recommended procedures of Brust et al. (2010). Adult sampling will use a standard timed search by two biologists searching with close-focus binoculars and aided by aerial nets. Survey distance and time will be recorded to provide an index of relative abundance.

DELIVERABLES

A study report will be prepared that presents methods and results of the survey after this 1-year study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The tiger beetle survey will be conducted during the first study year (2014) in July and August to coincide with adult emergence of both focal species. Identification of adults will occur in the field. Some larvae may be collected to be sent to taxonomic experts with determination expected in the fall of 2014 or winter of 2015. The study report will be prepared after the field season.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $45,000.

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Updated Study 27

Floodplain, Wetland, Riparian, and Littoral Habitats Study

RELEVANT STUDY REQUESTS

FWS-19; NHDES-15a; NHFG-15; NHNHB-01; VANR-25, -26; CRWC-16; TNC-03; Rock-02, -03

STUDY GOALS AND OBJECTIVES

In their study requests, FWS, NHDES, NHFG, NHNHB, VANR, CRWC, TNC, and the Town of Rockingham, Vermont, indicated that Wilder, Bellows Falls, and Vernon Project operations may affect the distribution, plant species composition, and structure of riparian, floodplain, wetland, and littoral habitats, and the wildlife that utilize these areas. The goal of this study is to provide baseline mapping and characterization of riparian, floodplain, wetland, and littoral vegetation and their habitats within the Wilder, Bellows Falls, and Vernon Project-affected areas and to ~~determine~~ assess the potential effects of water level fluctuations on those habitats.

The objectives of this study are to:

- quantitatively describe (e.g., substrate composition, vegetation type, and abundance with a focus on invasive species) and map riparian, floodplain, and wetland habitats within 200 feet of the river's edge and the extent of this habitat if it extends beyond 200 feet;
- quantitatively describe (e.g., substrate composition, vegetation type, and abundance) and map shallow water aquatic habitat types within the zone of daily water level fluctuations and where water depths at the lowest operational range are wetted to a depth of less than 1 foot (flats, nearshore area, gravel bars, with very slight bathymetric change);
- qualitatively describe associated wildlife (e.g., bald eagle nesting, waterfowl nesting); and
- assess potential effects of project operations on riparian, floodplain, wetland, and littoral habitats, and associated wildlife.

RELEVANT RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

FWS

- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protection, enhancement, or restoration of aquatic and riparian habitats and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

NHNHB

- Goals of the NHNHB include developing information about indigenous plants and natural communities and to determine protective measures and requirements necessary to their survival. Goals reference New Hampshire's Native Plant Protection Act (RSA 217:A).

- Goals of the NHDES Wetlands Bureau include protecting and preserving submerged lands and wetlands from unregulated alteration that would adversely affect wetlands structure and function, and that would depreciate or obstruct the commerce, recreation and aesthetic enjoyment of the public. Goals reference New Hampshire Fill and Dredge in Wetlands statute (RSA 482-A).

VANR

- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.

- Specific goal to identify and protect significant wetlands and their values and functions.

- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.

- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).

- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

This study will rely on several other studies for supplemental information. The Aquatic Habitat Mapping Study (Study 7) in the project impoundments and riverine sections will provide bathymetric and littoral habitat delineation for aquatic vegetation beds below 2 feet water depth. The results of Hydraulic Modeling and Operations Modeling studies (Studies 4 and 5) will provide site-specific detailed data on water level fluctuations and river flows. The riverbank erosion studies (Studies 1, 2, and 3) will inform the vegetation community and wildlife findings.

Goals associated with mapping vegetative types and wildlife species composition will be supported by specific studies including: Northeastern Bulrush Survey (Study 29); Cobblestone and Puritan Tiger Beetle Survey (Study 26); Dragonfly and Damselfly Inventory and Assessment (Study 25); and Fowler's Toad Survey (Study 28).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing habitat information in the PADs is based primarily on state or regional mapping efforts including the USGS land use cover maps (Homer, 2007), the Wildlife Action Plans for New Hampshire and Vermont, National Wetland Inventory mapping, and limited local data on floodplains and wetlands. Several towns in New Hampshire and Vermont have completed natural resource inventories, including Lebanon and Charlestown among others. These will be reviewed for additional data on habitats, plant communities and wildlife records.

Results from the 2012 TransCanada study of rare, threatened, and endangered plants and listed natural communities (Normandeau, 2013) will be used in combinations with existing records and locations of rare plant species and communities from VANR and NHNHB. General descriptions of those habitats and communities are available in Sperduto and Kimball (2011) and Thompson and Sorenson (2000). Other relevant studies that have been recently completed, are ongoing, or sponsored by TransCanada include a 2010 shoreline survey, eagle nesting studies and mussel surveys. The results and findings of these studies will inform the study of riparian, floodplains, wetland, and littoral habitats. To date, no detailed existing data set for wildlife or wildlife habitat has been identified in the project areas.

This study will provide more detailed mapping and characterization of riparian, floodplain, wetland, and littoral habitats, and will supplement our knowledge of wildlife habitat and use in the study area. The potential effects of project operations on those habitats and wildlife will be assessed using data from other studies of hydrology, erosion, and aquatic habitats.

Data for reference wetlands will not be collected, as proposed in an agency study request. On a large system such as the Connecticut River it is unrealistic for several reasons: few if any reaches of the river are not affected by water management; the river changes character rapidly north and south of the project areas; and lastly, the natural variability of any potential reference habitats would require a very large data set for effective comparisons to project habitats, of limited value and at significant expense.

PROJECT NEXUS

The Connecticut River provides habitat for vegetation communities ranging from upland to submerged aquatic systems. Groundwater and surface water close to the river are potentially influenced by daily and seasonal project operations, which in turn may affect the substrates, species composition, and structure of the vegetation communities bordering the river, particularly those in lower topographic settings such as wetlands and floodplains. Intact, natural riparian habitat is valuable wildlife habitat providing water quality, bank stabilization and wildlife travel corridors.

A more detailed understanding of the distribution and character of the existing habitats will allow an analysis of the potential effects of project operations on those habitats. Coincidental wildlife observations will better inform the analysis of wildlife species that rely on the river for part of their life cycle.

STUDY AREA AND STUDY SITES

The study area will extend from the top of Wilder impoundment to Vernon dam including the Wilder, Bellows Falls, and Vernon impoundments and the riverine sections downstream of Wilder and Bellows Falls dams, as well as project lands downstream of Vernon. All of the shorelines in Vermont and New Hampshire, including the river's edge, islands, sand and gravel bars and impounded portions of the tributaries, will be mapped. The terrestrial extent of the study will encompass 200 feet from the river's edge at a minimum. Where wetlands and floodplains extend further inland than 200 feet, the study will encompass either the entire wetland or floodplain, or to where the topography or site features indicate the river is no longer a significant influence on the habitat.

This study scope accommodates most study requests, which asked for riparian and wetland studies within 200 feet of the river or the extent of this habitat if it extends beyond 200 feet. The TNC study request asked for surveys to extend to the 100-

year floodplain, which in some areas could result in extensive mapping of terrestrial habitats far from the river. This will not contribute significantly to the information needed to assess the areas influenced by project activities, and hence is not included in this study plan. The littoral zone will extend from the river's edge to a depth of 1 foot below the lowest limit of water level fluctuation along the shorelines, islands, sand and gravel bars, and the impounded tributaries.

METHODS

Methods will include habitat mapping and field verification of riparian, floodplain, wetland, and littoral habitats, and observations for river-dependent wildlife. The methods will follow commonly accepted protocols, and will meet the components of the study requests, except where noted. For this study, the following definitions will apply:

- Riparian – all areas within 200 feet of the shoreline that are not classified as floodplain, wetland, or littoral. While 50 feet or 100 feet is more commonly used in a classic definition of riparian buffer (Williams, 2008; VANR, 2005), expanding the area to 200 feet, as requested by agencies, will allow a complete mapping of all land cover types within the study area.

- Floodplain – Floodplains are ecologically defined as occurring in the regularly flooded ~~valleys~~ lowlands of major rivers or ~~the floodplains of~~ lakes. This study will include the typical forested floodplains associated with large, high-gradient rivers like the Connecticut, dominated by silver maple or sugar maple with a sparse shrub layer and a lush herbaceous layer of either ostrich fern or sensitive fern depending on the gradient of the river (NHFG, 2005; Kart et al., 2005). Floodplains that have been converted to other uses, such as agriculture, development or recreation, or affected by riverine erosion processes will be mapped as well. ~~The soils in floodplain habitats are variable based on the exact location, but they tend to be exposed mineral soils, minerotrophic, and of alluvial origin (NHFG, 2005; Kart et al., 2005). A unique suite of flood-tolerant plant species characterizes this habitat type. When associated with large, high-gradient rivers like the Connecticut, the most common canopy cover is silver maple or sugar maple with a sparse shrub layer and a lush herbaceous layer dominated by either ostrich fern or sensitive fern depending on the gradient of the river (NHFG, 2005; Kart et al., 2005).~~

- Wetland – All Palustrine and Riverine wetlands as defined by the US Fish and Wildlife Service (Cowardin et al., 1979). Palustrine wetlands include all non-tidal freshwater wetlands dominated by trees, shrubs, persistent emergent vegetation, emergent mosses or lichens. Riverine wetlands include all wetlands and deepwater habitats within the river channel dominated by non-persistent emergent and aquatic vegetation. For the purposes of this study, the impoundments will be considered Riverine habitats.

- Littoral zone - For this study, the littoral zone will include all habitats within 1 foot below the lower limit of the water level fluctuation zone, and all submerged aquatic vegetation.

Habitat Mapping

Aerial maps of the study area will be obtained in LiDAR, and true color orthophoto format, and flown during leaf off, snow- and ice-free conditions. Stereo color photos may be available to resolve areas that are difficult to interpret. The LiDAR imagery will be collected at a data density sufficient to develop topography at 1-foot contour intervals in the study area.

The imagery will be used to digitally photo interpret vegetation community cover types within the riparian, floodplain, wetland, and littoral habitats in the study area as described above. The minimum map unit size will be 0.5 acre. Additional publicly available maps of the study area will be used in conjunction with the aerial imagery to increase confidence in the cover type mapping, including USGS topographic maps, NRCS soils maps, National Wetland Inventory maps, and recent leaf-on orthophotos. Each wetland resource area will be cover typed by the dominant cover class, using the FWS Wetland Classification system (Cowardin et al., 1979), where appropriate. The three-tier Vermont wetland classification system specified under the Vermont Wetland Rules will be applied on wetland cover types mapped in that state. The remainder of the terrestrial cover types will be classified according to a combination of land use, vegetation, substrate and hydrology. Ponds, streams and potential vernal pools will be identified within the various cover types. Polygons of the various cover types will be compiled in GIS for mapping and analysis.

The accuracy of mapping submerged aquatic vegetation (SAV) is poor using either of the remote methods because SAV is virtually undetectable on LiDAR and during the leaf-off aerial photography season. SAV and unvegetated substrates will be mapped using a combination of the results from the Aquatic Habitat Mapping Study (Study 7) and field verification.

Field Verification

A subset of the cover type maps will be field verified during the height of the growing season to confirm the accuracy of the mapped boundaries and cover typing. Representative sites for the various cover types will be selected to encompass the geographic and hydrologic variability of each cover type. For access reasons, most of the representative areas will be confined to suitable sites within TransCanada fee owned lands and publicly accessible lands. Outstanding or unique habitats within the study area on flowage easement lands may be visited, provided landowner permission for access is granted. Further field verification of cover type boundaries and other mapped features will occur where they are either accessible or visible from the river or a public road.

The selected sites will be visited to characterize the following habitat components: vegetation structure; species composition and abundance by structural layer, with a focus on invasive and rare species; soil type; hydrology; and other relevant aspects, including evidence of recent or historic disturbance, flooding or scour, and wildlife usage. GPS coordinates will be collected at distinct wildlife features such as bank nests, concentration of species or evidence of browse, large stands of invasive species, and other important site features. Photo-documentation will occur at each representative cover type.

~~Cover type boundaries will be field verified where either accessible or visible from the river or a public road. Wetland boundaries will not be delineated on the ground using the USACE 1987 delineation manual, as requested by VANR because 1) much of the land is in private ownership, not TransCanada fee-owned land, 2) jurisdictional boundaries are not necessary to verify cover types for baseline mapping, or for the effective evaluation of potential project effects, and 3) the cost of the delineation would be excessive relative to the minor additional information it would provide.~~

Wetlands

Wetland functions and values will be assessed at all field verified wetland cover types using the New England Division USACE Highway Methodology (USACE, 1995). This method is a descriptive, non-quantitative method which can be used to determine the degree to which a wetland provides a set of 13 functions and values: groundwater recharge/discharge; flood flow alteration; fish and shellfish habitat; sediment/toxicant/pathogen retention; nutrient removal/transformation; production export; sediment/shoreline stabilization; wildlife habitat; recreation; education/scientific value; uniqueness/heritage; visual quality and aesthetics; and threatened or endangered species habitat. The rationale for evaluating the performance of each function is developed from a series of criteria, and is supplemented by professional judgment. From this evaluation, the principal (most important) functions are identified. While this method is less rigorous than the methods proposed by the NHNHB and TNC, it allows a more rapid assessment of wetland functions and values while documenting the rationale and maintaining consistency between sites and users. Given the combined approximate 120-mile length of the three projects, the USACE highway methodology assessment method provides a reasonable balance between efficiency and effectiveness. As with all evaluation methods, it must be conducted by a qualified wetland scientist to maintain its intended quality and consistency.

Representative examples of vernal pools mapped from the orthophotos or otherwise encountered within the study areas will be visited to assess their likelihood of providing vernal pool habitat based on the definitions provided by the States of New Hampshire and Vermont. The focus will be on TransCanada fee-owned lands and public lands, but high quality examples of vernal pools with potential to be affected by the projects that occur on flowage easement lands may be visited with landowner permission. Because ground truthing will continue outside of the typical April-May window for identifying vernal pool amphibians, the potential for a pool or depression field checked later in the season to support vernal pool species will be inferred from habitat conditions.

Wetland boundaries will not be delineated on the ground using the USACE 1987 delineation manual, as requested by VANR because, 1) jurisdictional boundaries are not necessary to verify cover types for baseline mapping, or for the effective evaluation of potential project effects, 2) much of the land is in private ownership, not TransCanada fee-owned land and 3) the cost of a jurisdictional delineation would be excessive relative to the minor additional information it would provide.

Rare Plants and Communities

The New Hampshire and Vermont Natural Heritage Databases will be revisited to identify rare species and communities that occur within the mapping area for this study. Many of the known EOs were identified during the rare species identification and mapping effort conducted by TransCanada in 2012 (Normandeau 2013). Locations of species and communities that were not visited in 2012 will be identified in GIS, and a subset of recent (post-1990) EOs may be visited to assess their current status; however, detailed inventories of these species and habitats are not included in this study.

Invasive Plant Species

Non-native invasive plant species will be defined using the Invasive Plant Atlas of New England (IPANE 2012) which works with the States of New Hampshire and Vermont, The Nature Conservancy and Silvio O Conte National Wildlife Refuge to maintain a current list of invasives within the study area. Known locations specified on the existing map of invasives developed by TransCanada in 2010 (Kleinschmidt 2011) will be revisited and refined. Well--defined beds of invasives will be delimited with GPS or mapped on orthophotos. More diffuse or irregular boundaries will be estimated by a combination of GPS and field sketching. The mapping results will be added into the GIS dataset. Data collected in the field will include species, substrates, estimates of density, approximate elevation, and evidence of disturbance.

Wildlife Observations

All observations of wildlife and their sign will be noted during field verification, both at the representative cover type locations and during travel between sites. Species, approximate number, activity, habitat, and apparent level of use will be recorded, and locations will be documented with GPS. Particular emphasis will be placed on river-dependent species, including bald eagle, waterfowl, wading birds, shorebirds, bank nesting birds (e.g., kingfisher, bank swallow), breeding amphibians, basking reptiles, nesting turtles, and mammals (river otter, beaver, muskrat). All other wildlife sign and observations will be recorded as encountered. Coordination with TransCanada, Vermont FWD, NHFGD, and other organizations with local knowledge will provide additional search areas and likely habitats. The times of day for best capturing specific species (evening for chorusing frogs, early morning for breeding birds) will be utilized to maximize the chance of encountering desired species.

ANALYSIS

The results of the cover type mapping will be compiled into site maps and summaries of the acreages of the various cover types within each project and project-affected area. Descriptions of the representative cover types will be developed, and the relative functions and values of each discussed. Unique conditions or findings will be highlighted, including invasive species concentrations, rare species, and disturbance. The presence and quality of vegetative buffers along the shoreline will be evaluated for water quality, riverbank stability and wildlife movement functions. Lands leased by TransCanada for agriculture require 100-foot buffers to the Connecticut River. In these locations the presence/absence of buffers will also be noted. Notable differences of habitats among the projects will be analyzed and if appropriate, compared to the results of the rare species studies (Study 25, 26, 28 and 29 and Normandeau [2013]), hydrologic studies (Studies 4 and 5), and erosion studies (Studies 1, 2, and 3). The potential effects of project operations on the mapped riparian, floodplain, riparian, and littoral habitats, and wildlife usage areas will be assessed using the results of hydraulic and operations modeling (Studies 4 and 5).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methodologies for mapping, delineation, field verification, and analysis presented above are consistent with accepted scientific practice and have been used at other hydroelectric projects in the Northeast, most recently the Brassua Hydroelectric Project (FERC No. 2615).

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

The aerial imagery will be collected in late 2013 after FERC's study plan approval and/or early 2014, followed by delineation and mapping. The resulting cover type map will be field verified in the 2014 growing season. The final report will be produced at the end of 2014, after completion of analysis for this study and other relevant studies (Studies 1, 2, 3, 4, 5, 25, 26, 28, and 29).

LEVEL OF EFFORT AND COST

The preliminary estimated cost for this study is $198,000 excluding the costs for LiDAR and/or aerial photos.

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Updated Study 28

Fowler's Toad Survey

RELEVANT STUDY REQUESTS

VANR-31

STUDY GOALS AND OBJECTIVES

In its study request, VANR identified potential issues associated with operations of the Wilder, Bellows Falls, and Vernon Projects on Fowler's toad (*Anaxyrus fowleri*), mapped in Vermont's Wildlife Action Plan (Kart et al., 2005) as a high priority SGCN and listed as an S1, Very Rare species. This species is under consideration to be listed as endangered by the State of Vermont in 2014. The goal of this study is to conduct a survey to obtain baseline distributional and abundance data on Fowler's toad along the Connecticut River in the Bellows Falls and Vernon Project-affected areas.

The objectives of this study are to:

- develop additional information regarding the distribution and relative abundance of Fowler's toad;
- develop additional information regarding the distribution and condition of suitable habitat within the study area; and
- ~~determine if~~assess whether project operations are likely to have an affect on suitable Fowler's toad habitat, and if those effects are likely to be positive or negative.

RESOURCE MANAGEMENT GOALS

In its study request, VANR described various jurisdictional resource management goals for this study, as summarized below.

VANR

- Fowler's toad is a state SGCN. State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports aquatic biota and habitat.
- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals for conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-

based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005), including SGCN.

ASSOCIATION WITH OTHER STUDIES

Surveys for the distribution and abundance of Fowler's toads will be conducted in concert with other biological surveys for the relicensing effort, whenever feasible. The assessment of Fowler's toad habitat distribution and condition within project-affected areas will benefit greatly from data collected for other studies regarding the soil type, cover type, and the distribution and condition of wetlands.

The results of the *2012 Rare, Threatened, and Endangered Plant and Exemplary Natural Community Assessment* (Normandeau, 2013), and other related studies including Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27), Hydraulic Modeling (Study 4), Operations Modeling (Study 5), and the erosion studies (Study 1, 2, and 3) will assist in identifying suitable habitat, interpreting the toad data collected and in drawing conclusions about preferred habitat characteristics, and whether project operations affect this habitat.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Fowler's toad is considered a Species of Greatest Conservation Need in Vermont, and a Species of Special Concern in New Hampshire. To date, no studies have been conducted to identify the location or size of Fowler's toad populations within the project-affected areas, or to ~~determine~~ understand if project operations could affect toad populations, if present. The 2012 Species Status Review (provided as Appendix B to VANR's study request document dated March 1, 2013) for Fowler's toad by the State of Vermont Endangered Species Committee indicates that Fowler's toad has been recorded in towns bordering the the Connecticut River in both Vermont and New Hampshire. Fowler's toad was first reported and photographed in Vermont in 1983 in the Town of Hartford where it was reported as numerous. There was one 1985 report from Westminster, and a population in Vernon was well documented from 1994 through 2007. Additionally, there was one 2002 report from along the Saxton's River in Rockingham, VT.

In New Hampshire, Fowler's toad has been documented in Hinsdale (2002) and Westmoreland (2001) ~~along the Connecticut River~~ in Cheshire County (NHFG, 2010). No studies have been conducted to quantify the habitat occupied by Fowler's toad in the vicinity of the Connecticut River, or to identify apparently suitable habitat along the river, based on the literature.

PROJECT NEXUS

Project operations have the potential to affect Fowler's toad habitat that may be present. This species has specialized habitat requirements that may benefit from shoreline disturbance as a result of flooding and/or wave action. Hydraulic regimes that deposit sand and gravel along the shoreline and clean away vegetation may help to create suitable habitat for this species. The sandy, unvegetated shoreline, river banks and floodplains may provide small pools for breeding, and suitable habitat for aestivation and hibernation.

Fowler's toad undergoes regular short-term population fluctuations. Hydraulic regimes that promote habitat fragmentation, e.g., reduced flooding allowing substantial plant growth, may disrupt this species' ability to move between breeding and terrestrial sites as well as recolonize appropriate habitats. Results of this study could be used to identify important habitats for Fowler's toad, and to define the riverine processes that affect these habitats.

STUDY AREA AND STUDY SITES

The study area includes the shorelines and terrestrial lands of the Bellows Falls and Vernon impoundments, the Bellows Falls riverine project-affected area, and TransCanada lands below Vernon dam. The Wilder impoundment and Wilder riverine project-affected area are unlikely to support this species, as these areas lie north of the northernmost Vermont record for Fowler's toad, and that report is the northernmost record in the Northeast, with the exception of a disjunct population in Canada. The precise study sites within the study area are to be determined, based on the results of a desktop assessment of potential habitat. Surveys will be conducted on TransCanada's fee-owned Project lands; those flowage easement lands that may be hydrologically connected to the Connecticut River; and , lands that are publicly accessible by boat or by foot. The survey will focus on likely breeding pools as indicators of Fowler's toad presence within the projects.

METHODS

This study will begin with a desktop analysis of existing data regarding the habitat available to Fowler's toad within the study area. Information that will be considered will include soil types, vegetation and cover type, and the locations and condition of existing wetlands in and directly adjacent to the project-affected areas. Sources of data that will be considered include relevant reports and maps created from concurrent studies as well as existing maps and aerial photos.

Records of historic and recent locations and extent of Fowler's toad in Vermont and New Hampshire will be requested from the relevant agencies. Fowler's toad requires temporary pools for breeding, and loose sandy or gravelly soils above the waterline but below the frost line, for aestivation and hibernation burrows. Dense vegetation impedes the ability of this species to burrow into suitable soils. The results of the desktop analysis will be ground truthed by field-checking a subsample of the areas identified as suitable.

Fowler's toads are most effectively located by their calls during the breeding season. As requested by VANR, standard call surveys will be used to identify and map species occurrence. The methods describe below are based on Droege (undated) and Tupper et al. (2007):

- Likely breeding locations will be identified based on historic and recent records and the results of the desktop habitat suitability analysis. Of those likely breeding locations, a determination as to whether or not they are potentially affected by project operations will be conducted. Those outside the project boundary and those that are not likely to be affected by project operations will be identified as potential habitats but eliminated from further survey and analysis.

- A survey route based on results of the desktop study will be created and field-checked to verify that breeding areas identified with the desktop appear suitable (ground truthing).

- Suitable breeding locations will be surveyed three times, roughly 2 weeks apart, during the survey period, which is late May through early July. The survey period may be extended to further into July if needed, to capture suitable air and water temperatures.

- Surveys will be conducted within 3 hours after sunset, with no to light winds, and water temperature of potential breeding ponds above 17.8°C. Light rain that does not interfere with listening is also a suitable survey condition.

- All survey conditions will be recorded along with survey results, including survey beginning and end times, weather conditions, water and air temperatures, and ambient noise levels.

- In the event that Fowler's toad is documented within the project area, the conditions in the breeding pool and the adjacent habitat where the toad is located will be documented. The information collected about the breeding pool will include pool location, size, and depth. The soil and substrate type, approximate elevation, vegetation typr, hydrologic conditions, and a list of other animal species observed during the habitat data collection will be recorded for both the breeding pool and the surrounding habitat area.

- Decontamination procedures designed to comply with any VANR and NHFG standards for biomonitoring equipment will be applied to survey equipment used in breeding pools (i.e., boots, waders, nets, collection pans)

In the study request, VANR also suggested several additional methodologies that are not included in this study plan. VANR suggested that surveys could be conducted using nighttime wet road surveys, nearshore boat surveys, FrogLoggers, and environmental DNA sampling.

The call surveys may be conducted in part by boat if necessary to reach remote areas. Nighttime wet road surveys will not be used because call surveys can be conducted under a greater range of conditions and are more efficient, allowing a greater area to be surveyed. Depending on the extent of suitable habitat identified for survey, up to 5 wildlife acoustic recorders (FrogLoggers is one brand) may be placed at the locations historically known to be occupied by this species.. However, acoustic recorders will not be the primary method of Project-wide survey as the call of Fowlers' toad is distinctive and easily perceived, making direct listening a more efficient option for surveying a large area. Environmental DNA (eDNA) sampling is relatively new and an apparently effective method for detecting rare species in aquatic ecosystems (Ficetola et al., 2008; Goldberg et al., 2011). However, because it is a technique still undergoing development, there is not yet good data on how eDNA is transported and distributed by surface or groundwater flow and how long eDNA persists under varying conditions (Goldberg et al., 2011). Therefore, its value for identifying occupied habitats in riverine systems is uncertain and will not be included in this study.

~~In the event that Fowler's toad is documented within the project area, the habitat where the toad is located will be thourouly documented. The information collected about the occupied habitat will include pool location, size, depth, substrate, elevation, vegetation, hydrologic conditions, and a list of other animal species observed during the habitat data collection.~~

ANALYSIS

The analysis will combine the results of the desktop study with the results of the call survey to determine the suitability of the project-affected areas for Fowler's toad, and the likelihood that the species is currently present in the study area. The analysis will define habitat requirements based on literature and field survey results; document/map currently suitable habitats; and ascertain whether these habitats are affected, positively or negatively, by project-related flows or other project related activities.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

Call surveys are generally accepted as an efficient, accurate method for determining habitat occupancy by amphibians that vocalize as part of their breeding activities. Standard methodologies have been developed by the USGS (Droege, undated), and call surveys are used by the North American Amphibian Monitoring Program (USGS, 2013) and by many states to inventory vocal amphibians.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will summarize the desktop and field results, including maps of potential habitat, survey locations, and survey results showing whether operations of the projects are likely to have effects on suitable Fowler's toad habitat, and if those effects are likely to be positive or negative. A final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated. If Fowler's toad is state-listed when the final report is completed, an internal and a public version of the final report will be prepared as needed, to comply with any requirement to hold the locations of occupied habitat confidential.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This study will be conducted in the first study year (2014). As noted in the methods section, suitable habitats will be ~~determined~~ identified through a desktop analysis prior to the summer 2014; field surveys will be conducted during the month of June, under appropriate weather conditions. Analysis of field data and potential model application to ~~determine~~ assess project effects will occur in Fall 2014 and into 2015.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for the study is $~~49~~56,000.

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Updated Study 29

Northeastern Bulrush Survey

RELEVANT STUDY REQUESTS

FWS-19; NHDES-15a, NHFG-15; NHNHB-01, -04; VANR-26; CRWC-16; Rock-03

STUDY GOALS AND OBJECTIVES

In their study requests relative to aquatic vegetation and habitats within the Wilder, Bellows Falls, and Vernon Project-affected areas, stakeholders specifically requested a survey for northeastern bulrush (*Scirpus ancistrochaetus*), a federally listed endangered species known to occur in one location within the Bellows Falls Project on a beaver flowage in Rockingham, VT.

The goal of this study is to ~~determine~~ assess the potential effects of project operations on northeastern bulrush within the Wilder, Bellows Falls, and Vernon Project boundaries.

The objectives of this study are to:

- document the presence or absence and status of previously documented populations of northeastern bulrush in the study area;
- survey for additional locations of populations of northeastern bulrush in likely habitats;
- estimate the elevation of identified populations of northeastern bulrush to daily operational flows and impoundment levels to assess the potential influence of project operations on those populations; and
- assess effects on populations from non-flow related project operations within the project boundaries (e.g., recreation, agricultural leases).

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

Federal and state resource agencies described various jurisdictional resource management goals for this study in their requests, as summarized below:

FWS

- Northeastern bulrush is a federally listed endangered species. The goal for northeastern bulrush is species recovery for removal under the Endangered Species Act in accordance with the FWS' Northeastern bulrush (*Scirpus ancistrochaetus*) Recovery Plan (FWS, 1993).
- General goals for relicensing including to ensure that protection, mitigation, and enhancement measures are commensurate with

project effects and help meet regional fish and wildlife objectives; and to conserve, protect, and enhance habitats for fish, wildlife, and plants affected by the projects.

- General goals related to aquatic resources including protecting, enhancing, or restoring aquatic and riparian habitats; and minimizing project effects on water quality and aquatic habitat.

NHDES

- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG

- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR

- General goals related to aquatic resources including protecting, enhancing, and restoring habitats necessary to sustain healthy aquatic and riparian communities; providing instream flows to meet the requirements of resident fish and wildlife including invertebrates; and minimizing project effects on water quality and aquatic habitat.
- VFWD general goals related to conserving, enhancing, and restoring natural communities, habitats, species, and the ecological processes that support them; and providing fish and wildlife-based activities including viewing, harvesting, and utilization of fish, plant, and wildlife resources. Goals reference Vermont's Wildlife Action Plan (Kart et al., 2005).
- VFWD general goals related to resource conservation, fish and wildlife recreation and use, and human health and safety. Goals reference Vermont Fish and Wildlife Strategic Plan (VFWD, 2006).

ASSOCIATION WITH OTHER STUDIES

Other TransCanada studies addressing other federally listed species have been completed or are proposed including Jesup's milk vetch (*Astragalus robbinsii* var *jesupii*) Normandeau 2013a); 2012 study of rare, threatened and endangered plant species (Normandeau, 2013b); dwarf wedgemussel (*Alismodonta heterodon*) (Biodrawversity and LBG, 2012) and in the Dwarf Wedgemussel and Co-Occurring Mussel Study (Study 24); and Puritan tiger beetle (*Cicindela puritana*) in the Cobblestone and Puritan Tiger Beetle Survey (Study 28). In addition, Hydraulic

Modeling and Operations Modeling (Studies 4 and 5) will provide information on potential effects on habitats for this species due to project operations.

The bald eagle (*Haliaeetus leucocephalus*) is no longer listed under the Endangered Species Act, but continues to receive federal protection under the Bald and Golden Eagle Act. Ongoing studies of bald eagle nesting activity in the project area are conducted by the New Hampshire Audubon Society with financial support from TransCanada.

The aerial photographs collected for the Floodplain, Wetland, Riparian, and Littoral Habitats Study (Study 27) will be reviewed to identify possible locations of new populations of northeastern bulrush, and to ~~determine~~ identify the land use in and adjacent to identified populations of this species. The Recreation Facility Inventory and Use & Needs Assessment (Study 30) will be reviewed in the event that northeastern bulrush populations appear to be affected by a recreational activity. Additional studies that will be used during the northeastern bulrush study will include the Instream Flow (Study 9), Hydraulic Modeling (Study 4), and Riverbank Erosion (Study 3) studies to assess the potential for water level fluctuations to affect populations of northeastern bulrush within the project boundaries.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Northeastern bulrush is listed as Endangered by the US Fish and Wildlife Service, New ~~Hampsire~~Hampshire and Vermont. One record of northeastern bulrush is known to occur within the Bellows Falls Project boundary. While the specifics of its habitat preferences are poorly understood, northeastern bulrush, like other sedges, grows in wet areas – small wetlands, sinkhole ponds or wet depressions with seasonally fluctuating water levels. It may be found at the water's edge, in deep water or in just a few inches of water, and during dry spells there may be no water visible where the plant is growing (FWS, 1993b). The species appears to flourish in small ponded areas with full light availability, and relatively stable water levels, although many seemingly suitable habitats are unoccupied by northeastern bulrush.

The results of this study will establish baseline information on the distribution and habitat characteristics of northeastern bulrush populations within the project boundaries, and will assess the effects of project operations on the species. The assessment will consider the potential for existing project operations to influence surface and groundwater conditions at the northeastern bulrush sites.

PROJECT NEXUS

One record of northeastern bulrush is known to occur within the Bellows Falls Project boundary, but is located outside of the flow-related influence of operations. The northeastern bulrush was not found during the 2012 TransCanada study of rare, threatened and endangered plant species (Normandeau, 2013b) which focused on habitats immediately adjacent to the river and directly affected by the projects' flow-related operating range; however, that study did not include a survey specific to northeastern bulrush because FWS indicated that it was unlikely to be found within the geographic scope of that study, ~~which was focused on habitats immediately adjacent to the river and were directly affected by the projects' flow-related operating range~~. This new study will include surveys for northeastern bulrush within the project boundaries that are not subject to river and impoundment fluctuations. This approach will provide information that supports the two recovery strategies recommended in the FWS recovery plan for the species: 1) provide protection for known populations, and 2) survey for new populations (FWS, 1993).

STUDY AREA AND STUDY SITES

The study area includes areas within the Wilder, Bellows Falls, and Vernon Project boundaries, including fee-owned properties and lands with flowage rights held by TransCanada. Although northeastern bulrush is only known to occur in the Bellows Falls Project area outside of the range of project operational flows, additional information will be sought from agencies and botanists who are expert in this species to identify possible new populations and habitats in other locations within the study area.

METHODS

Information on existing populations of northeastern bulrush and the habitats known to support the species will be gathered from state databases and botanical specialists for this species. Aerial photographs, soil survey data, and other remote sources of data will be reviewed to identify locations in which to search for new populations.

The appropriate state and federal collecting permits will be obtained prior to field sampling. Field surveys will include site visits to known and likely locations during the fruiting season when the species is best identified (~~late June through August~~August-September). Found populations will be documented according to Vermont NHIP and New Hampshire NHB protocols. Both protocols require data collection on the target species (e.g., phenology, population size, age structure and vigor, distribution and general health), and the habitat in which the species is found (e.g., aspect, slope, canopy, topographic position, moisture regime, elevation and associated plant species). The hydrologic inputs to the site will be qualitatively assessed from the site setting, surface water sources and indicators of seepage, flooding or disturbance. The limits of the population ~~and approximate elevation of each location~~ will be collected with GPS with ~~3-D,~~ submeter capabilities. Site elevations will be estimated from the LiDAR topographic contours. Photographs documenting the species and the habitat will be collected. If species identification is uncertain, specimen examples may be collected. Visual observations of land use in the vicinity of found populations will be noted.

Sites that are unoccupied in 2014 and which appear to provide similar habitat to sites supporting northeastern bulrush will be identified as potential sites. Northeastern bulrush may not fruit every year, depending on environmental conditions, thus identifying potential habitat may be important for future surveys. At each potential site, a GPS point will be taken, and data on general habitat characteristics will collected, including hydrology, setting, vegetation communities, and elevation.

ANALYSIS

The results of the habitat and population surveys will be mapped and analyzed in GIS. The findings will be qualitatively assessed relative to activities within the project boundaries (both flow-related and non-flow related such as recreation, agriculture, development, and other land uses) that have the potential to affect the species or its habitat. Habitat characteristics such as hydrologic regime, setting, and elevation relative to project operations (via the two modeling studies) will be used to assess the potential effects of project operations. Other features such as surrounding land use, evidence of disturbance, proximity to development and presence of invasive species will be used to assess the potential effects resulting from non-flow Project activities and other sources, if relevant.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods of rare, threatened, and endangered plant data collection, survey, and analysis are consistent with generally accepted scientific practice, and are similar to what was provided in the 2012 rare plant and community survey (Normandeau 2013b).

DELIVERABLES

~~A stand-alone confidential report will be provided to FWS, NHNHB, and VANR. The~~ A report will be prepared which includes maps of locations of identified populations and unoccupied potential habitats for northeastern bulrush, documentation of findings, and an assessment of project ~~operational~~ effects.

A non-confidential draft study report summary will be provided after the research and analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in a final report with an explanation of any stakeholder comments not incorporated.

Results and non-confidential conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application. A stand-alone confidential report will be provided to FWS, New Hampshire NHB, and Vermont NHIP, in which specific locations and details of individual populations will be provided.

SCHEDULE

The field work for this study will be conducted during the northeastern bulrush growing season of the first study year (2014). Preliminary research and mapping will occur in the spring with field surveys conducted ~~between late June and August~~in August and September. A study report will be provided after the research and analysis is complete and the results are available.

COST ESTIMATE

The preliminary estimated cost for this study is approximately $23,000.

REFERENCES

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Updated Study 30

Recreation Facility Inventory, Use & Needs Assessment

RELEVANT STUDY REQUESTS

FERC-10; NPS-01; NHDES-01a, -01b, -01c; NHFG-01a, -01b, -01c; VANR-32; AMC-VRC-FRs-01; NEF-AW-01, -02; NEF-AW-AMC-02a, -02b, -02c; NEF-AW-AMC-05, Rock-04, -05; TwoRiv-01

STUDY GOALS AND OBJECTIVES

Public comments during scoping meetings and input from FERC, NHDES, NHFG, VANR, NPS, recreational user groups, the Town of Rockingham, VT, and Two Rivers Ottauquechee Regional Commission indicate a strong public interest in recreation access and opportunities, and a belief that there may be undocumented or underrepresented user groups and recreation opportunities available in the projects. This study will address recreation resource opportunities, uses, and needs within the project boundaries of Wilder, Bellows Falls, and Vernon Projects. In addition, the study will inventory public recreation access opportunities at the Connecticut River from the upstream end of the Wilder impoundment to downstream limit of the Vernon project.

The goals of this study are to:

- obtain information about the condition of existing recreation facilities and access sites at the projects and along project-affected reaches of the Connecticut River;
- obtain information about existing recreation use and opportunities, access, and present and future use estimates for sites within and in riverine sections between the projects;
- conduct an assessment of the need to enhance recreation opportunities and access at the projects;
- present the recreation use and opportunities at the projects within the larger context of opportunities within the region;
- photograph views from public recreation facilities to document existing aesthetic conditions; and
- lay the foundation for preparation of a Recreation Management Plan (RMP) for the projects that will be included in the license applications.

Key objectives associated with the various components of this study are summarized as follows:

A. Recreation Facility Inventory

1. Identify existing information on recreation resources adjacent to and within the projects, and update existing data through site assessment and consultation with public and private recreation providers.

2. Provide a general characterization of the white water-oriented recreational opportunities within the region.

3. Provide an inventory of informal and formal public and private waterfront recreational sites/facilities within and adjacent to each project boundary including within the Bellows Falls bypassed reach and riverine reaches downstream of the Wilder and Bellows Falls Projects.

4. Create detailed GIS-based map layers denoting recreation sites/facilities, and populate the database with information identified in 1-3 above.

5. Prepare a recreation sites/facilities inventory summarizing the information collected, and categorize it by recreation type or interest; distinguish whether or not facilities are project facilities and if not identify the site manager, to the extent practical.

6. Photo-document representative views of each inventoried recreational site to capture current aesthetic resources.

B. Recreation Use and Needs Assessment

1. Collect data on visitation levels, activities, and trip frequencies related to recreational use (including active and passive recreation types) and user preferences and perceptions (e.g., adequacy of facilities, crowding) at existing formal and informal public access sites within the project boundaries.

2. Collect information (e.g., activity type and resource needs, visitation levels and trip frequency, obstacles to recreation in vicinity of the projects) regarding recreational use and user preferences of uncommon and potential user groups.

3. Characterize existing and potential recreational uses at the projects by season and activity.

4. Characterize current user preferences and any identified needs.

5. Summarize parking lot utilization and identify sites that receive heavy use. If TransCanada project recreation areas are recorded at maximum capacity or are likely to be within the term of a new license, examine opportunities for TransCanada to repair or upgrade their sites.

6. Summarize current recreation use from the information collected.

C. Future Recreational Use Assessment

1. Collect information regarding local and regional population trends and trends in recreation activities throughout the Upper Connecticut River Valley in Vermont and New Hampshire.

2. Document current trends in recreation, and use available accepted literature to make future use estimates.

3. Estimate future use levels (by activity) at each project.

4. Identify if changes in the public access facilities would be needed and where those facilities would be beneficial.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In their study requests, federal and state resource agencies described various jurisdictional resource management goals for this study, as summarized below.

NPS
- The Connecticut River has been designated a National Blueway, part of the America's Great Outdoors Initiative. Among the stated goals are "to advance a whole-river, water-based approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play."

NHDES
- State water quality standards and designated uses for Class B waters including aquatic life, fish consumption, drinking water supply after treatment, primary and secondary contact recreation, and wildlife.

NHFG
- General goals related to sustainable fish populations, habitats, recreational fishing, and healthy aquatic ecosystems. Goals reference New Hampshire Fish and Game Department Strategic Plan 1998–2010 (NHFG, 1998).

VANR
- State water quality standards for designated uses of Class B waters relative to levels of water quality that fully supports all recreational uses.
- General policy related to protection of the quality of state waters with scenic, recreational, cultural, and natural values; balance competing uses; provide improved public access for water-based recreational opportunities. Policy references the 1993 Vermont Recreation Plan (VANR, 1994).

Not included in agency study requests, but included in the project PADs, the states of New Hampshire and Vermont have published Statewide Comprehensive Outdoor Recreation Plans (New Hampshire, 2007; Vermont, 2005) containing goals related to recreation resource management throughout each state.

ASSOCIATION WITH OTHER STUDIES

This study will supply context and background for the Whitewater Boating Flow Assessment -- Bellows Falls and Sumner Falls (Study 31), and the Bellows Falls Aesthetic Flow Study (Study 32).

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Section 3.10.3 of the PAD for each project provides a summary of FERC Form 80 Recreation Use Report annual visitation estimates for 2008. Section 3.10.2 provides a general description of public recreation facilities, activities, and demand at the projects. However, the PADs do not provide detailed information regarding the condition of existing facilities or type or location of various uses. Site-specific information regarding visitor perceptions and identified needs at the projects, current use, and whether existing access facilities in the area are meeting current and expected future recreation demand has not been collected.

PROJECT NEXUS

The projects include impoundments, tailwater areas, and a bypassed reach at Bellows Falls, some of which are inherently attractive recreation features. An analysis of existing recreation use and access at the projects would help form the basis for determining the projects' ability to provide public recreation access opportunities. Also, an assessment of the current level of recreation use would provide information necessary to develop an RMP for efficient management of the recreational components of the projects over the term of new licenses.

STUDY AREA AND STUDY SITES

The study area for the recreational facility inventory extends from the upstream end of the Wilder impoundment to the downstream limit of the Vernon Project. The study area for the recreational use and needs assessment and future use estimates includes the Wilder, Bellows Falls, and Vernon Projects (lands and waters within the project boundaries). Figures 3.10-1 of the Wilder, Bellows Falls, and Vernon PADs show these publically accessible recreation sites. Specifically, the study area includes the project impoundments and existing formal and informal public recreation areas including TransCanada access areas, state and municipal lands and access areas, and commercial recreation areas (marinas) located adjacent to the projects that provide water and land based recreation opportunities for the general public. The study will draw on information gathered from public recreation area visitors; residents from neighboring communities and less common user groups (e.g., snowmobile clubs, whitewater boaters, angling groups).

METHODS

Several methods will be used to collect current and estimate future recreation use and needs for the Wilder, Bellows Falls, and Vernon Projects land and waters potentially affected by project operations. The study will assess data on recreational use and needs gathered during the 2014 peak recreation season (May 1 through September 30, 2014).

A. Recreation Facility Inventory

The recreation facility inventory will be developed through site visits to each publicly accessible site within ~~and adjacent to~~ the project boundaries to document existing facilities and resources. Visits to documented facilities and resources will also be made to public riverine access sites between Wilder and Bellows Falls and between Bellows Falls and Vernon. All sites that will be inventoried are summarized in the following table.

Table 30-1. Publicly accessible sites to be included in the Wilder, Bellows Falls, and Vernon recreation facility inventory.

Wilder Project	Bellows Falls Project	Vernon Project
Newbury-Haverhill Bridge Access	~~Andrews Road~~ Wilgus State Park	Putney Boat Landing
Bedell Bridge State Park	Ashley Ferry Boat Landing	Dummerston Landing
Bugbee Landing Access Point	Hoyts Landing	(Chesterfield) River Road Access
Orford Boat Landing	Patch Park	Old Ferry Road Access
Richardson Conservation Land	Charlestown Boat Launch and Picnic Area	Retreat Meadows Boat Launch
North Thetford Landing	Green Mountain Marina	West River Marina
Hewes Brook Boat Launch	Herrick's Cove Boat Launch and Picnic Area	Norm's Marina
Ompompanoosuc Launch	Pine Street Boat Launch and Portage Trail Take-Out	Hinsdale ~~Island~~Access
Wilson's (Fullington) Landing	Bellow Falls Fish Ladder Visitor Center	Fisherman Access Area
Ledyard Canoe Club	Bellows Falls dam portage put-in	Broad Brook Access

Wilder Project	Bellows Falls Project	Vernon Project
Norwich Landing	Bellows Falls bypassed reach	Prospect Street Launch
East Wilder Boat Launch		Vernon Canoe Portage
Chambers Preserve		Vernon Glen
Cole Park		Vernon (Governor Hunt) Recreation Area & Boat Launch
Hartford (Wilder) Picnic Area at Kilowatt Park		Vernon Neck Open Space
Wilder dam (Olcott Falls) Boat Launch		
Fishladder and Angler Parking		
Lebanon (Wilder dam) Picnic Area Vista and hiking trails		
Wilder dam portage and downstream natural areas		
Downstream Access Sites		
Lyman Point Park Launch	Connecticut River Cartop Access (Westminster Bridge/Cold River Hand Launch)	
Two Rivers Park		
Lebanon Public Boat Launch		
Blood’s Brook Launch (a.k.a True’s Landing)		
Ottauquechee Launch		
Sumner Falls (Hartland Rapid)		
Cornish Boat Landing		
Connecticut River Trail Campsites inside Project Boundary		
Harkdale Farm	Wilgus State Park	Windyhurst
Vaughn Meadows	Student Conservation Association (SCA)	Wantastiquet - Hinsdale Canoe Rest Area
Bugbee Landing	Lower Meadow	Stebbins Island Canoe Rest Area
Underhill Camp		
Pastures Campground		

Wilder Project	Bellows Falls Project	Vernon Project
Birch Meadow		
Roaring Brook		
Gilman Island		
Gilman Island -Titcomb Cabin		
Campsites downstream of Project Boundary		
Burnap's Island		
Burnham Meadow Campsite		

Amenities at each site, such as number and type of boat ramps, the presence and type of restrooms, types of activities supported, parking spaces, and parking surface, will be recorded along with digital photos and GPS points. Attachment 30-A shows the inventory form that will be used to record site details in a systematic way. This inventory will identify and characterize the public facilities and resources, as well as identify any barrier-free sites/facilities, and the conditions of those facilities. River access sites will be visually assessed and photographed to record any opportunities or challenges for hand launched boats (e.g., canvas canoe). Attachment 30-B shows the inventory site use condition assessment forms that systematically characterize the physical conditions of the sites as well as the visual evidence of use and possible related damage. Survey staff responsible for recording the inventory form data will be trained to record data following the prompts given in the forms to reduce subjectively and maintain consistency across all access points. Inventory of sites will occur as one of the first tasks once the study begins.

At Bellows Falls, the facility inventory will include the feasibility of incorporating a shorter and safer portage (i.e., a path that reduces boater proximity and time near NH State Route 12) around Bellow Falls dam. Staff will work with existing conditions to evaluate potential options by reviewing land ownership information surrounding the dam and bypassed reach and investigate shoreline slope conditions (e.g., steepness) for alternative take-out options downstream of Pine Street Park on both sides of the river that could serve as an alternative path to the current route. Land ownership and shoreline slopes will also be researched for the downstream put-in.

The results of the inventory will provide baseline information regarding existing recreation facilities and resources at the projects and along project-affected riverine reaches. The inventory information will be assessed in conjunction with the information obtained through the visitor intercept survey (see below).

The expected results of the inventory effort will be:

- inventory of recreation sites and opportunities within and adjacent to each project;
- digital photographs of each of the recreation sites; and
- GIS map layers with links to digital photos and inventory information.

B. Recreation Use and Needs Assessment

The use and needs assessment will attempt to document all recreation activity types known to occur or potentially occurring at each project. Use assessments will be based on three components to collect existing and potential (future) recreational visitor use data. These components are: 1) existing public use (traffic counters, spot counts, and visitor interviews); 2) potential visitors (mailed and/or online questionnaire); and 3) use from other shoreline operators (e.g., publicly accessible marinas, and state parks [interviews and/or shared recreation data]).

Existing Public Use

Traffic counters, spot counts, and visitor exit interviews from the public access points listed above will be used to estimate current recreation use and activity levels at each project's public access sites.

Traffic counters will be installed at public access sites within the project boundaries that are conducive to this form of data collection. These are sites where there is a clearly designated entrance and exit to the recreation site. An assessment will be made in the field regarding the suitability of using a traffic counter at each site. From study plan development related desktop analysis it appears very few of the sites would not have an appropriate location to place a traffic counter however its inappropriate to commit as to which sites would receive a traffic counter without field verification at this time. Researchers intend to install traffic counters at as many of the recreation sites listed in table 30-1 as possible.

Spot counts and interviews will be conducted at all public access sites listed in table 30-1 above that are accessible from the road. Interviews with users at access sites would capture the through boaters as they end their trip or portage the dams. Spot counts will collect data on the amount of occupied parking spaces, recreational activities observed and use numbers, and general climate conditions. Attachment 30-C contains the spot count data collection form. Atypical uses not listed on the spot count form (e.g., observation of school groups) will be recorded in the notes section and tabulated at the conclusion of the field work.

Intercept surveys will be conducted with visitors to collect data on people's use of recreation sites, their attitudes concerning recreation needs and opportunities, safety concerns, and perceptions on site aesthetics. Survey questions will ask the visitors about group size, activities participated in, duration of and frequency of visits, primary activity, satisfaction, perceptions related to operation of the projects, and insight into site or project needs. Attachment 30-D shows the proposed on-site interview questionnaire. The date and time of the interviews and the information collected on the public's perceptions of impoundment levels or flows will be correlated to the actual levels during the interviews. Key aesthetic places and areas will be identified through the interview process and will be photographed. The goal of each site visit is to capture use numbers from traffic counts, characterize them with spot counts, and obtain as many interviews as possible to get a representative sample of the recreating public and characterize their uses, opinions, attitudes, and experiences.

A stratified random sampling scheme, such as by month, time of day, and location, will be used to gain representative responses from the visitors. The following bullets outline the proposed spot count and interview methods:

- Interviews will be collected simultaneous with spot counts;
- interviews and spot counts will be collected from May 1 to October 15;
- a sampling day (8 hours) will begin either 1 hour after sunrise or end 1 hour before sunset[*] (calculated from sunrise/sunset times for Burlington, VT) and will focus either on the AM or PM time period;
- start times weighted AM=0.33, PM=0.66 over the entire study;
- routes between sites will be the same; however the starting location will change each sample day so as to cover each site at different times throughout the day during the study;
- the Connecticut River will be separated into zones to ensure each zone receives equal coverage during a single survey day;
- due to its length and the number of sites, sites within Wilder and downstream to Bellows Falls will be separated into two (2) zones (north and south);
- sampling will occur within each zone 9 days a month; six (6) weekend and three (3) weekdays will be randomly selected;
- one day of each holiday weekend will be sampled (Memorial Day, 4th of July [Friday in 2014] and Labor Day);
- only persons 16 years of age or older will be surveyed;

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[*] For reference, on June 21 sunrise is 5:08 AM and sunset is 8:41 PM

- a single person will be randomly selected from a group (e.g. closest birthday to survey date); and

- routes and sampling times may be modified to enhance survey collection as season progresses.

Potential, Uncommon, and Non-Visitors

On-site interviews generally capture common activity types and potentially miss groups with unique recreation resource needs. These potential, uncommon or non-user groups (e.g., adjacent residential land owners, ice fishing/snowmobile uses–, hunters) will be surveyed using a mixed mode (mail and internet) approach inquiring about their recreational uses and needs of the Connecticut River within the projects as well as reasons for not visiting the projects. The mixed mode survey will follow the Dillman Method or modified Dillman Method (Dillman, 1978), and include items such as frequency and duration of visits to the projects, qualitative ratings of existing public access and recreation facilities in the project area, and reasons for visiting or not visiting the projects for recreation. Approximately 2,400 residents of Caledonia, Orange, Windsor and Windham counties in Vermont and Grafton, Sullivan, and Cheshire counties in New Hampshire who reside at varying distances from the Projects and who may recreate at project impoundments and downstream riverine reaches will be invited to participate in the recreation survey. Names and addresses will be purchased from a firm specializing in the sale of survey sample mailing addresses. These residents will be mailed an initial introductory letter, a follow up hard copy of the questionnaire, and subsequent follow up post cards to encourage responses. Residents will be provided the option to respond using a mail survey or a web-based survey. Surveys will be coded so web entries can be tracked against unique mailing criteria to limit duplicate entries (both hard copy and web entry), or ballot stuffing from forwarded emails, or sharing of hard copy surveys among survey recipients.

Attachment 30-E shows the Potential, Uncommon, and Non-User questionnaire. Distribution within each county will be based on the proportion of the study area population in each county. Based on the study area population and estimated return rates, 2,400 individuals will be surveyed. This sample size assumes a 95% confidence level with a 5% confidence interval. The final confidence interval will be calculated and reported with the final results.

Needs Assessment

The needs assessment will include the suitability of whitewater boating in the bypassed reach of Bellow Falls, existing boating opportunities within the project areas (including at the impoundments and immediately downstream of the dams), feasibility of providing additional public access at the impoundments and riverine reaches (potential locations, type of facilities and access, and any associated costs), identifying visitor perceptions regarding the adequacy of recreation facilities, and access in the project areas, and assessing currently proposed recreation facility improvement projects near each impoundment.

Expected results of the use and needs assessment will be:

- annual recreation use estimates by activity type, for each project;
- visitor profile information including results of interviews and mixed mode surveys;
- characterization of existing recreational visitation based on the assessment of information gathered via spot counts, traffic counter information, and available use information of recreation facility providers;
- characterization of existing recreational use and user preferences based on intercept surveys and mail/internet survey information; and
- assessment of visitor perceptions of project operations and management (e.g., fluctuating reservoir levels, minimum flow releases) on recreation and recreation opportunities at the projects.

C. Future Use Assessment

Future recreation estimates will be calculated for each project. Future use estimates will calculated by assessing future demand for recreation activities and population trends for the expected term of new licenses (to year 2050). Population estimates for the communities surrounding the projects will be obtained from the respective state agencies. Growth in recreation activities and the recreation use projections for the anticipated growth in recreational use through ~~2050~~ 2060 will be developed using *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends* (Cordell et al., 1999), Outdoor Recreation Participation in the United States – Projections to 2060 (Bowker, et al, 2012) and Outdoor Recreation Trends and Futures: A Technical Document Supporting the Forest Service 2010 RPA Assessment (Cordell, 2012). Current use estimates will be projected with indexed values of expected changes in the number of recreation days for given activities at the projects to estimate future recreation use in the project for 10-year increments out to 2050.

The expected results will be:

- data tables of expected population growth surrounding the projects in 10 year increments to 2050; and
- data tables of expected activity use levels for each project in 10-year increments to 2050.

ANALYSIS

The information acquired would be used to characterize and quantify recreation opportunities and conditions of recreation facilities, activity types, and levels of use by season, parking lot use through peak and weekend periods, visitor perceptions and recommendations, estimate future activity levels, and lay the ground work for a draft RMP. Results from the Bellows Falls inventory and suitability work will inform the Whitewater Boating Flow Assessment Study (Study 31).

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods to be used in this study are consistent with professional practices. The overall approach is commonly used in FERC relicensing proceedings and is consistent with generally accepted methods used by federal and state agencies for conducting recreation inventory, use, and needs studies. In addition, the methods are consistent with the FERC study request.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This will be a one year study conducted during the first field season (2014). Desktop and pre-field work will begin in late 2013, after FERC's study plan approval. Field work will focus on the peak recreational season with exact start and stop dates to be determined in consultation with the recreation working group, and is anticipated to start May 1 through September 30, 2014.

LEVEL OF EFFORT AND COST

The estimated budget for the study is approximately $3~~5~~80,000.

REFERENCES

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Attachment 30-A: Recreation Facility Inventory Form

Site Name:
Photos:
Location:
Facility Type:
Owner:
Manager:
Staffed:
Peak season maintenance schedule:

Acreage:
Gated:
Season/Hours:
Entrance Fee(s):

Primary Uses:

Parking
Lot name/identification if more than 1:_____________________________
Day use fee:

Vehicle Spaces:	**Parking lot type:**
Vehicle w/trailer spaces:	**Parking lot length:**
ADA designated spaces:	**Parking lot width**
Total parking spaces:	
Notes:	

Boating
Ramp name/identification if more than 1:_____________________________
Launch fee:

Boat Ramp: Y/N	**Ramp lanes:__________**	**Condition Assessment**
Boat Ramp Barrier Free: Y/N		
Boat Ramp Materials:		
Boat/Courtesy Dock:		
No. of Dock Slips:		
Suitability of site for hand launching:		
Notes:		

Fishing

Formal Angling: Y/N	**Type:**	**Condition Assessment**
Bank Angling: Y/N	**Approximate length:**	
Common Ice Fishing Access Point Y/N		
Notes:		

Camping, Swimming, Picnic, View Point, and Trail Amenities

Number of campsites:	**Number of barrier free campsites:**	**Condition Assessment**
Camping fee:		
Camping area acreage:		
Swim beach: Y/N	**Swim beach acreage:**	
Trail names	**Miles**	
a.		
b.		
c.		
Number of picnic tables:	**Number of barrier free tables:**	
View Point/Vista: informal/formal		
Playground: Y/N		
Grills:	**Fire Pits:**	
Garbage cans:	**Dumpsters:**	
Other amenities:		

List of signs on site and sign wording:
(photograph)

Comments:

Attachment 30-B: Site Condition and Visitor Use Form

The text in the various ratings are examples or suggestions of notes field staff would make during the evaluation. Staff will also add specific notes that informed their decision. Photos will be used to support the evaluation in the final report.

Facility site condition evaluation categories and criteria (filled out for each site).

Variable	0-Poor	1-Fair	2-Good
Roads & Parking (circulation and condition of surface paving)	All surfaces are in disrepair and need of immediate reconditioning or replacement. Current conditions create safety hazards.	Need for improved maintenance and repair in some areas. No major safety concerns.	All surfaces in excellent condition and well maintained. No rehabilitation required.
Recreation Site Amenities (condition of vehicle spur, picnic tables, fire ring/grills, boat ramps, etc.)	Facilities require immediate repair or replacement. Little evidence of recent maintenance.	Some facilities damaged or in need of replacement. Could be accommodated through routine maintenance.	Facilities generally in good condition and well maintained.
Recreation Site Buildings (condition of restrooms, maintenance buildings, and other structures)	Structures in disrepair requiring immediate attention. Significant rehabilitation likely. Problems could include rot, leaks, and sagging roofs.	Some structures need minor repairs, such as painting or replacement of roof/shingles. Repairs should be made, but are not needed immediately.	All structures appear in sound, well maintained condition. No significant problems observed.
Environmental (river buffers, direction of runoff, presence of BMP's),	All surfaces drain directly to river with riparian buffer less than 2 ft	Riparian buffer between 2-5 ft. Portions of impervious surfaces drain to temporary pond or immediately away from CT River	Riparian buffer >5 feet; impervious surfaces designed to move runoff away from river into stormwater ponds, site designers incorporated environmental design into facility layout
Signs (presence/condition of project and recreation signs)	Signs do not exist or require immediate repair or replacement.	Some signs damaged or in need of replacement.	Signs generally in good condition and well maintained.
Notes:			

Based on the rating of each variable/site component in the table above, an overall facility evaluation score will be calculated using the following scale.

- Score = ~~8~~9-10: Excellent condition
- Score = 6 to ~~7~~8: Good condition - requiring routine care/maintenance
- Score = ~~3-~~3 to 5: Fair condition - may require some rehabilitation
- Score = 0 to 2: Poor condition - requires immediate rehabilitation work or replacement

Visitor Use-Visible Impacts Form

Visitor use impacts - categories and criteria (filled out for each site)

Variable	0-Low Impact	1-Moderate	2-High Impact
Presence of litter, broken glass, fishing line, etc.	no evidence of litter, broken glass, or fishing line. Debris from high flows not included	may be a few pieces of litter clearly visible but easily transported to trash can; maybe a broken glass or other more difficult litter to pick up but not extensive	extensive litter throughout site that would take >hr to remove; multiple broken bottles or areas with difficult litter to removal
Dumping	no large items or bulk piles of trash	1 or 2 large items left on purpose (not flow related)	Clear intentional dumping, regularly observed, trash bags, appliances, furniture, etc.
Tree cutting, damage or vegetation clearing	Vegetation appears natural with no human disturbances	Areas less than 5' cleared for campfires, etc; small branches clipped for paths in select areas,	Areas more than 5' cleared for open space, both small and large branches removed to expand the site
Inadequate clearance around fire pits/rings	appropriate clearances and distances from water	fire rings between 50-20' from water; adjacent to trees/vegetation or infrastructure	multiple fire rings under low hanging tree canopy, less than 20' from water
Visible OHV use/tracks	no visual evidence	old tracks may be visible in dried mud or starting to be revegetated with grasses, maybe a single, fresh track around the perimeter	multiple, fresh tracks and mud tracked across site; new damage to vegetation and built ramps, jumps or other modifications to the sites landscape
Trampled vegetation, bare ground, compacted soils	no bare places in the vegetation outside designated areas	spotty bare patches near main trails or access points, seasonally revegetation possible	Well worn, bare areas throughout the site with little to no chance of revegating without serious effort
Human waste, toilet paper	no evidence of toilet paper, human waste or negative smells	faint negative smells; singular location of human waste in vegetation	multiple scatterings of toilet paper and areas of human waste; strong, consistent negative smells

Based on the rating of each variable in the table above, an overall Visitor Use impact score will be calculated for the facility using the following scale:

- Score = 10 to 14 Very Poor condition - requires immediate attention
- Score = 6 to 9: Fair condition - may require some rehabilitation
- Score = 3 to 5: Good condition - requiring routine care/maintenance
- Score = 0 to 2: Excellent condition – routine monitoring at this time

Attachment 30-C: Spot count data collection form

Date & Time__________ **Name**_____________
Location______________
Temperature__________
Weather: Sunny/Humid/Partly Cloudy/Cloudy/Fog/Drizzle/Rain

How many people are:

Picnicking		Bank/dock Fishing	
Visiting Beach (swim/sunbathing)		Hiking	
Using Playground		Viewing Wildlife	
Sightseeing		Hunting	
Walking			
Other:			

How Many Campsites are Occupied?______
No. of interview requests denied_________

Number of drive through (people who didn't get out of vehicle at access area)________

Comments:

Vehicle Information:

License Plate (State)	Number
VT	
NH	
MA	
ME	
NY	
Others:	

Number of Launches Observed:

Motorboat	
Sailboat	
Kayak	
Jet Ski	
Canoe	
Raft	
Skull	
Other:	

Parking Area		Vehicles w/out Trailers	Vehicles w/Boat Trailers	Vehicles w/Jet ski trailers	Vehicles w/car top gear	Empty Trailers (no vehicle)	Total parking spaces filled
1							
2							
3							
4							

Locations with multiple parking lots	Parking Lot Name
	Main Boat Ramp 1
	Remote Boat Ramp 2
	Remote Boat Ramp 3
	Picnic Area
	Boat Ramp
	Picnic/Beach
	Boat Ramp
	Picnic/Beach
	Overflow Boat Ramp
	Boat Ramp_1
	Boat Ramp_2
	Picnic/Ranger office
	Fishing Pier

Attachment 30-D: On-Site Intercept Survey

Hello, my name is ______________ and I am conducting a survey with visitors to Wilder, Bellows Falls, or Vernon Project Areas and the riverine sections between the reservoirs on behalf of TransCanada. This information will be used as an aid in understanding more about land and water based recreation in the area. The survey will take about 10 minutes and your responses will be kept confidential. Thank you for your time and input.

1. Date: __________________

2. Location: _______________________________

3. Current Weather: Sunny/ Partly Cloudy/Cloudy/Foggy/Drizzle/Rain

4. Today's Temperature: ___________

5. Time: __________________

6. Surveyor: _______________

---

7. Have you previously been interviewed as part of this study?
   Yes – thank you for your time. We are only interviewing each person once in this study.
   No - CONTINUE

8. How many people are in your group today (including yourself)? _____________

9. How many vehicles did your group come with? ______________

10. Have you ever visited PROJECT before? Yes No

11. If yes, in a typical year how many times do you visit PROJECT for recreation ___________(times/year)

12. What is your primary motivation for coming to this site today?________________________________

~~12~~13. What is your zip code?____________________

~~13~~14. On this trip, are you staying overnight in the area?
   Yes – How many days is your trip?__________
   No – How many hours will you be spending in the area recreating today?_____________

~~14~~15. Which of the following activities did you participate in on this trip? (mark all that apply)

ON THE WATER	ON SHORE
Motor boating (not fishing)	Fishing from shore
Fishing from boat or Ice fishing	Wildlife Viewing; Birding
Water skiing/tubing	Sightseeing/Driving for pleasure
Jet Skiing/PWC	Picnicking/Family Gathering
Canoe/Kayak – flat water	Hunting
Canoe/Kayak - whitewater	Tent/Vehicle Camping
Multi Day Float Trip	Bicycling/Mt. Biking
~~Sailing (not likely….)~~	Walking/Hiking

Sculling	Swimming/Sunbathing from shore
Swimming/sunbathing from a boat	
Tubing	
Other:	

~~15~~16. Of the activities listed above, what was your primary activity on this trip? ________________________

17. We are also interested in what activities you participate during other visits throughout the year. Please mark all the activities by season that you participate in while visiting Wilder, Bellows Falls, Vernon reservoirs or the areas downstream. (mark all that apply)

ACTIVITY	**Summer** (Jun, Jul, Aug)	**Fall** (Sept, Oct, Nov)	**Winter** (Dec, Jan, Feb)	**Spring** (Mar, Apr, May)
ON THE WATER				
Motor Boating (not fishing)				
Fishing from boat				
Water skiing/tubing				
Jet Skiing/PWC				
Canoe/Kayak – flat water				
Canoe/Kayak - whitewater				
Multi Day Float Trip				
Sculling				
Swimming/sunbathing from a boat				
Tubing				
ON SHORE				
Fishing from shore				
Wildlife Viewing				
Sightseeing/Driving for pleasure				
Picnicking/Family Gathering				
Hunting				
Tent/Vehicle Camping				
Bicycling/Mt. Biking				
Walking/Hiking				
Swimming/Sunbathing from shore				
Other:				

~~17~~18. Overall, how satisfied are you with the **number of** recreation facilities and opportunities (please circle one number)?

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

~~18~~19. If not extremely satisfied, what additions, changes, or improvements would make you more satisfied?_____________________

~~19~~20. At what location(s) are these recreation facilities needed? ________________________________

~~20~~21. Please rate your level of satisfaction with the **condition of the facilities** that you used (please circle one number).

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

~~21~~22. If you were not extremely satisfied, what changes or improvements would make you more satisfied?_________________

~~22~~23. Overall how satisfied were you with the **reservoir water level (or flow if downstream)** during this visit (please circle one number)?

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

~~Did you have any experiences on the water today that negatively affected your primary activity?~~

~~Yes No If so, please describe____~~

~~23~~24. Did fluctuating water levels (either at Wilder, Bellows Falls or Vernon reservoirs, or immediately downstream) affect your recreation experience today?

YES *CONTINUE WITH FOLLOW UP*

NO *SKIP TO QUESTION 28*

~~24~~25. What type of fluctuation did you experience? (check one)

Rising
Lowering
Both

~~25~~26. Briefly explain how the fluctuation you are thinking of positively or negatively affected your recreation experience?

____

~~26~~27. In general, would you prefer fluctuations that were: higher, lower, or about the same (check one)?

a. much lower fluctuations
b. slightly lower fluctuations
c. about the same; current situation is appropriate for my uses
d. slightly higher fluctuations
e. much higher fluctuations

28. Did you check public flow information (e.g., USGS website, American Whitewater website, or other sources) or the TransCanada flow phone prior to visiting today?

a. Yes
b. No
c. Didn't know it existed

~~273~~29. Please choose the response that best describes how **safe** you felt **at this site** today?

1	2	3	4	5	6	7	8	9
Extremely Safe		Safe		Neither safe or unsafe		Unsafe		Not at all safe

~~284~~30. If you answered Unsafe or Very Unsafe (7, 8 or 9), why did you not feel safe? ____________________

~~29~~31. How would you rate the scenery at this location?

1	2	3	4	5	6	7	8	9
Extremely appealing		Appealing		Average		Unappealing		Not at all appealing

~~30~~32. If you answered less than extremely appealing, what detracts from the scenic/aesthetic quality of this location? ______________________________

~~31~~33. What adds to the scenic/aesthetic quality of this location? ___________________________________

~~30~~34. Now think of scenic areas around THE PROJECT. What are the top 3 attributes about those areas that make it scenic? (e.g., natural setting, shoreline features, striking or rare natural features, etc.)

a.________________________ b.________________________ c.________________________

~~32~~35. Male Female

~~33~~36. (check one)

Age	Race
18 – 24	White
25 - 34	African American
35 – 44	Hispanic or Latino
45 – 54	Asian
55 – 59	American Indian or Alaskan Native
60 – 64	Native Hawaiian and Pacific Islander

65 – 74	Other:
75 – 84	Decline to answer
85 and over	
Decline to answer	

THANK YOU FOR YOUR TIME.

Attachment 30-E: Potential Visitor Questionnaire (mail/internet survey)

TransCanada is interested in learning the opinions of potential recreation visitors to the Connecticut River around Wilder, Bellows Falls and Vernon reservoirs and the areas immediately downstream of them. TransCanada is conducting on-site interviews at public recreation areas; however these visits may not capture all the potential users visiting these sections of the river. To the best of your ability, please respond to the questions below. This information will be used as an aid in understanding more about land and water based recreation in the area. The survey will take about 10 minutes and your responses will be kept confidential. Thank you for your time and input.

1. Home zip code ____________

2. During the past year (Labor Day 2013 through Labor Day 2014) did you or members of your household participate in outdoor recreation activities at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream? *CHECK ONE*

a Yes *SKIP TO SECTION 1*

b No

3. Why did you or members of your household **not** participate in recreation activities at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream? *FILL IN THE BLANK*

____

____

____ *SKIP TO SECTION 2*

____

____

SECTION 1
Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream

This section contains questions about how you or members of your household typically used Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream for recreation during the past year, from Labor Day 2013 through Labor Day 2014. If you don't recall an answer exactly, please give us your best estimate.

4. What was the primary motivation for choosing to recreate in these reservoirs or immediately downstream during the past year?

5. What was the **PRIMARY** outdoor recreation activity that you or members of your household participated in at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year (Labor Day 2013 through Labor Day 2014)? *PLEASE CHECK ONLY ONE BOX FROM THE LIST BELOW.*

Motor Boating (not fishing)	Fishing from shore
Fishing from boat	Wildlife Viewing
Water skiing/tubing	Sightseeing/Driving for pleasure
Jet Skiing/PWC	Picnicking/Family Gathering
Canoe/Kayak – flat water	Hunting
Canoe/Kayak - whitewater	Tent/Vehicle Camping
Multi Day Float Trip	Bicycling/Mt. Biking
Sailing	Walking/Hiking
Sculling	Swimming/Sunbathing from shore
Swimming/sunbathing from a boat	Snowmobiling
Tubing	Snow skiing
	Other:

6. Typically, what was the primary season in which you or members of your household participated in outdoor recreation activities the most at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year?
CHECK ONE FOR EACH OF THE THREE PROJECT VICINITIES YOU HAVE VISITED

Wilder	Bellows Falls	Vernon
Winter (Dec-Mar)	Winter (Dec-Mar)	Winter (Dec-Mar)
Spring (Apr-May)	Spring (Apr-May)	Spring (Apr-May)
Summer (Jun-Sept)	Summer (Jun-Sept)	Summer (Jun-Sept)
Fall (Oct-Nov)	Fall (Oct-Nov)	Fall (Oct-Nov)

7. Typically, what was the average number of people in the group that participated in outdoor recreation activities at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream with you or members of your household during the past year (Labor Day 2013 through Labor Day 2014)? *FILL IN THE BLANK*

__________ Adults ___________Children (under 16 years)

8. Select **ALL** outdoor activities, for each season, that you or members of your household participated in at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream during the past year (Labor Day 2013 through Labor Day 2014)?

CHECK ALL APPLICABLE BOXES FOR THE LISTS BELOW

ACTIVITY	**Summer** (Jun, Jul, Aug)	**Fall** (Sept, Oct, Nov)	**Winter** (Dec, Jan, Feb)	**Spring** (Mar, Apr, May)
ON THE WATER				
Motor Boating (not fishing)				
Fishing from boat				
Water skiing/tubing				
Jet Skiing/PWC				
Canoe/Kayak – flat water				
Canoe/Kayak - whitewater				
Multi Day Float Trip				
Sailing				
Sculling				
Swimming/sunbathing from a boat				
Tubing				
ON SHORE				
Fishing from shore				
Wildlife Viewing				
Sightseeing/Driving for pleasure				
Picnicking/Family Gathering				
Hunting				
Tent/Vehicle Camping				
Bicycling/Mt. Biking				
Walking/Hiking				
Swimming/Sunbathing from shore				
Other:				

9. Is the number of access points at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream adequate to meet your needs?

CHECK ONE FOR EACH RESERVOIR

Wilder	Yes	No
Bellows Falls	Yes	No
Vernon	Yes	No

10. Is the location of access points at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream adequate to meet your needs?

CHECK ONE FOR EACH RESERVOIR

Wilder	Yes	No
Bellows Falls	Yes	No
Vernon	Yes	No

11. Please rate your overall level of satisfaction with the <u>number</u> of Public Recreation Areas at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream that you or members of your household used over the past year.

CHECK ONE NUMBER FOR EACH RESERVOIR

Wilder

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

Bellows Falls

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

Vernon

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

12. Please rate your overall level of satisfaction with the <u>type</u> of Public Recreation Areas at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream that you or members of your household, used over the past year.

CHECK ONE NUMBER FOR EACH RESERVOIR

Wilder

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

Bellows Falls

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

Vernon

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

13. Please rate your overall level of satisfaction with the <u>location</u> of Public Recreation Areas at Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream you or members of your household used over the past year.

CHECK ONE NUMBER FOR EACH RESERVOIR

Wilder

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

Bellows Falls

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

Vernon

1	2	3	4	5	6	7	8	9
Extremely satisfied		Moderately satisfied		Neutral	Slightly satisfied			Not at all satisfied

14. Please tell us what types of recreation facilities you think are needed and at what specific location(s)? *FILL IN THE BLANKS*

Type: ____

Location(s): ____

Type: ____

Location(s): ____

Type: ____

Location(s): ____

15. Have fluctuating water levels either at Wilder, Bellows Falls or Vernon reservoirs or immediately downstream ever affected your recreation experience?

YES *CONTINUE*

NO *SKIP TO SECTION 2*

16. What type of fluctuation affected your experience? (check one)

Rising

Lowering

Both

17. Briefly explain how the fluctuation you are thinking of positively or negatively affected your recreation experience?

____

18. In general, would you prefer fluctuations that were: higher, lower, or about the same (check one)?

a. much lower fluctuations

b. slightly lower fluctuations

c. about the same; current situation is appropriate for my uses

d. slightly higher fluctuations

e. much higher fluctuations

19. Prior to visiting the Connecticut River do you check public flow information (e.g., USGS website, American Whitewater website, or other sources) or the TransCanada flow phone?

a. Yes

b. No

c. Didn't know it existed

SECTION 2 Recreation Use Outside of Connecticut River Hydro Projects a.k.a ALTERNATIVE RECREATION AREAS

This section contains questions about how you or members of your household typically recreated at ALTERNATIVE RECREATION AREAS NOT at Wilder, Bellows Falls or Vernon Reservoirs or immediately downstream during the past year, from Labor Day 2013 through Labor Day 2014. If you don't recall an answer exactly, please give us your best estimate.

20. Did you or members of your household visit ***ALTERNATIVE RECREATION AREAS*** within a day's drive from the Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream to recreate during the past year?

CHECK ONE

a. __________Yes b. _________No *SKIP TO SECTION 3*

21. Please list ***ALTERNATIVE RECREATION AREAS*** within a day's drive from the Wilder, Bellows Falls, or Vernon reservoirs or immediately downstream where you or members of your household traveled to recreate during the past year? *FILL IN THE BLANKS*

a.____ State__________

b.____ State__________

c.____ State__________

d.____ State__________

e.____ State__________

f.____ State__________

22. What was the average number of people in the group that participated in recreation activities during the past year at ***ALTERNATIVE RECREATION AREAS*** (NOT WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM)?

FILL IN THE BLANK

_________________________ Adults______________ Children (under 18 years)

23. During which season(s) did you or members of your household recreate the most at ***ALTERNATIVE RECREATION AREAS*** (NOT WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM) during the past year?

CHECK ALL THAT APPLY

a. _____Winter (Dec-Mar) b. _____ Spring (Apr-May)

c. _____Summer (Jun-Sept) d. _____ Fall (Oct-Nov)

24. What outdoor activities did you or members of your household participate in at ***ALTERNATIVE RECREATION AREAS (***NOT at WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM) during the past year (Labor Day 2013 through Labor Day 2014)?

PLEASE CHECK **ALL** APPLICABLE BOXES FOR THE LISTS BELOW.

ACTIVITY	**Summer** (Jun, Jul, Aug)	**Fall** (Sept, Oct, Nov)	**Winter** (Dec, Jan, Feb)	**Spring** (Mar, Apr, May)
ON THE WATER				
Motor Boating (not fishing)				
Fishing from boat				
Water skiing/tubing				
Jet Skiing/PWC				
Canoe/Kayak – flat water				
Canoe/Kayak - whitewater				
Multi Day Float Trip				
Sailing				
Sculling				
Swimming/sunbathing from a boat				
Tubing				
ON SHORE				
Fishing from shore				
Wildlife Viewing				
Sightseeing/Driving for pleasure				
Picnicking/Family Gathering				
Hunting				
Tent/Vehicle Camping				
Bicycling/Mt. Biking				
Walking/Hiking				
Swimming/Sunbathing from shore				
Other:				

25. How many calendar days during the past year (Labor Day 2013 through Labor Day 2014) did you or members of your household participate in outdoor recreation activities at ***ALTERNATIVE RECREATION AREAS (***NOT at WILDER, BELLOWS FALLS, OR VERNON RESERVOIRS OR IMMEDIATELY DOWNSTREAM)?

NUMBER OF CALENDAR DAYS____________(Estimate if needed)

SECTION 3 – ALL RESPONDENTS

This section contains questions about your background that will help us compare your responses to those of other people. All of your answers are strictly confidential.

26. Are you a member of any of the following organizations? *CHECK ALL THAT APPLY*

- 1 Adjacent landowner
- 2 Appalachian Mountain Club
- 3 Ledyard Canoe Club
- 4 American Whitewater
- 5 New England FLOW
- 6 The Nature Conservancy
- 7 Trout Unlimited
- 8 Ducks Unlimited
- 9 Vermont Rivers Conservancy
- 10 Connecticut River Joint Commissions
- 11 Connecticut River Watershed Council
- 12 Upper Valley Trails Alliance
- 13 Upper Valley Land Trust
- 14 Audubon Society
- 15 Bass Fishing Club
- ~~15~~16 Other(s):________________________
- X No, I am not a member of any of the above categories or organizations

27. Please select your gender, age and race.

a. Male

b. Female

Age	Race
18 – 24	White
25 - 34	African American
35 – 44	Hispanic or Latino
45 – 54	Asian
55 – 59	American Indian or Alaskan Native
60 – 64	Native Hawaiian and Pacific Islander
65 – 74	Other:
75 – 84	Decline to answer
85 and over	
Decline to answer	

Updated Study 31

Whitewater Boating Flow Assessment

Bellows Falls and Sumner Falls

STUDY REQUESTS

FERC-11; NPS-02a, -02b; AMC-VRC-FRs-02; NEF-AW-AMC-03

STUDY GOALS AND OBJECTIVES

Public comments during scoping meetings and study requests received from FERC, NPS, AMC-VRC-FRs, and NEF-AW-AMC indicate a strong public interest in evaluating the suitability of whitewater boating opportunities at the bypassed reach below Bellows Falls dam and studying the effects of operations of the Wilder Project on paddling opportunities at Sumner Falls.

The goal of this whitewater flow study is to assess the presence, quality, access, flow information, and flow ratings for paddling opportunities in a stepwise manner.

The objectives of the study are to:

- identify recreational paddling opportunities at Sumner Falls and the suitability of the Bellows Falls bypassed reach for whitewater boating;
- describe flow-quality relationships at each location, and identify acceptable and optimal ranges for each. Information will be organized independently for Sumner Falls and the Bellows Falls bypassed reach;
- describe potential effects of operations on paddling at each location, and identify boater's sensitivity to current operations regimes (e.g., project discharges ranging from minimum flow to full generation);
- broadly characterize recreational paddling-relevant hydrology of the existing operating regime, and qualitatively describe the relationship between paddling opportunities and project operations;
- characterize the potential for whitewater boating in the Bellows Falls bypassed reach within the context of regional opportunities and those provided through current operation;
- determine the number of days flows for whitewater boating are available under the projects' current operation at both locations;
- identify resource needs (e.g., aquatic habitat) and competing recreational uses (e.g., canoeing or fishing) that are or would be affected by flows suitable for whitewater boating;

- identify all safety issues associated with whitewater boating and further development of opportunities for such at both locations;
- identify public access obstacles at Sumner Falls and Bellows Falls bypassed reach; and
- characterize effects on current project operations associated with providing various flows for recreational paddling.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

In its study request, NPS identified the following resource management goals related to this study.

NPS	• The Connecticut River has been designated a National Blueway, part of the America's Great Outdoors Initiative. Among the stated goals are "to advance a whole-river, water-based approach to conservation, outdoor recreation, education, and sustainable economic opportunities in the watersheds in which we live, work, and play."

Also as included in the project PADs, the states of New Hampshire and Vermont have published Statewide Comprehensive Outdoor Recreation Plans (New Hampshire, 2007; Vermont, 2005) containing goals related to recreation resource management throughout each state.

ASSOCIATION WITH OTHER STUDIES

Study results from this effort will help characterize the whitewater boating opportunities; however, conducting the study and interpreting the results will need to be done in a comprehensive manner. Results from other studies will help provide the context in which to assess the results of this study to properly balance the resource needs. Similarly, the study can be coordinated with other studies to achieve efficiencies associated with mobilized staff and operational requirements and so that study components are implemented in a stepwise manner so any potential conflicts in resource needs are identified and avoided.

Sumner Falls

TransCanada conducted investigations into the federally listed Jesup's milk vetch (*Astragalus robbinsii* var *jesupii*) (Normandeau, 2013), which resulted in the development of stage flow relationships in the reach below Wilder dam to assess the relationship between flows and Jesup's milk vetch. The area surrounding Sumner Falls also serves as critical habitat for state-listed Cobblestone Tiger Beetle, which will be studied in Study 26.

This location would also likely be studied in further detail under the Instream Flow Study (Study 9) with analysis of minimum and operational flows related to various aquatic habitats. Results from the Hydraulic Modeling (Study 4) and Operations Modeling (Study 5) studies will contribute to the understanding of the potential effects on operations of whitewater flows. Sumner Falls access, uses, and user interviews (among other data) will be documented with the Recreation Facility Inventory and Use &Needs Assessment (Study 30). This information will help characterize the social and human dimensions related to recreational use of the site, which will provide a richer context for understanding the relationship between the Wilder Project and natural and recreational resources.

Bellows Falls Bypassed Reach

Similar to the Sumner Falls section above, results from this study will provide inputs into the comprehensive understanding of the relationships between operations and natural, recreation, and aesthetic resources. Results from the Instream Flow Study (Study 9) will help describe flow habitat relationships. Flow effects from operations will also be assessed through the Hydraulic Modeling (Study 4) and Operations Modeling (Study 5) studies. The American Eel Upstream Passage Assessment(Study 18) will provide insights into eel passage needs and flow relationships.

This study will also draw on the documentation of the bypassed reach described in Study 30, Recreation Facility Inventory Use &Needs Study (e.g., gradient, access, length).

This study is dependent on controlled releases from the Wilder Project and from Bellows Falls dam into the Bellows Falls bypassed reach, and the timing and magnitude of those releases could be scheduled to accommodate various studies. Controlled flows provided for the Instream Flow Habitat Study (Study 9) could be used in lieu of separate flows for this study. That study would also produce hydraulic modeling (2-D) outputs that could provide additional information about flows (e.g., depths, water velocity, direction) and be used to supplement this study. The Bellows Falls Aesthetic Flow Study (Study 32) is similarly dependent on controlled flows and would most likely be coordinated around scheduled releases.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

The Bellows Falls PAD does not include information on the suitability of boating in the bypassed reach because that is not part of the project's current operation. Currently there is no reasonably available information on the characteristics or boating suitability of the Bellows Falls bypassed reach, or the range of boatable flows. Furthermore, there is no information available to analyze whether flows could be provided to enhance whitewater boating opportunities in the bypassed reach.

In terms of physical capability to release water into the Bellows Falls bypassed reach, the PAD indicates that no minimum flow is required in the bypassed reach under the current project license, and the amount of flow present is determined by the amount of spillage and leakage. When flows exceed project capacity the excess water is spilled into the bypassed reach through two 115-foot long roller gates that discharge water 15 to 18 feet below the impoundment surface. Flows through the flash board section of the dam would occur when inflows exceed roller gate capacities combined with generator discharge (approximately 40,000 cfs). The minimum sustained gate opening for these roller gates is 1 foot to prevent river debris from damaging the submerged seals or getting lodged and preventing the closure of the gate. Considering the overall 3-foot range of operation of the impoundment, a 1-foot opening discharges 3,000 to 3,300 cfs into the bypassed reach.

There have been historical instances of personal injury and accidents, including at least one fatality, due to public use or attempts at boating spill related flow in the bypassed reach. The level of danger requires safety considerations to be a key component of all studies and demonstration flows. This should apply to both the demonstrations if evaluators require presence in the bypassed reach itself and potential for future requirements for flow in the bypassed reach with respect to instream public use.

The Wilder PAD recognizes Sumner Falls (also known as Hartland Rapid) for its whitewater characteristics and summarizes some basic information about the site; however, the PAD does not include information about the relationship between flow releases from Wilder and the characteristics, boating suitability, or other flow-dependent recreation effects of those releases.

Existing Wilder and Bellows Falls operations data can provide baseline information about opportunities for boating and flow dependent recreation under current operations.

PROJECT NEXUS

Operation of the Wilder Project regulates the level of flow downstream of the dam. Recreational paddling opportunities at Sumner Falls can be affected by the timing, duration, and magnitude of those releases. A better understanding of operations and recreational paddling opportunities for this location is needed.

Bellows Falls Project operation diverts flows from the bypassed reach of the Connecticut River that could, in theory, provide whitewater boating opportunities. Other than leakage from the dam, flows into the bypassed reach only occur during high flow events when inflow exceeds station capacity and the excess is spilled at the dam. An analysis of project operations relative to a range of boatable flows would help form the basis for assessing how often boatable flows occur in the bypassed reach under existing conditions and the quality of those flows.

STUDY AREA AND STUDY SITES

This study focuses on two specific locations: Sumner Falls, which is downstream of the Wilder Project but affected by project discharge, and the Bellows Falls bypassed reach directly downstream of Bellows Falls dam. Sumner Falls is a series of ledges sprawled across a wide section of the Connecticut River about 7 miles downstream of Wilder dam creating a quarter mile stretch of rapids as the river drops 7 vertical feet. The Bellows Falls bypassed reach comprises natural river bed approximately 3,500-feet long that receives minimal flow from dam leakage, and high flow events or powerhouse outages.

METHODS

The methods used in this study are designed to gather information to assess flow ranges for recreational paddling in a stepwise, or phased, manner. Specific protocols related to study components will follow accepted practices outlined by Whittaker et al. (1993, 2005).

A phased approach encourages advancing the level of effort needed to quantify specific opportunities and flow needs for a reach only if less intensive work is unable to provide that information. For example, whitewater boating already exists at Sumner Falls, but the relationship to Wilder Project operations and the quality of the recreational paddling is less well documented. This approach is even more important for Bellows Falls because it is currently unknown if the bypassed reach is suitable for whitewater boating. The basics of the reach and any insurmountable risks should be documented and assessed prior to committing to on-water flow reconnaissance or controlled flow evaluations.

Study phases will progress according to the levels prescribed by Whittaker et al. (2006). Study information acquisition will begin with “Level 1” methods (a review of existing information and limited reconnaissance of river segments at a single flow), and will also include “Level 2” (structured interviews with experienced recreation users for target opportunities and on-land boating feasibility assessment). Decisions about whether or not to proceed will be made at the conclusion of each task (level) working towards “Level 3” methods (e.g., on-water single-flow reconnaissance or multiple flow controlled flow study). Taken together, this level of precision/study intensity is expected to provide sufficient quantification of flow ranges or flow fluctuation tolerances to assess broad project effects from current operations.

Review of Existing Documents (Level 1)

A review of relevant resource documents (e.g., guidebooks)and operational data is an important first step in a flow assessment for recreation. This study component will include a directed assessment of existing project hydrology data and operational constraints relative to recreational paddling opportunities. These materials will help clarify existing or potential opportunities and flow issues and allow researchers to become familiar with operations and resulting recreation-relevant hydrology of the river reaches.

Existing available hydrology information will be used to generally describe the range of flows available in reaches during specified recreation seasons; this provides context for conducting field work, interviews, and controlled flow study components.

Resource Reconnaissance (Level 1)

Field work is planned for spring/summer 2014. This time frame allows researchers to identify potential study participants and observe recreation opportunities at common flow levels (assuming normal conditions are available). It also provides sufficient time to develop preliminary hydrology information, become familiar with the resource via interviews and existing information, and define logistics with local recreational paddlers who may help guide reconnaissance. Potential study participants will be experienced recreation users who will be identified by the study leads through networking. TransCanada's consultants will contact existing paddler groups, agencies, and stakeholders as well as proactively contact individuals that use the river for recreation. Potential study participants will be interviewed and selected for further involvement through the Level 2 and potentially Level 3 assessments pending the outcomes of each step. Study participants will be selected based on their paddling experience, familiarity of the river, and representativeness of their boating type relative to the suitability of boating within the bypassed reach and Sumner Falls. Experience with other similar FERC relicensing studies indicates a comparative list is typically comprised of American Whitewater members, guides, outfitters, and boaters with many years and trips on the river for particular types of recreation, and may include members of the public who are well known to local resource agency staff.

Simultaneous with the efforts to characterize hydrology and build a study participant panel, TransCanada will work to identify feasible methods to control releases for study evaluation. The need to make releases and provide access into the bypassed channel is also of importance to a number of other proposed study plans such as the Instream Flow (Study 9), Upstream Eel Passage (Study 10), Resident Fish Assemblage (Study 11), and Bellows Falls Aesthetic Flow (Study 32) studies to name a few.

Interviews and Land-Based Feasibility Assessment (Level 2)

Interviews with key resource experts or recreation users offer complementary information about recreational paddling and the system's hydrology. Interviews are proposed with a minimum of two to four experienced recreation users (and/or agency staff) for each recreational paddling opportunity (e.g., canoe, whitewater kayak [various types]).

[Somewhere in this stage we should review any pre-recorded video of bypass flows and examine such factors as flow levels, access, safety and hazards. For instance, the examination of these events will assist in determining the suitable starting point or proposed range of flows for the whitewater boating assessment.]

Interviews will be semi-structured with specific topic areas, and questions will focus on how people boat at Sumner Falls or related to characterizing the suitability of whitewater opportunities within the bypassed reach. The goal is to describe the character of the recreational paddling opportunities and identify flow-dependent attributes while recognizing any insurmountable risks. A second series of questions will focus on the effects of flows on those attributes and whether interviewees can identify specific flows or fluctuation levels that affect the quality of opportunities (e.g., acceptable and optimal ranges and fluctuation tolerances). The interviews will also inform the land-based assessment of a single flow at the two study sites.

The land-based feasibility assessment will include visually evaluating Sumner Falls and the bypassed reach and having open discussion with interview participants related to the recreational paddling opportunities (and specifically the feasibility of boating within the bypassed reach), possible flow ranges, and potential risks and safety hazards. Land-based assessments will be informed by any pre-recorded video of flows in the bypassed reach to examine such factors as flow levels, access, safety and hazards. Access will be evaluated prior to inviting study participants into the field to visually assess flows associated with this study level. Access on foot through the constriction near the fish barrier dam is unknown and strongly influenced by flows. Views from near the Villas Bridge (Key Observation Points 2 and 3 from the Bellows Falls Aesthetics Flow Study No. 32) will inform access and safety considerations prior to entering the bypassed reach.

Results from the interviews and land-based assessments will be summarized and included in the interim report. The results from these activities and review of any pre-recorded video of flows in the bypassed reach will help inform the next steps, which may include Level 3 on-water assessment(s) and the suitable starting point or proposed range of flows.

Controlled Flow Study (Level 3)

Sumner Falls

TransCanada will make three different sized releases from Wilder which will be used at Sumner Falls to assess recreational paddling opportunities and rate the quality of the flows at this location. Study leads will invite between 8 and 12 intermediate, advanced and expert paddlers to participate in a controlled flow study at Sumner Falls. Study participants will be selected through networking efforts similar to and derived from the Level 1 effort. In addition to the networking initiated by the study leads, intermediate to experienced paddlers representing various paddling opportunities popular at Sumner Falls (e.g., canoe, play boating) can be nominated by stakeholders and agencies as well as derived from TransCanada Community Relations contact lists. Study leads will be proactive in networking the boating community to identify and select the appropriate boaters for this portion of the study. Selection process will include interviews with potential paddlers prior to finalizing the study team to ensure their capabilities, experience level with boating Sumner Falls, understanding of the purposes of and their personal involvement in the study, and expectations while participating.

Participants will complete a pre-fieldwork interview on their experience and boating preferences, paddle Sumner Falls at each flow and assess flows, and participate in a focus group after each flow. After all flows have been observed, participants will provide their overall evaluations using a "flow comparison" format. Attachment 31-A shows the proposed questionnaire for paddlers participating in the Sumner Falls controlled flow study. Photos and video footage of key rapids, pools, or other features and conditions with different user types will be taken and will provide useful documentation, particularly in combination with qualitative focus group notes, quantitative data from surveys, and relevant hydraulic modeling outputs.

Bellows Falls Bypassed Reach

If whitewater boating is deemed feasible and safe in the Bellows Falls bypassed reach after the on-land assessment described in Level 2, between 2 and 4 expert boaters will be invited to boat a single flow in the reach and respond to predetermined rating questionnaires. The actual questions would be similar to those developed for Sumner Falls (see Attachment 31-A) but will be finalized after the Level 2 assessment. Whittaker (2005) notes that on-water, single flow boating assessments may be a planned interim step when a controlled flow study is recommended and that when this occurs, fewer participants and a professional judgment-level analysis rather than formalized evaluations may be sufficient and minimize costs. Potential boaters will be identified similar to the panel for Sumner Falls.

Experienced boaters would participate in a single flow reconnaissance trip to better understand the whitewater characteristics within the reach. Focus group discussion after the run will be used to summarize opinions about the suitability of boating, types of opportunities, possible flow ranges, or insurmountable hazards associated with the bypassed reach. Photos and video will also be used to document the run.

If the single trip is successful and more information is required to quantify acceptable and optimal flow ranges, types of boats and potential trips, multiple boat trips will be made either as stand-alone study releases or in coordination with controlled flows scheduled for the Instream Flow Study (Study 9). Commencement of this portion of the study would proceed based on the proceeding efforts. During this step, 8-12 expert whitewater boaters would paddle the river at up to three controlled releases with final flows, required boater experience, and boater numbers to be developed in consultation with the paddlers and TransCanada after integrating results of the Level 1 and 2 portions of this study. After all flows have been boated, participants will provide their overall evaluations using a "flow comparison" format using a form similar to the one currently developed for Sumner Falls. Development of the survey tool for Bellows Falls multiple flow assessment is premature at this point given the lack of understanding of how TransCanada will make the controlled releases, the flexibility in controlling the magnitude of those releases, boater safety, and input from expert boaters on the issues to be evaluated. Hydrological flow modeling (2-D) conducted as part of that study could be used to show current direction, water velocity, and depth patterns in the bypassed reach and linked with boater criteria or observational data as a supplement to the qualitative approaches.

ANALYSIS

Results from each level of the stepwise approach will be documented and will inform the process as the study progresses. Results from the literature review and field-based reconnaissance will be used in determining if and at what flow, a single reconnaissance flow trip should be made in the bypassed reach. Successful completion of a single flow trip would inform the flow levels and types of watercraft that would be appropriate for a multiple flow controlled flow study. Similarly, results from interviews and observations at Sumner Falls will help to identify the flows needed for the multiple flow assessments. Quantitative ratings will be made for whitewater boating opportunities and conditions. Results will incorporate hydrology, project operations, interview results, and quantitative data collected from the rating forms (questionnaires) that would be completed by study participants. An overall flow preference curve for paddlers will be provided.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods used in this study are consistent with professional practices. The overall approach is commonly used in FERC relicensing proceedings and is consistent with generally accepted methods used by federal and state agencies for conducting recreational flow assessments. In addition, the methods for the study are consistent with FERC study requirements under the ILP.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study. The report will 1) describe the whitewater boating attributes of the range of flows examined, including level of difficulty, play spots, safety and portage requirements, etc.; 2) identify the acceptable and optimal flows for the reach and the frequency of availability of the identified flows under current project operations; and 3) incorporate relevant results from the Recreation Facility Inventory and Use & Needs Assessment (Study 30),including characterization of the access or suitability of the bypassed reach for whitewater boating (e.g., gradient, length, character of potential).

A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the projects. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

This will be a one year study conducted during the first study year (2014). Desktop and pre-field work will begin in late 2013 after FERC's study plan approval. This is a flow study in which the methods for making controlled releases and the magnitude of those releases is not fully developed yet. The process could be coordinated to occur with spring run-off spill events as early learning sessions to observe spills in the bypassed channel. Once the mechanics of making releases is understood, this study will likely rely on distinct controlled releases or those provided for the Instream Flow Assessment (Study 9). Controlled flows may be required over the course of 3 to 4 consecutive days during which the multiple flow on-water trips would occur.

LEVEL OF EFFORT AND COST

The estimated budget for the study is approximately $86,000.

REFERENCES

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Attachment 31-A: Boater Survey

SUMNER FALLS (HARTLAND RAPIDS) BOATINGSTUDY

Date: ____/ ____/ 2014 Flow: _____ cfs Your name: ____________________________

SectionA: General

1. How many years have you been taking trips to this location? ________________years

2. Are you an outfitter, guide, or private river user?
   - Outfitter
   - Guide
   - Private User
   - Other_______________

3. How would you rate your own skill level?
   - ~~Beginner (some previous boating experience)~~
   - Intermediate
   - Advanced
   - Expert

4. Do flow levels influence whether or not you take a trip?
   - Yes
   - No

5. Do flow levels influence ***how*** you take trips (when you go, what craft you use, which rapid you run, how much gear you take, etc.)? If yes, please describe below.
   ____
   ____
   ____

Section B: Post-run Questions

1. What type of craft did you use for this run? *(Circle one)*
   Kayak: (hybrid · play boat · creek boat · river boat) Inflatable kayak Canoe Other: __________

2. In general, what class (I–III+) was the whitewater difficulty at this flow? _____

3. Did you have any significant problems (e.g., had to swim, eskimo roll or other problems such as pinned or wrapped a boat) during your run? Please provide a brief description and location of any incident (continue on back if needed).

4. Please evaluate the flow on this trip for your craft and skill level for each of the following characteristics. *(Circle one number for each item).*

	Totally Unacceptable			Marginal			Totally Acceptable
Boatability	1	2	3	4	5	6	7
Availability of technical rapids	1	2	3	4	5	6	7
Availability of powerful hydraulics	1	2	3	4	5	6	7
Availability of play boating areas	1	2	3	4	5	6	7
Overall whitewater challenge	1	2	3	4	5	6	7
Safety (due to flow levels)	1	2	3	4	5	6	7
Hazards present in river							
Aesthetics of river/channel	1	2	3	4	5	6	7
~~**Rate of travel**~~	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~
Overall Rating	1	2	3	4	5	6	7

5. In general, would you prefer a flow that was higher, lower, or about the same as this flow? *(Circle one).*
   1. Much lower flow
   2. Slightly lower flow
   3. About the same; this was close to an optimum flow
   4. Slightly higher flow
   5. Much higher flow

6. What is the minimum skill level necessary to successfully run this segment at this flow level?
   a. Novice (no previous boating experience)
   b. Beginner (some previous boating experience)
   c. Intermediate
   d. Advanced
   e. Expert

7. If this flow were provided periodically, are you likely to return for future boating? *(Circle one).*
   1. Definitely no
   2. Possibly
   3. Probably
   4. Definitely yes

Section C:Close-out Questions

1. Compared to other play spots or reaches, how would you rate the boating opportunity at this location (assume optimal flows).
(Circle one number for each; if you are unsure about a comparison, leave that item blank).

Compared to…	This reach is… Worse than average	Below average	Average	Above average	Much better than average
…other rivers within 2 hours of Sumner Falls (Hartland Rapid)	1	2	3	4	5
…other rivers in New England	1	2	3	4	5

2. Please provide overall evaluations for the reach for the following flows for your craft and skill level. Please consider all the flow-dependent characteristics that contribute to high quality trips (e.g., boatability, whitewater challenge, safety, availability of surfing or other play areas, and aesthetics~~, and rate of travel~~).*(If you do not feel comfortable evaluating a flow you have not seen, don't circle a number for that flow).*

Sumner Falls	Totally Unacceptable			Marginal			Totally Acceptable
700	1	2	3	4	5	6	7
1000	1	2	3	4	5	6	7
1700	1	2	3	4	5	6	7
2000	1	2	3	4	5	6	7
2700	1	2	3	4	5	6	7
3500	1	2	3	4	5	6	7
5500	1	2	3	4	5	6	7
7000	1	2	3	4	5	6	7
9000	1	2	3	4	5	6	7
11000	1	2	3	4	5	6	7

3. Please specify the flows that you think would provide the following types of experiences on the reach.
(Note: It's okay to specify flows you have not observed, but which you think would provide the type of experience specified).

	Flow in cfs
~~Think of the river as a waterway used for transportation.~~ ~~What is the lowest flow you need to simply get down the reach in your craft?~~ What is the highest water level that a through canoe boater would run (above this they would portage)	
Some people are interested in a "technical" experience at lower flows. Think of this "technical" experience in your craft.	
What is the lowest flow that provides an acceptable experience at this location?	
What is the best or optimal range of flows for a technical experience at this location?	to
Some people are interested in taking trips at somewhat higher flows that have stronger hydraulics but may offer less technical routes through rapids. Think of this "standard trip" in your craft. What is the lowest flow that provides an acceptable experience for a standard trip at this location?	
What is the best or optimal range of flows for this type of use at this location?	to
Some people are interested in taking trips at much higher flows that have more powerful hydraulics and larger waves. Think of this as "big water use" in your craft. What is the lowest flow that provides an acceptable experience for a "big water" type of trip?	
What is the best or optimal range of flows for this type of trip?	to
What is the highest safe flow for your craft and skill level?	
If TransCanada were to provide a boating release, what flow would you prefer	

Updated Study 32

Bellows Falls Aesthetic Flow Study

RELEVANT STUDY REQUESTS

VANR-34

STUDY GOALS AND OBJECTIVES

In their study requests, VANR and the Rockingham Conservation Commission indicate a need to characterize the aesthetic attributes of the Bellows Falls bypassed reach.

The goals of this study are to:

- characterize the aesthetic conditions in the bypassed reach at various levels of flows; and
- provide a range of aesthetic ratings that can be used to assess conditions relative to Vermont's water quality standards.

The primary objectives of this study are to:

- collect videography and still photography to document the appearance of the bypassed reach under existing and various controlled flows conditions;
- identify populations potentially affected by the aesthetic conditions in the bypassed reach and determine how the interests of these populations relate to the aesthetic conditions;
- identify flow ratings and timing preferences across the full range of potential user groups; and
- estimate the costs to provide different levels of flow and assess the trade-offs of the various flows among the different populations.

RELEVANT RESOURCE MANAGEMENT GOALS

In its study request, VANR described jurisdictional resource management goals for this study, as summarized below.

VANR	• State water quality standards for designated uses of Class B waters relative to aesthetic values including water character, flows, water level, and bed and channel characteristics.

Note that the Bellows Falls bypassed reach is located primarily in New Hampshire. New Hampshire water quality standards do not include aesthetics as a parameter for Class B waters.

ASSOCIATION WITH OTHER STUDIES

This study requires observations of specific, measured flow releases into the bypassed reach for rating by study participants. Similarly, ranges of controlled flows may also require a level of observation as a component of the Instream Flow Study (Study 9) and the Whitewater Boating Flow Assessment (Study 31). At this time it is unclear how and what level demonstration flows would be necessary in those studies to meet those study objectives. If it is feasible and to the extent practicable, we will incorporate the elements of this aesthetic flow assessment analysis to the range of flows associated with those studies.

Furthermore, there may be preliminary, non-flow assessment criteria and information that is required to determine what, if any, flows are suitable for those interests. TransCanada is investigating the mechanics of making controlled releases to the bypassed reach. All of this associated study determination should be completed before conducting a series of controlled flows specifically to address this study's aesthetic analysis. Alternatively, a series of controlled releases could be attempted solely for the purposes of this study should either of the associated flow demonstrations not prove feasible or adequate to meet the needs of this study's objectives. To the extent possible, aesthetic evaluations could also include naturally occurring spill events.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

No information is available to characterize the aesthetic conditions in the Bellows Falls bypassed reach. No minimum flow is required in the bypassed reach, and the amount of flow present depends on the amount of spillage and leakage from the dam. When flows exceed project capacity, the excess water is spilled into the bypassed reach through two, 115-foot long roller gates that discharge water 15 to 18 feet below the impoundment surface. Flows over the stationary flashboards would occur when inflows exceed roller gate capacities combined with generator discharge (approximately 40,000 cfs). The minimum gate opening for these gates is 1 foot to prevent river debris from damaging the submerged seals or getting lodged and preventing the closure of gate. Considering the overall 3-foot range of operation of the impoundment, a 1-foot opening discharges 3,000 to 3,300 cfs into the bypassed reach.

PROJECT NEXUS

Lack of consistent flow passing the dam and into the bypassed reach directly affects aesthetic resources associated with the dam and the bypassed reach itself. VANR requests a study of alternative flows released from Bellows Falls dam. This information will be needed to characterize existing and potential aesthetic conditions before VANR can determine whether the project would meet Vermont water quality standards.

STUDY AREA AND STUDY SITES

The study area includes the Bellows Falls bypassed reach from the base of the dam to a point below the fish barrier dam at the confluence with the tailrace. The fish barrier dam will be considered an element associated with the bypassed reach for the purposes of this study. The bypassed reach will be assessed under different flow conditions from publicly accessible and representative observation points. Review of site conditions suggests direct views into the bypassed reach are very limited. Figure 32-1 shows the public, key observation points (KOPs) which include (from upstream to downstream): KOP-1: Arch Bridge, from the sidewalk looking over the dam into the bypassed reach*; KOP-2: along New Hampshire Route 12 (River Street or Main Street); KOP-3: the now-closed Vilas Bridge (Bridge Street)†; and KOP-4: from the access road downstream of the fish barrier dam on the Vermont shore overlooking the downstream portion of the bypassed reach. If additional field investigation reveals that KOP-1 is inadequate for viewing, we will attempt to locate another publically accessible viewing point.

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* Views into the bypassed reach from KOP 1 are limited to pedestrians as the concrete barrier of the bridge, and the train trestle over the dam severely limits views into the reach from vehicles driving across the bridge. Final determination of including this KOP in the study or a potential alternative KOP will be made after assessing the views in the field.

† Concrete 'Jersey' barriers are in place to deter both vehicle and pedestrian access across the Vilas bridge.

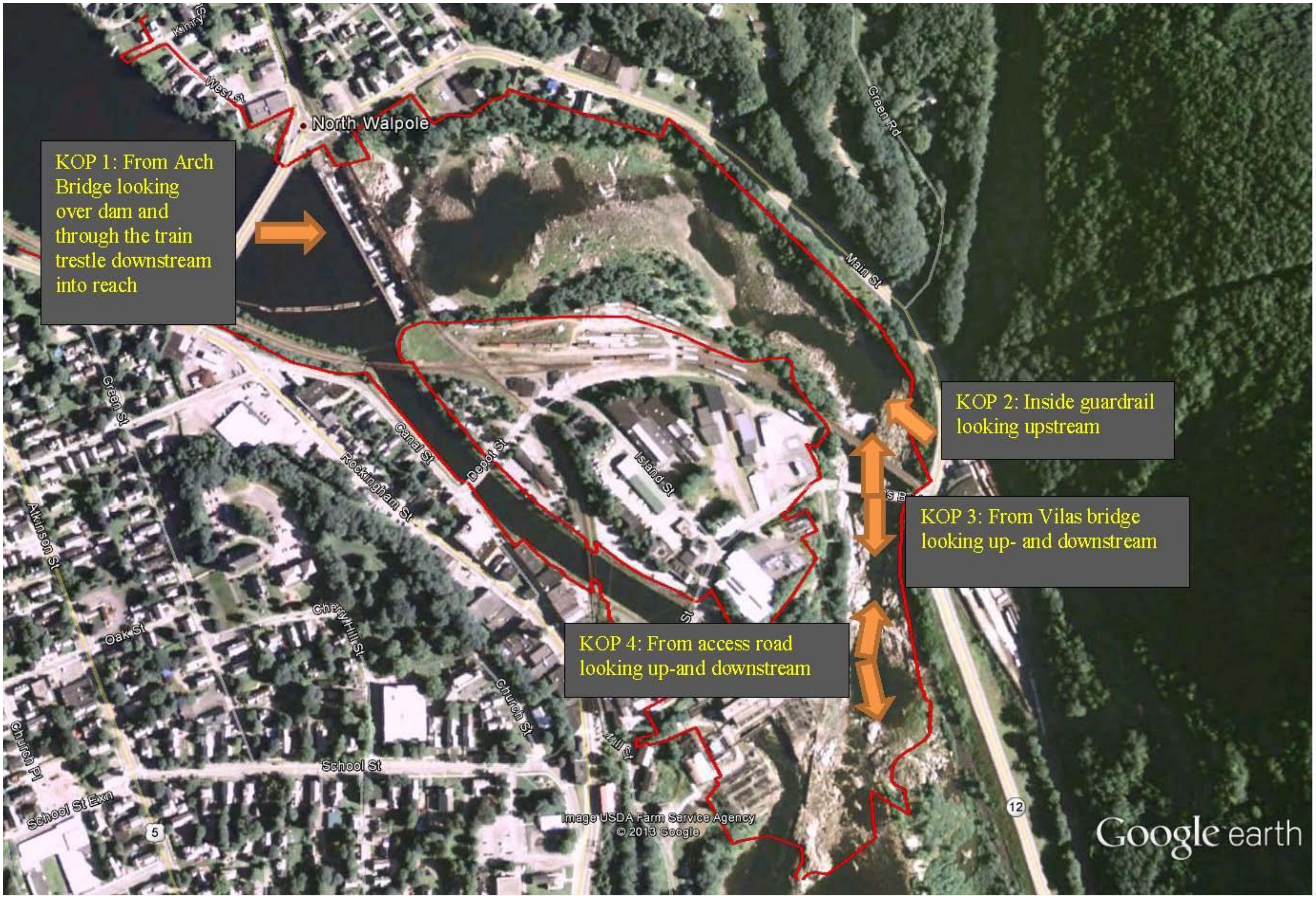

Figure 32-1. Locations of key observation points for Bellows Falls aesthetics flow study.

METHODS

The conditions of the bypassed reach during a range of flow releases will be recorded (digital videography and photographs) and rated using the comparative method. Photos and videos of demonstration flows or controlled releases scheduled as part of the Instream Flow Study (Study Plan 9) or the Whitewater Boating Flow Assessment (Study Plan 31) would be recorded and edited for use in this study.

The Bellows Falls Project is a central feature to the villages of Bellows Falls, Vermont and North Walpole, New Hampshire. To evaluate the scenic components of various flows at the local landscape level, study leads will organize between 10-12 residents, business owners, and employees in the local area to respond to survey questions designed to evaluate various flows in the bypassed reach in a focus group setting. Kruger (2008) recommends focus groups between 8-10 people and states a larger group will limit the detail of some responses because participants feel a pressure to share airtime with others and conversely, participants in a smaller group may feel an uncomfortable pressure to talk more than they would otherwise to fill dead air. In study plan development discussions, FERC staff suggested considering including up to 16 participants in the focus group to ensure an appropriate cross section of the broader population.

Ten to twelve participants should strike an appropriate balance between Kruger citation (8-10 participants) and FERC suggestions (16 participants) given the relatively small populations in the two towns and the lack of clear sight lines into the bypassed reach. The three key observation points represent the only public locations where people can view the bypassed reach during the leaf-on seasons and one of these is on a closed bridge. During leaf-off conditions, sight lines into the bypassed reach from Route 12 would likely improve; however the views would continue to be obstructed by the remaining tree branches, evergreens, residential structures, and further obstructions associated with viewing while driving along the road (e.g., short view times, lack of concentration due to requirements of driving).

Out of area residents were considered for inclusion in the panel but subsequently dismissed due to: (1) two of the key observation points are from the perspective of pedestrians (both bridges) and it is unlikely many out of area visitors are likely to walk across either bridge when visiting the area as they do not connect two commercial centers; (2) sight lines from Route 12 are very poor with only a few seconds of viewing opportunity into the bypassed reach from a moving vehicle due to the dense vegetation during the leaf-on condition and private residences along the eastern side of the reach limiting both local viewers and out of area visitors opportunities to view the bypassed reach; and (3) personal preferences of the aesthetics of flows is subjective and there is no basis to believe out of area visitors subjectivity is any different than the local population.

TransCanada Community Relations, Vermont Agency of Natural Resources and Rockingham Conservation Commission staff will provide initial input (e.g., contacts) as to potential study participants. These contacts can nominate additional or alternate participants. Potential participants will be screened for bias and must not be employed or related to an employee of TransCanada or have any preconceived notion regarding appropriate flow levels in the bypassed reach.

Study participants will convene at a single location to view a series of photos and videos of different levels of flow including existing conditions in the bypassed reach taken from the key observation points. Each participant will be asked to rate the conditions in the photos under the specified flow releases using a predefined rating form (included as Attachment 32-A). A seven-point Likert acceptability scale ranging from -3 (labeled "totally unacceptable") to +3 (labeled "totally acceptable") with a 0 midpoint (labeled "neutral") will serve this purpose. Researchers have advocated the use of this type of metric for assessing recreation and aesthetic flows (Shelby et al., 1992; Whittaker et al., 1993, 2005). After the single flow assessments, participants will be asked to provide input comparing between flows. At a minimum, participants will complete a form to rate the leakage flow conditions and each of the controlled demonstration flows released in the bypassed reach. The actual cfs will not be disclosed and respondents will be asked to evaluate the various flows by referring to them by demonstration flow number only. Representing different flows through photographic media provides an efficient way to avoid having users observe flows onsite (Whittaker et al., 2005).

TransCanada may photograph and video record natural spill events from the key observation points prior to any demonstration releases to capture these natural events for possible use in this study. In theory, any pre-controlled release photography and video would capture a range of natural spill and seasonal conditions (e.g., early spring runoff, potential icing or misting) which would augment the photos and videos used to capture the controlled releases. TransCanada does not intend to conduct winter demonstrations for viewing of seasonal conditions (e.g., icing or misting) or dam safety.

ANALYSIS

Survey responses will be summarized, and results will be tallied to identify whether each assessed flow creates acceptable, neutral, or unacceptable conditions for the group. Survey responses will be assessed as to whether or not there are trends associated with a particular user group and the results relationship to the Vermont Class B water quality management objectives pertaining to aesthetics. This information will be correlated with operational data to estimate the costs to provide different levels of flow.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The methods for the study are consistent with professional practices. The overall approach is commonly used in FERC relicensing proceedings and is consistent with generally accepted methods used by federal and state agencies for conducting aesthetic flow assessments. Photographing and videotaping the bypassed reach when it contains each of the alternative flows and using these recordings to survey a group of individuals using the comparative method is an equivalent and efficient methodology to the on-site demonstration flow approach.

DELIVERABLES

A report will be prepared that presents methods, analysis, and results of the study and will include photos and short videos of the various flows assessed in the study. A draft final study report will be provided after the study analysis is complete and the results are available. The report will be prepared for stakeholder review and comment. Stakeholder comments on the draft final report will be included in the final report with an explanation of any stakeholder comments not incorporated.

Results and conclusions will be reported in either the PLP or draft license application for the project. Exhibit E of the final license application will include modified results and conclusions, as appropriate, in response to stakeholder comments on the PLP or draft license application.

SCHEDULE

Timing for this one year study will depend on the associated study schedules. Background materials (e.g., photos and videos) will be prepared in advance of the evaluation phase. Because this is a flow-dependent study, the timing of field work to photograph and record flows in the bypassed channel depends on scheduled releases. At a minimum, the controlled flow releases to be provided for the associated flow studies (Studies 9 and 31) would be videotaped and photographed for use in this study. Evaluations of all flows will be done collectively after all associated demonstration flows have been recorded, anticipated to conclude by summer 2014.

LEVEL OF EFFORT AND COST

The estimated budget for the study is approximately $40,000.

REFERENCES

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Attachment 32-A: Aesthetic Survey

Bellows Falls Bypassed Reach Aesthetics Flow Study

Date: _____ / _____/2014 Demo Flow: _________ cfs Your name: ______________________

Section A: General

6. Which statement best represents your perspective? Today I am viewing the flows in the Bypassed Reach as: *CHECK ONE*
   - Bellows Falls/North Walpole Resident → *LIST TOWN*____________________
   - Area Resident → *LIST ZIP CODE*_____________________
   - Bellows Falls/N. Walpole Business Owner or Employee → *LIST BUSINESS TYPE AND LOCATION*_________________
   - Commuter → *TYPICAL TIME OF DAY PAST VIEWS OF THE BYPASSED REACH* ____________
   - Out of Area Visitor → *LIST ZIP CODE*______________________

7. How would you rate your familiarity with the Bellows Falls bypassed reach? *CHECK ONE*
   - Drive/walk by - ~~/~~see it ~~very~~ frequently (time scale days between visits)
   - See it seasonally (time scale months between visits)
   - Few ~~visits~~ viewings (time scale years between ~~visits~~viewings)
   - Rare ~~visits~~ viewings (time scale decades between ~~visits~~viewings)
   - First time ~~visiting~~viewing

8. Consider your typical viewing of the bypassed reach, how long do you typically look at and consider the conditions within the bypassed reach during each viewing opportunity? _________________minutes/hours

9. What is the most common condition you observe while viewing the bypassed reach?
   - Spilling
   - Leakage flows (non-spill)

~~8.~~10. How important to you are the overall aesthetics of the Bellows Falls bypassed reach? *CHECK ONE NUMBER*

-3	-2	-1	0	1	2	3
Not at all important		Slightly important	Neutral	Moderately important		Extremely important

Section B: Key Observation Points and Flow Evaluations*

Key Observation Point 1 - Demo Flow #:___________________

~~9.~~*11.* Please evaluate the flow at this level for each of the following characteristics. *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
~~Safety~~ Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of ~~water~~ pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water	-3	-2	-1	0	1	2	3
Amount of water through/over dam	-3	-2	-1	0	1	2	3
	~~-3~~	~~-2~~	~~-1~~	~~0~~	~~1~~	~~2~~	~~3~~
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

~~10.~~12. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*

- Much lower flow
- Slightly lower flow
- About the same; this was close to an optimum flow
- Slightly higher flow
- Much higher flow
- Doesn't matter

~~11.~~13. List any positive attributes of this flow level (LIST SOME):

____

____

____

~~12.~~14. List any negative attributes of this flow level (LIST SOME):

____

____

____

* This section would be repeated for each KOP at each release plus the existing leakage condition; however in an effort to minimize redundancies and potential waste individual sheets for each flow are not included here.

____

Key Observation Point 2 - Demo Flow #:____________________

~~13.~~*15.* Please evaluate the flow at this level for each of the following characteristics. *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
~~Safety~~ Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of ~~water~~ pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water, hydraulic features or drops	-3	-2	-1	0	1	2	3
	~~-3~~	~~-2~~	~~-1~~	~~0~~	~~1~~	~~2~~	~~3~~
Flow over fishdam	-3	-2	-1	0	1	2	3
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

~~14.~~16. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*

- Much lower flow
- Slightly lower flow
- About the same; this was close to an optimum flow
- Slightly higher flow
- Much higher flow
- Doesn't matter

~~15.~~17. List any positive attributes of this flow level (LIST SOME):

____

____

____

~~16.~~18. List any negative attributes of this flow level (LIST SOME):

____

____

____

Key Observation Point 3 - Demo Flow #:__________________

~~17.~~19. Please evaluate the flow at this level for each of the following characteristics. *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
~~Safety~~ Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of ~~water~~ pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water, hydraulic features or drops	-3	-2	-1	0	1	2	3
Flow over fishdam	-3	-2	-1	0	1	2	3
	~~-3~~	~~-2~~	~~-1~~	~~0~~	~~1~~	~~2~~	~~3~~
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

~~18.~~20. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*

- Much lower flow
- Slightly lower flow
- About the same; this was close to an optimum flow
- Slightly higher flow
- Much higher flow
- Doesn't matter

~~19.~~21. List any positive attributes of this flow level (LIST SOME):

____

____

____

~~20.~~22. List any negative attributes of this flow level (LIST SOME):

____

____

____

Key Observation Point 4 - Demo Flow #:__________________

~~21.~~23. Please evaluate the flow at this level for each of the following characteristics. *(Check one number for each item).*

	Totally Unacceptable			Neutral			Totally Acceptable
Sound level	-3	-2	-1	0	1	2	3
Sound interest	-3	-2	-1	0	1	2	3
Amount of pools/still water in channel	-3	-2	-1	0	1	2	3
Amount of visibly moving water in channel	-3	-2	-1	0	1	2	3
Amount of exposed rocks/streambed in channel	-3	-2	-1	0	1	2	3
Contrast between pools and moving water, hydraulic features or drops	-3	-2	-1	0	1	2	3
	-3	-2	-1	0	1	2	3
Overall Aesthetic Rating	-3	-2	-1	0	1	2	3

~~22.~~24. In general, would you prefer a flow that was higher, lower, or about the same as this flow from this view? *(Check one).*

- Much lower flow
- Slightly lower flow
- About the same; this was close to an optimum flow
- Slightly higher flow
- Much higher flow
- Doesn't matter

~~23.~~25. List any positive attributes of this flow level (LIST SOME):

____

____

____

~~24.~~26. List any negative attributes of this flow level (LIST SOME):

____

____

____

Section C: Comparative Flow Questions, after all demo flows have been viewed from all KOPs

22. At what flow level do the aesthetics or scenic quality of the bypassed reach decline?

    Demo Flow # ________________

23. What flow level would you consider acceptable for a minimum aesthetic flow?

    Demo Flow # ________________

24. What was your preferred flow condition?

    Demo Flow # ________________

Updated Study 33 – Clean Version

CULTURAL AND HISTORIC RESOURCES STUDY

RELEVANT STUDY REQUESTS

FERC-12; VT SHPO-01, -02, -03; Nolumb-01; additional information requests from FERC, and comments from the New Hampshire Division of Historical Resources (NH SHPO)

In their comments following the review of the Project PADs, FERC, the Vermont State Historic Preservation Office (VT SHPO), New Hampshire State Historic Preservation Office (NH SHPO), and The Nolumbeka Project, Inc. requested additional information about cultural resource studies that have been or will be conducted at the Vernon, Bellows Falls, and Wilder Projects as part of the overall FERC relicensing process. A meeting was held on June 7, 2013 with those and other interested parties to discuss the initial draft of the cultural resources study plan, and yielded clarification and additional information about those requests. The following were identified as the primary issues that the study plan for cultural resources must address:

- completion of consultation to determine the Area of Potential Effect (APE) for the Projects
- information about cultural resources investigations that have been carried out to date, including Phase 1A archaeological surveys and historic architectural resource determinations of National Register of Historic Places (National Register) eligibility
- methodology and schedule for carrying out investigations to complete the identification and evaluation of archaeological sites, historic architectural resources, and traditional cultural properties (TCPs) within the APEs

STUDY GOALS AND OBJECTIVES

The overall goal of this cultural resource study is to assist FERC in complying with Section 106 of the National Historic Preservation Act (NHPA), as amended, and its implementing regulation 36 C.F.R. Part 800. The objectives are to define the APE for the Projects; identify and evaluate historic properties, which are defined as buildings, sites, structures, objects, and TCPs that are listed or eligible for listing in the National Register (36 C.F.R § 800.16(l)(1)), within the APE; assess the potential effects of the relicensing of the Projects on historic properties pursuant to 36 C.F.R. § 800.5; and resolve any potential adverse effects through the development of Programmatic Agreements (PA) in accordance with 36 C.F.R. §

800.6. The work will be conducted within the framework of the Section 106 process and will be carried out in close coordination with the consulting parties.

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

The relevant resource management goal related to this study is to ensure the protection of cultural resources in compliance with Section 106 of the NHPA. The study will also comply with other relevant federal laws, including the National Environmental Policy Act (NEPA), the Archaeological Resources Protection Act (ARPA) of 1974 (16 USC 469), the American Indian Religious Freedom Act (AIRFA) of 1978 (42 USC 1996 and 1996a), the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 USC 3001), Executive Order 11593 (Protection and Enhancement of the Cultural Environment) of 1971 (16 USC 470), the American Antiquities Act of 1906, and Executive Order 13007 (Indian Sacred Sites) of 1996 (73 Federal Register 65, pp. 18293-24).

ASSOCIATION WITH OTHER STUDIES

For all three projects, the effects of project operations on historical resources that might lead to revisions to the presently defined APE, as well as an understanding of the contribution of non-project effects on the same, will rely upon the results of hydraulic modeling and operations modeling studies (Study 4 and 5), and the three erosion studies (Study, 1, 2, and 3). These studies will help to understand the spatial extent of project effects on riparian resources including historic resources typically associated with active erosion that ultimately defines the APE.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing Information

Archaeological Phase 1A Studies

Phase IA archaeological reconnaissance surveys have been conducted within the recommended APEs (see "Study Area and Study Sites" below) for Wilder, Bellows Falls, and Vernon Projects to identify known archaeological sites and additional areas of archaeological sensitivity where documented and previously unrecorded sites are likely to exist. The methodology employed in conducting those investigations is included in Attachment 33-A.

The Phase IA survey for the Wilder Project identified a total of 48 archaeological sites within the project boundary: 28 sites on flowage lands including river shoreline and 3 sites within fee-owned lands in Vermont; and 16 sites on flowage lands including river shoreline and 1 site within fee-owned lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Wilder PAD (pages 3-146 through 3-153). The Phase IA survey also documented 56 locations that could contain additional archaeological sites (27 in Vermont, 29 in New Hampshire) based on archival research (i.e., historical maps), five of which were identified during the Phase IA survey and assigned archaeological site numbers. The other 51 documented sites were not field-verified during the Phase IA survey. The documented sites are summarized in Table 3.12-2 (Vermont) and Table 3.12-3 (New Hampshire) in the Wilder PAD (pages 3-154 through 3-161). Of the 48 sites identified in the project APE, two are potentially eligible for listing in the National Register and one is ineligible. The National Register eligibility of the other 45 identified sites within the APE has not been determined.

The Phase IA survey for the Bellows Falls Project identified a total of 43 archaeological sites within the project boundary: 16 sites on private flowage lands, 8 sites on fee-owned lands and adjacent private flowage, and 2 sites on fee-owned lands in Vermont; and 6 sites on private flowage lands, 5 sites on fee-owned lands and adjacent private flowage, and 6 sites on fee-owned lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Bellows Falls PAD (pages 3-157 through 3-165). The Phase IA survey also documented 26 locations that could contain additional archaeological sites (12 in Vermont, 14 in New Hampshire) based on archival research (i.e., historical maps), three of which were identified during the Phase IA survey as corresponding to previously recorded archaeological sites. The other 23 documented sites were not field-verified during the Phase IA survey. The documented sites are summarized in Table 3.12-2 (Vermont) and Table 3.12-3 (New Hampshire) in the Bellows Falls PAD (pages 3-166 through 3-169). Of the 43 sites identified in the project APE, three are currently listed on the National Register, and three are eligible for listing on the National Register. The National Register eligibility of the other 36 identified sites within the APE has not been determined.

The Phase IA survey for the Vernon Project (Cherau and O'Donnchadha, 2008) identified a total of 37 archaeological sites within the project boundary: 28 on fee-owned and private flowage lands in Vermont; and 9 on fee-owned and private flowage lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Vernon PAD (pages 3-182 through 3-188), and include potential site locations documented through archival research (i.e., historical maps). Of the 37 sites identified in the project APE, two are eligible for listing in the National Register, and one of these may also be an unlisted National Historic Landmark. One site is potentially eligible for listing in the National Register. The National Register eligibility of the other 34 identified sites within the APE has not been determined.

The Phase IA archaeological field investigations at the Wilder and Bellows Falls Projects documented erosion along the impoundment shorelines, upstream of Bellows Falls dam and immediately below Wilder dam. The Phase IA surveys were conducted in the months immediately following Tropical Storm Irene (August 2011), and the high flow-related erosion may have been a result of flooding associated with the storm. No high flow-related erosion was observed in the Vernon Project during the Phase IA survey, which was conducted 4 years earlier (August 2007). The archaeological investigations were not designed to ascertain the causation, extent, and mechanics of the observed erosion at the Wilder or Bellows Falls Projects.

Historic Architectural Property Identification and Evaluation

The Vernon, Bellows Falls, and Wilder Projects have previously been determined or evaluated as eligible for listing in the National Register as historic districts through a variety of surveys and other types of investigations that have been conducted over time. The following describes the primary efforts that have resulted in the identification and evaluation of those resources.

Hydroelectric Generating Facilities in Vermont Multiple Property Submission

The Vernon and Bellows Falls Projects are identified as being eligible for listing under the Hydroelectric Generating Facilities in Vermont Multiple Property Submission (MPS) (Berger 1992). The MPS documentation was prepared by Louis Berger & Associates, Inc. in 1992 and was signed by the Keeper and entered in the National Register in 2004. It provides the overall context and registration requirements for listing individual hydroelectric power facilities in Vermont that were constructed between 1882 and 1941. The Vernon and Bellows Falls Projects, which were developed in 1909 and 1928, respectively, are identified in the documentation as historic districts that are eligible for listing under the MPS, but neither has ever been formally nominated to the National Register.

Deerfield and Connecticut River Hydroelectric Projects System-wide Historical and Photographic Documentation

A full inventory of historic aboveground properties within the FERC boundaries of the Vernon, Bellows Falls, and Wilder Projects was compiled during a survey conducted by PAL in 1999 (Doherty and Kierstead 1999). The purpose of the survey was to identify and evaluate historic architectural properties within the boundaries of all the hydroelectric developments that are currently owned by TransCanada on the Deerfield and Connecticut Rivers. The survey information was used to evaluate the significance of the resources and prepare state-level written and photographic documentation that meets the standards of the Historic American Engineering Record (HAER). The documentation was intended to provide a permanent record of the historic developments and serve as a baseline for assessing the impacts of subsequent Project-related undertakings that had the potential to impact their qualities of significance. It included the development of historic context statement for the development of hydroelectric power facilities on the two rivers and the recordation of each of the hydroelectric developments, including information about all individual aboveground resources within the Project boundaries that contribute to their historical significance. Copies of the documentation for the Connecticut River Projects were submitted to the VT and NH SHPOs for transmittal to the state archives in those states and local archival repositories in the vicinity of the Projects.

Vernon Project

In 2006 TransCanada conducted a project to upgrade the generating capacity at the Vernon Project that required an amendment to the license. As the project subject to review under Section 106 of the NHPA, FERC and TransCanada consulted with the VT and NH SHPOs and other parties regarding the project's effects on historic properties. The consultation resulted in a determination that the historic architectural resources within the Vernon Project are eligible for listing in the National Register as a historic district under National Register criteria A and C at the state level in the areas of Industry, Engineering, and Architecture (Table 1). It derives its primary historical significance from being the first large capacity electrical generation facility in New England designed to deliver electricity via a long-distance transmission network. The effects of the proposed upgrade project on the historic powerhouse were resolved through the execution of a Memorandum of Agreement (MOA) that specified a variety of mitigation activities, including the preparation of a Historic Properties Management Plan (HPMP). The HPMP, which was completed and approved in 2008, specifies the treatment and management of historic properties within the Vernon Project Boundaries (Olausen and Cherau 2008).

Table 1. List of contributing resources within the Vernon Hydroelectric Project historic district.

Resource Name	**Location**	**Date**	**Description**
Dam	Connecticut River between Vernon, VT and Hinsdale, NH.	1907-1909	956-foot-long, 58-foot-high concrete gravity dam, with a spillway section that includes trash sluice gates, flood gates, tainter gates, and hydraulic flashboards
Powerhouse	West end of Dam, Vernon, VT and Hinsdale, NH	1907-1909	Rectangular, 328 feet long by 55 feet wide, Renaissance Revival-style building with a steel- frame structural system and brick exterior walls
Superintendent's House	Governor Hunt Road, Vernon, VT	1907	2½-story, wood-frame, clapboard-sided, Colonial Revival-style house with an asphalt-shingled gable roof. It was built about 1907 to house the Vernon Station's superintendent and his family
Superintendent's Garage	Governor Hunt Road, Vernon, VT	c, 1907	1-story, wood-framed, clapboard-sided, gable-roofed garage

Resource Name	Location	Date	Description
Hoister House	Governor Hunt Road, Vernon, VT	c. 1907	1-story, clapboard sided, gable-roofed, wood-frame shed. Originally house a compressed air-powered hoist used to haul railroad cars during construction of the Project. Currently used for equipment storage
Pump House	Governor Hunt Road, Vernon, VT	c. 1909	Brick-walled, one-story shed with a slate-sheathed gable roof. Built to pump potable water to the Powerhouse and the company-built employee dwellings
Crew Shack	East end of Dam, Hinsdale, NH	c. 1909	1-story, clapboard-sided, rectangular, building with an asphalt shingle roof. Provided shelter for power company personnel, particularly those working on the dam in bad weather.

Bellows Falls Project

The Bellows Falls Island Multiple Resource Area (MRA) was listed in the National Register in 1990 (Mulholland et al. 1988). The documentation covered a number of historic resources located on Bellows Falls Island that were associated with the industrial development of the area during the nineteenth and early twentieth century. The Bellows Falls Hydroelectric Powerhouse was named in the documentation as a contributing resource, but the New England Power Company, the owner of the Project at that time, objected to its listing in the National Register. In accordance with the Section 101(a)(6) of the National Historic Preservation Act, the Keeper determined the property eligible for listing and provided the appropriate notifications to that effect.

A portion of the Canal that provides water to the Bellows Falls Powerhouse is a contributing resource within the Bellows Falls Downtown Historic District, which was listed in the National Register in 1982 (Henry 1981). The boundaries of the district were drawn to exclude the Bellows Falls Hydroelectric Development powerhouse, but a portion of the Canal between Bridge Street on the south and the Green Mountain Railroad Bridge on the north is included in the district.

Other resources, including the Dam and several ancillary buildings that may contribute to a potential Bellows Falls Hydroelectric Project Historic District, were identified during the survey that PAL conducted in 1999. Table 2 provides a list of the resources that were evaluated as eligible for inclusion in the potential district.

Table 2. List of contributing resources within the potential Bellows Falls Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Dam	North Walpole, NH and Bellows Falls, VT	1927	643" long, 30" high, linear, poured concrete, gravity-type structure divided into five ogee-profile spillway sections separated by massive concrete pylons
Canal	East of Canal Street, Bellows Falls, VT	1802/1927	540' long, and 100' wide, except where it widens slightly to form a forebay immediately above the Powerhouse. The walls and floor of the canal are lined with cut granite blocks.
Power House	12 Mill Street, Bellows Falls	1927	Renaissance Revival-style, 2-story, cruciform-plan, brick-walled, steel-framed building with a concrete foundation and flat, reinforced concrete slab roofs with raised parapets
Gauge House	Intersection of Church and River Sts, North Walpole, NH	c. 1927	Rectangular, 1-story, brick-walled building with an asphalt-shingled ridge-hip roof
Crew Shack	Intersection of Church and River Sts, North Walpole, NH	c. 1930s	1-story, 3-by-2-bay, wood-frame building with a concrete slab foundation, clapboard siding, and an asphalt-shingle gable roof
Six-man Garage	South of Bridge Street, Bellows Falls, VT	c. 1875	long, narrow, 1-story, rectangular brick building built on fieldstone and concrete foundations, attached to east wall of the Canal
Line Shed	Mill Street, Bellows Falls, VT	c. 1940	1-story, square-plan, wood-frame building with a concrete slab foundation, corrugated metal walls, and a shallow-pitch, corrugated metal gable roof

Resource Name	Location	Date	Description
Red Barn	West end of Pine Street at Connecticut River, North Walpole, NH	c. 1870	Greek Revival-style, rectangular, 2-story, brick-walled, building with a fieldstone and concrete foundation and a slate-sheathed gable roof with corbeled brick cornices and returns

Wilder Project

The Wilder Project has never been formally determined eligible for listing in the National Register. The Project was included in PAL's 1999 survey and was evaluated at that time as potentially eligible for listing. The contributing resources of the potential district are identified in Table 3.

Table 3. List of contributing resources within the potential Wilder Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Powerhouse	351 Wilder Dam Road, Hartford, VT	1950	Colonial Revival-style, rectangular, 183' long, 46' wide, 60' high, six-by-one-bay, two-story building with a high concrete foundation, brick-clad, steel-frame walls, and a slate-sheathed gable roof.
Dam	Wilder Dam Road, Hartford, VT; Rte 10, Lebanon, NH	1950	2,900' long earth and concrete dam, consisting of a 2,100' long earth fill structure and a 680' long, 59' high, linear, poured concrete gravity-type structure with an ogee-profile spillway.
Old Visitor's Center	Rte 10, Lebanon, NH, south end of Wilder Dam	ca. 1950	Rustic-style, 1-story, cruciform-plan building with a concrete foundation and an asphalt-shingled gable roof.
Garage	Wilder Dam Road, Hartford, VT	ca. 1950	40' by 120', wood-framed, one-story building with a concrete slab foundation, and corrugated metal gable roof and siding

Resource Name	Location	Date	Description
Oil Storage Shed	Wilder Dam Road, Hartford, VT	Ca. 1950	1-story, rectangular, two-by-one-bay, steel frame building with a concrete slab foundation, pressed metal clapboard siding, and a corrugated metal gable roof

NEED FOR ADDITIONAL INFORMATION

FERC has requested that a complete inventory of historic properties within the Wilder, Bellows Falls, and Vernon Projects be completed through Phase IB identification surveys and NRHP evaluations to be conducted during first and second season field investigations. The VT SHPO specifically requested that the Project APE for Wilder, Bellows Falls, and Vernon be enlarged to include all terrace margins and adjacent areas where active erosion is destabilizing the riverbanks within the Project corridors. Pending the definition of the Project APEs by FERC in consultation with the SHPOs and Native American tribes, particularly in relation to project operations and erosion, Phase IB archaeological surveys and Phase II evaluation studies through second season field investigations, if necessary, will be conducted. The need for Phase IB survey for the Vernon Project will be determined following the scheduled 2013 Archaeological Monitoring Program as described in the 2008 Vernon HPMP. The identification of TCPs will be conducted by Native American tribes who have identified themselves as having a traditional connection to the Project corridors.

PROJECT NEXUS

Activities related to the operation and maintenance of the Wilder, Bellows Falls, and Vernon Projects over the license term have the potential to affect cultural resources that are eligible for listing in the National Register. Phase IB archaeological site identification and Phase II archaeological site evaluation studies will identify National Register eligible archaeological sites that may be directly or indirectly affected by project operations and maintenance activities. Similarly, a National Register evaluation of the historic hydroelectric components of the Wilder Project will complete the identification of historic aboveground properties. The inventory of TCPs, including sacred landscapes will be compiled by Native American tribes, specifically the Narragansett Indian Tribe, who will partner with the Nolumbeka Project Inc. as their primary researcher. The information obtained from archaeological site and above ground historic property identification and evaluation studies as well as TCPs will be used to assess the potential effects of the relicensing of the three projects on cultural resources.

In the event that FERC, in consultation with the VT and NH SHPOs and Native American tribes, determines that the relicensing has the potential to cause adverse effects on historic properties, the information will form the basis of continued consultation to resolve the effects. The product of that consultation will likely be a Programmatic Agreement (PA) developed for each of the projects that stipulates actions that will be taken to avoid, minimize, or mitigate the adverse effect. One of the key provisions of the PAs will be the development of new HPMPs for the Wilder and Bellows Falls Projects and the revision of the existing Vernon HPMP.

STUDY AREA

The study area for cultural resources corresponds to the APEs established pursuant to 36 C.F.R § 800.4(a)(1). The term *Area of Potential Effects* means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 C.F.R § 800.16(d)).

The recommended APEs for all three projects are defined as all land owned in fee simple by TransCanada and the land privately owned by others within the project boundary, upon which flowage rights are retained, that are directly affected by the operation at full pond under normal flow conditions. For areas where potential erosion has been identified during Phase 1A archaeological field investigations (see below) the recommended APE extends 10 meters inland from the top of the river bank. For the Wilder Project the extent of project boundary is based upon full pond based upon elevation 385.0 feet msl at the dam; for the Bellows Falls Project, it is based upon full pond based upon elevation 291.61 feet msl at the dam; and for the Vernon Project it is based upon full pond elevation 220.13 feet msl at the dam.

The recommended Project APE map sheets (USGS 7.5 minute topographic quadrangles) for the Wilder, Bellows Falls, and Vernon Projects are included as Attachment E to the document "Responses to Commission Staff's Identification of PAD Deficiencies, Requests for Additional Information and Status of Study Reports" which is being filed simultaneously with FERC. Copies of those maps are attached here as Attachment 33-B.

The proposed APE for Vernon Project relicensing was described in the Vernon Phase IA archaeological report submitted to the VT SHPO and NH SHPO on April 10, 2008. The proposed Vernon APE was also described in the Vernon HPMP submitted to the VT SHPO and NH SHPO on October 21, 2008. The NH SHPO concurred with both the Phase IA report findings and recommendations and the HPMP for Vernon in letters dated May 22, 2008, and December 2, 2008. No responses were received from the VT SHPO. The APE defined through consultation with state SHPOs and Vernon Project's HPMP cover all aspects of current and future potential project effects on cultural and historic resources within the project boundary. TransCanada believes that the present APE, together with the HPMP, including the ongoing monitoring and management responsibilities, adequately addresses project effects.

The recommended APE for Wilder and Bellows Falls Project relicensing was described in the Phase IA archaeological reconnaissance survey methodologies submitted to the NH SHPO on September 29, 2011, as part of the NH SHPO's Request for Project Review. On October 11, 2011, the NH SHPO concurred with the project APE definition and the survey methodologies provided in the Phase IA methodology Request for Project Review Forms prepared prior to the Phase IA survey fieldwork. The VT SHPO was notified similarly of the proposed APE in the Phase IA archaeological reconnaissance survey methodologies on November 9, 2011. No response or comments were received.

Based upon the collective results from the yet-to-be-completed hydraulic modeling and operations modeling studies (Study 4 and 5), together with the erosion studies (Studies 1, 2, and 3), a revision in the APE is possible. The recommended APE recognizes the potential for project effects associated with bank erosion and includes such active areas by extending the area 10 meters inland from the top of the river bank.

The final determination of the APE Consultation among FERC, the VT and NH SHPOs, Narragansett THPO, and other parties invited to participate in the Section 106 process, will be conducted during the summer of 2013. Based on this consultation, the FERC will make a final determination of the APEs for the Vernon, Bellows Falls, and Wilder Projects.

METHODOLOGIES

Review of Bellows Falls and Wilder Project Phase IA Archaeological Reconnaissance Survey Reports

Phase 1A reports for the Wilder Project and Bellows Falls Project were submitted to the VT and NH SHPOs, and the Narragansett Indian Tribal Historic Preservation Officer (THPO) on May 29, 2013. Phase 1A reports for these projects together with the 2008 Phase 1A report for the Vernon Project were also submitted to FERC on July 1, 2013. The Phase IA report for the Vernon Project was provided to the Narragansett Indian THPO on June 19, 2013. The draft reports include copies of all SHPO consultation to date. The submittal of the final reports will follow the draft review.

Vernon Project 2013 Monitoring Program/Update of Phase 1A Archaeological Reconnaissance Survey Report

The archaeological monitoring program, as described in the Vernon HPMP (Olausen and Cherau, 2008:25-26), will be implemented by qualified archaeologist(s) assisted as needed by a geologist, soil scientist, forester, and/or engineer with physical, geotechnical, or hydraulic experience pertinent to riverine hydraulics, reservoir operation and erosion, depending on the condition of the sites and locales to be visited. The monitoring program will include a physical inspection of previously identified archaeologically sensitive shoreline areas and sites with the goal of updating the initial Phase IA archaeological survey report prepared by PAL in

2008 (Cherau and O'Donnchadha 2008). Native American Tribal representatives will accompany the archaeologists during this fieldwork, if so desired, in order to collect existing conditions data on TCPs, including sacred landscapes, during the visual inspections.

Should erosion or other threats to sensitive areas and/or sites be identified during the monitoring, a Phase IB identification survey of the affected areas will be conducted (see Methodology described below). For the known National Register eligible sites or other sites subsequently identified as eligible for listing in the National Register, any identified threats will be addressed through controls or other measures designed to preserve their integrity. Threats that cannot be checked or otherwise resolved may require mitigation through the implementation of a Phase III archaeological data recovery program. The findings of the monitoring effort will be presented in a stand-alone report that will be submitted to FERC, VT SHPO, NH SHPO, and Native American tribes.

Phase 1B and Phase II Archaeological Investigations

As determined in consultation with FERC, the SHPOs, and Native American tribes, Phase IB surveys will be conducted in the Wilder, Bellows Falls, and Vernon APEs to locate and identify known and undocumented archaeological resources in areas of active erosion or other identified project-related impacts. Phase II field evaluations will be conducted, as needed, to determine the NRHP eligibility of identified archaeological sites. Phase IB survey will be completed during the 2014 field season. Phase II site evaluations, if necessary, will also be conducted in the 2014 field season. Phase IB survey and Phase II methodologies will be reviewed and approved by the VT and NH SHPOs prior to the start of fieldwork. The survey methodologies will be designed and implemented in accordance with the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the National Historic Preservation Act of 1966, as amended, and related regulations (36 CFR 800); the VDHP/SHPO's *Guidelines for Conducting Archeology in Vermont* (final adoption June 2007); and the NHDHR/SHPO's Archaeological Standards and Guidelines.

Native American Tribal representatives will be notified of the Phase IB and II schedules and will, if so desired, accompany the archaeologists during the fieldwork in order to collect data on identified Native American sites and TCPs including sacred landscapes.

Phase IB Identification Surveys

Phase IB identification surveys will be conducted in archaeologically sensitive areas where active erosion was identified during the Phase IA surveys including the 2013 monitoring program for Vernon. These archaeologically sensitive areas will include the borders of active shoreline erosion up to 10 meters (33 feet) back from the top of the embankments. Bordering areas on private property that were not included in the Phase IA surveys will initially be subjected to a complete walkover with close ground surface inspection to assess existing conditions and the presence of visible cultural materials. The results of the walkover survey will inform the locations of Phase IB subsurface testing designed to locate and identify archaeological deposits including small sites that may be present. The Phase IB identification surveys including additional walkover and subsurface testing will be conducted in consultation with the VT SHPO and/or NH SHPO. For the purposes of this proposal, Phase IB survey will be conducted in archaeological site and sensitive areas where direct project impacts are occurring, and as identified during the Phase IA surveys and depicted on the Appendix B maps included in the Phase IA survey reports.

The Phase IB subsurface testing will be conducted in the form of shovel test pits. All Phase IB survey test pits will measure 50-x-50-centimeters (cm) in size and will be placed at 10-meter (m) intervals along transects, and at 2.5 and 5-m intervals in test pit arrays where potentially significant cultural materials are identified during the initial testing. The exact placement (e.g., 10 m from the edge of the riverbank to cover erosional undercutting of the soils) and amount of test pits in each archaeological site and/or sensitive area will be determined following the consultation and agreement on the Wilder, Bellows Falls, and Vernon Project APE definition and Phase IB identification survey methodology.

If access to private property is needed for the additional walkovers and subsurface testing, landowner permissions will be obtained by TransCanada prior to the start of fieldwork. No fieldwork will be conducted on private lands where landowner permission has not been obtained by TransCanada. The correspondence relating to landowner permissions will be included in the Project survey files.

All test pits will be excavated by shovel in arbitrary 10-cm levels to sterile glacial subsoils. All excavated soil will be screened through ¼-inch hardware cloth and remaining cultural material will be collected. Soil horizons/profiles will be recorded using Munsell soil descriptions for each unit. Cultural material and samples will be bagged and labeled with provenience information. Digital photographs will be taken of the Project APE areas subjected to subsurface testing. Test pit soil profiles will be photographed if they contain potentially significant cultural features, soil anomalies, and/or structural remains. All test units and cultural deposits will be located using GPS technology and plotted on USGS 7.5 minute topographic maps and project plans.

All cultural materials, including those that may be identified by Native American tribal representatives, collected during the Phase IB surveys will be returned to the PAL facility in Pawtucket, Rhode Island for laboratory processing and analyses. These activities will include: cleaning, identification, and cataloging of any recovered cultural materials; analysis of spatial distributions of cultural materials; and map and graphics production.

Phase II Site Evaluations

Should potentially significant archaeological deposits be identified during Phase IB subsurface testing, then additional testing in the form of Phase II evaluations will be conducted during the 2014 field season, if needed. The Phase II evaluations will consist of the excavation of shovel test pits (50-x-50-cm) and larger units (primarily 1-x-1 meter) for each identified site area. The shovel test pits will be used to determine the archaeological site boundaries along with natural landforms, historic and/or modern structures/features, and artificial (disturbed) elements. The larger units will be hand excavated to examine cultural material concentrations and/or features (e.g., fire pits, hearths, privies) and inform on the age and internal configuration/complexity of the site. This information will be used to assist in a determination of the site(s)' significance and their eligibility to meet the criteria for listing in the NRHP.

The exact placement and amount of Phase II testing at each identified site area will be based on the results of the Phase IB survey. The Phase II excavation and recordation procedures will follow those established above for the Phase IB survey subsurface testing.

Archival research including land evidence records and local town histories will be conducted as needed for any potentially significant post-contact period sites. The research will be used to refine archaeological site boundaries in relation to historic property divisions and assist in applying the NRHP criteria of eligibility to these resource types.

If NRHP eligibility determinations for identified archaeological sites cannot be made during the first and second field seasons, the need for follow-up site evaluations to determine NRHP eligibility will be included in each Project's HPMP.

TCP Identification Survey

The identification of TCPs including sacred landscapes will be conducted by Native American tribes who have identified themselves as having a traditional connection to the Project corridors. To date, the Narragansett Indian Tribe has indicated a traditional connection to the Vernon, Bellows Falls, and Wilder Projects in the Connecticut River Valley. The Narragansett Indian Tribe will partner with the Nolumbeka Project Inc. as their primary researcher for the Projects. The identification of TCPs will involve a review of previously conducted historic and archaeological studies in the Project corridors including the Phase IA archaeological surveys and visual inspections of the three Projects. The visual inspection of the Vernon Project will be conducted concurrently, if so desired, with the 2013 archaeological monitoring program. Visual inspections of the Bellows Falls and Wilder Projects are anticipated be conducted by the Tribe in 2013. The identification of TCPs will continue during subsequent 2013 and 2014 Phase IB identification and Phase II evaluation surveys conducted in all three Projects.

The research, visual field inspections, and Phase IB survey and Phase II evaluation field monitoring will result in the generation of a TCP inventory and electronic database by the Narragansett Indian Tribe. The database will be used and augmented by the Tribe as part of its commitment to Section 106 consultations during the life of the Project license agreements.

Survey and Evaluation of Historic Architectural Resources

The objectives of the survey of historic architectural resources will be to provide an assessment of the existing condition of all resources that were previously identified in the 1999 survey conducted by PAL, identify any other potentially significant resources within the APEs, and evaluate the significance of resources that have not yet been formally determined eligible for listing in the National Register. The work will be conducted in the following manner.

The historic architectural survey and evaluation will be carried out by a team consisting of an architectural historian and industrial historian who meet the Secretary of the Interior's Professional Qualification Standards (36 CFR part 61 Appendix A). The initial phase of the survey will consist of a review of available sources and documentation regarding the history of the hydroelectric projects. The review will include visits to the offices of the Vermont Division for Historic Preservation and New Hampshire Division of Historical Resources to review inventory records and other relevant files they may contain.

The field survey will consist of walkover of the lands within the Project APEs. The team will visit each of the previously identified resources and document any other resource that appears to be 50 years of age or older. Information about the current appearance, including the setting, physical condition, and character-defining architectural features of the resources will be recorded. High-resolution digital photographs will be taken of each resource. Additional photography will include general context views that show the resources in relation to one another and their surroundings. A photo log will be kept and the locations of the views will be recorded on a base map.

Upon the completion of the field investigations, PAL will analyze all collected data and prepare historical contexts that identify the significant themes, events, and/or people that had an impact on the historical development of the potential districts. The historic contexts and field notes regarding integrity will serve as the basis for the National Register evaluation of the district and individual resources that contribute or do not contribute to its significance. PAL will determine the areas, period(s), and level(s) of significance for the district and apply the National Register criteria for evaluation. The integrity of the resources will be evaluated to determine if the properties retain a sufficient amount of their historic appearance to be considered for listing in the National Register.

The product of the survey will be a report that provides information about previous National Register evaluations and recommendations regarding the potential National Register eligibility of resources that have not been formally evaluated. The reports will contain a narrative description of the resources identified during the survey, including information about the general setting and current physical condition. The narrative will provide a statement of integrity that addresses changes that have occurred over time.

The description will be followed by historic context statement that will provide information about the general historical development of hydroelectric facilities on the Connecticut River during the early twentieth century and other themes, if any, that may apply to resources identified in the field.

The recommendations section of the report will include the results of the National Register evaluation for the potential Wilder and Bellows Falls Hydroelectric Project Historic Districts and any updates of the Vernon Hydroelectric Project Historic District, which has previously been determined eligible for listing in the National Register. Recommendations will include a narrative statement of significance that will define the applicable National Register criteria, criteria considerations (if any apply), areas of significance, and periods of significance for the districts. The narrative will include a summary statement of significance that will establish the level(s), period(s), and areas of significance. Each area of significance will be supported by a statement that identifies the historical development of the district and defines the themes, trends, events, and people that are important in American history and lend the district its significance.

Other components of the report will consist of a bibliography of sources consulted and graphical information, including a map of the district and photographs of the contributing and non-contributing resources. The map will be prepared in ArcGIS format and will include the scale, north arrow, and legend. All contributing and non-contributing resources and prominent landscape features will be clearly labeled to correspond with information provided in the district data sheet. The map will also show the district boundaries and location of views corresponding to the photographs included with the documentation.

Development of Historic Property Management Plans

HPMPs will be developed for the Bellows Falls and Wilder Projects and the existing HPMP for the Vernon Project will be updated prior to the issuance of the new FERC license. The HPMPs will govern future actions as they relate to historic properties, including standing structures and archaeological sites, within the boundaries of the projects. The HPMPs will identify the nature and significance of historic properties within the project boundaries that may be affected by project-related maintenance and operation, proposed improvements to project facilities, and public access. The HPMPs will identify goals for the preservation of historic properties; establish guidelines for routine maintenance and operation; and establish consultation procedures. They will identify the responsible TransCanada officer in charge of executing the plan and establishing procedures for training plant operators, maintenance staff, and other employees in its implementation. The HPMPs will be integrated with existing management plans, as appropriate.

The HPMP for each project will be developed according to the following principles and procedures:

- **Consultation.** The HPMPs will be prepared through a process that will involve consultation with, and input from FERC, VT SHPO, NH SHPO, Native

American tribes, historic preservation experts, and other interested parties that may be identified.

- **Identification of Historic Properties.** The HPMPs will identify known historic properties within the projects and include mechanisms for the completion of identification and evaluation tasks for previously unidentified historic properties within the projects, as necessary.

- **Routine Project Operations.** The HPMPs will include a description of how historic properties, including known and predicted archaeological resources, are or could be affected by routine project operations. This discussion will include the suspected or known cause of an effect on each site or feature. The HPMPs will identify and prioritize preservation issues associated with routine project operations.

- **Protection of Historic Properties.** The HPMPs will address the continuation of routine project operations in relation to the protection of the integrity of historic properties. These operations include, but are not limited to: continued use and maintenance that affects historic properties, shoreline erosion caused by routine operations, recreational developments, other project-related ground-disturbing activities, and vandalism.

- **Mitigation of Adverse Effects.** The HPMPs will include a process for determining and mitigating unavoidable adverse effects on historic properties.

- **Discovery of Human Remains.** The HPMPs will include mechanisms for the treatment and disposition of any human remains that may be discovered, taking into account applicable Vermont and New Hampshire state laws and the Advisory Council on Historic Preservation's *Policy Statement Regarding Treatment of Human Remains and Grave Goods*.

- **Discovery of Previously Unidentified Properties During Project Operations.** The HPMPs will include a plan to deal with previously unidentified properties discovered during project operations.

  Public Interpretation. The HPMPs will specify the implement a program to provide interpretation of the historic and archaeological values of the projects to the general public.

ANALYSIS

The results of proposed Phase IB and Phase II archaeological surveys, TCP identification survey, and National Register evaluation report for historic architectural resources will be used to determine the potential for adverse effects to historic properties created by the continued operation of the Wilder, Bellows Falls, and Vernon Projects. The information on potential effects will be used as the basis for preparing the HPMPs for each of the Projects, which will guide the Licensee's actions relating to Section 106 during the term of the new licenses.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The archaeological monitoring/Phase 1A survey update at Vernon as well as any subsequent Phase IB survey and Phase II investigations that may be necessary will be conducted according to the applicable federal and state regulations and guidelines. The archaeological surveys in Vermont will be conducted in accordance with VDHP/SHPO *Guidelines for Conducting Archeology in Vermont*, dated June 2007 (final adoption). In New Hampshire, the archaeological surveys will be conducted in accordance with the NHDHR *Archaeological Standards and Guidelines*. In addition, all surveys will meet the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the NHPA.

DELIVERABLES

2013 cultural resource reporting deliverables for the Wilder, Bellows Falls, and Vernon Projects are as follows.

- Final Phase IA archaeological reconnaissance survey reports for the Wilder and Bellows Falls Projects;

- Draft and Final Vernon 2013 archaeological monitoring program/Phase 1A survey update report, including information on identified TCPs by Native American Tribes.

- TCP Identification Survey, Progress Report for the Wilder and Bellows Falls Projects, based on preliminary research and visual inspections, to be provided by the Narragansett Indian Tribe.

- Historic Architectural Resources National Register Evaluation Report.

2014 cultural resource reporting deliverables for the Wilder, Bellows Falls, and Vernon Projects will follow the completion of first and second season Phase IB survey and Phase II evaluation fieldwork, research, and laboratory analyses.

- Phase IB Archaeological Identification Survey and Phase II Evaluation reports for the Wilder, Bellows Falls, and Vernon Projects. Draft report(s) will be prepared for comment by the SHPOs and Native American tribes. Each technical report will contain a description of the Project APE, cultural contexts, results of the fieldwork, and conclusions and recommendations for the treatment of identified NRHP eligible sites. The reports will each contain maps showing the Project APE, testing locations, and all identified archaeological sites. The final reports will follow the draft review.

TCP Identification Survey, Final Reports for the Wilder, Bellows Falls, and Vernon Projects, based on the results of research and fieldwork, to be provided by the Narragansett Indian Tribe.SCHEDULE

The final Phase IA archaeological reconnaissance reports for Wilder and Bellows Falls will be submitted following the draft review by FERC, the VT and NH SHPOs and the Narragansett Indian Tribe.

The Vernon archaeological monitoring program is scheduled to be conducted in the summer of 2013. A draft report of the 2013 monitoring program findings will be prepared and filed with FERC, the VT and NH SHPOs, and Narragansett Indian Tribe within 30 days following the fieldwork, anticipated to be no later than September 30, 2013. The final report will follow the draft review and be submitted by December 31, 2013.

The Historic Architectural Resources National Register Evaluation Report will be prepared and filed with FERC and the VT and NH SHPOs by September 30, 2014.

Phase IB survey fieldwork will begin during the 2014 field season. The Phase II site evaluation fieldwork will begin continues and/or be completed in the 2014 field season. The draft reports for the first and second field season investigations will follow the completion of fieldwork and laboratory analysis, with an anticipated submittal date of August 2014. Due to the sensitive nature of the information that will be provided in the archaeological reports, they will be issued as "stand alone" documents and will only be distributed to the SHPOs, involved tribes, and FERC.

The schedule for the completion of the TCP inventory and reporting will follow the schedule established above for the archaeological survey and reports. The information on TCPs generated by the Native American tribes may be incorporated into the archaeological report narratives for both the 2013 and 2014 field season deliverables.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for the study broken down by major tasks is as follows:

- Submittal of Final Wilder and Bellows Falls Phase 1A reports and SHPO and stakeholder consultation: $1,500
- Vernon 2013 Monitoring/Phase 1A Survey Update: $30,000
- TCP Identification Survey Reports for Wilder, Bellows Falls, and Vernon Projects: unknown pending input from the Narragansett Indian Tribe.
- Historic Architectural Resources National Register Evaluation Report: $15,000

- Phase 1B and II investigations 2014 field seasons: unknown pending Vernon 2013 monitoring/updated Phase IA survey effort.

- Development of new HPMPs for Wilder and Bellows Falls and revised HPMP for Vernon: $50,000 to $55,000

REFERENCES

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Hubbard, M., S.G. Cherau, J. Daly, and O. Elquist, PAL. 2013. Phase IA Archaeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892), Windsor and Orange Counties, VT, and Grafton County, NH. 351 pp.

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Mulholland, Mitchell, Hugh Henry, and Giovanna Peebles . 1988. Bellows Falls Island Multiple Resource Area, Rockingham, Vermont. National Register of Historic Places Multiple Property Submission. National Register Information System Reference No. 64000888.

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ATTACHMENT 33-A

Phase IA Archaeological Reconnaissance Surveys

TransCanada has completed Phase IA archaeological reconnaissance surveys of the recommended APEs at the Wilder, Bellows Falls, and Vernon Projects. The Phase IA surveys were undertaken by TransCanada as the first step in the identification and treatment of significant archaeological resources to assist FERC in fulfilling its obligations under Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended. The Phase IA surveys were completed by professional archaeologists who meet the qualifications set by the National Park Service (36 CFR Part 66, Appendix C) and have at least two years of supervisory experience and two years of field experience in New England.

The Phase IA survey of the Vernon Project APE was conducted in the fall of 2007. The survey methodology and results are presented in the technical report titled *Phase IA Archaeological Reconnaissance Survey, Vernon Hydroelectric Project (FERC No. 1904), Windham County, Vermont and Cheshire County, New Hampshire* (PAL report, Cherau and O'Donnchadha, March 2008). The Wilder and Bellows Falls surveys were conducted in the fall of 2011. The survey methodologies and results are presented in the technical reports titled *Phase IA Archaeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892), Windsor and Orange Counties, Vermont and Grafton County, New Hampshire* (PAL report, Hubbard et al. May 2013) and *Phase IA Archaeological Reconnaissance Survey, Bellows Falls Hydroelectric Project (FERC No. 1855), Windham and Windsor Counties, Vermont and Cheshire and Sullivan Counties, New Hampshire* (PAL report, Hubbard et al., May 2013).

The technical reports comply with the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the National Historic Preservation Act of 1966, as amended, and related regulations (36 CFR 800); the VDHP/SHPO's *Guidelines for Conducting Archeology in Vermont* (final adoption June 2007); and the NHDHR/SHPO's Archaeological Standards and Guidelines.

Goals and Objectives

The Phase IA archaeological reconnaissance surveys were designed to inventory previously recorded archaeological sites and identify additional areas of archaeological sensitivity where documented and unrecorded sites are likely to exist within the recommended APEs for the Wilder, Bellows Falls, and Vernon Projects. This phase of survey did not include any Phase IB or Phase II subsurface investigations to locate, identify, and evaluate previously documented and undocumented sites for their eligibility for listing in the NRHP, or an assessment of existing or future project effects on any such identified historic properties within the Project APE.

Methodology

To accomplish this objective, two research strategies were used: 1) archival research, including a review of literature and maps; and 2) field investigations, consisting of a riverine and shoreline visual survey carried out from a boat, and a terrestrial walkover/surface inspection of upland (shoreline and non-shoreline) fee-owned parcels within the Projects. The field survey for private lands where TransCanada only has flowage rights included the impoundment or river channel and adjacent lands affected by the normal operating range of the Project's reservoir. The flowage rights areas were examined primarily from the boat. The field crew did not access any privately owned lands during the Phase IA survey fieldwork.

The archival research and field investigations provided the information needed to develop environmental and historic contexts for the project study area and develop a predictive model for archaeological sensitivity. Archaeological sensitivity is defined as the likelihood for belowground cultural resources to be present and is based on various categories of information: locational, functional, and temporal characteristics of previously identified historic properties in the project area or vicinity; and local and regional environmental data reviewed in conjunction with existing project-area conditions documented during the field investigations and archival research about the Project's land-use history.

Archival Research

Specific sources reviewed as part of the archival research for the Phase IA reconnaissance survey of the Wilder, Bellows Falls, and Vernon Projects include:

1) State Site Files, Artifact Collection Reports, and Town Reconnaissance Surveys

The state site files at the Vermont Division for Historic Preservation (VDHP) and the New Hampshire Division of Historical Resources (NHDHR) were reviewed to locate any known Native American and EuroAmerican sites in or close to the project lands. The VDHP and NHDHR inventories include cultural resources listed or eligible for listing in the National Register of Historic Places. Both sets of files also include an inventory of known archaeological site locations, catalogs of cultural material, and brief site summaries. The VDHP has also assembled a comprehensive survey of Vermont towns and compiled brief outlines of their historical development. Cultural contexts and artifact collection studies were reviewed in the *Journal of the Vermont Archaeological Society* and the *New Hampshire Archeologist* for data relevant to the Connecticut River Valley.

2) Cultural Resource Management Reports

Cultural resource management (CRM) survey reports previously conducted within the general Project vicinities were reviewed for relevant information concerning known archaeological sites, sensitivity models and assessments, and environmental and cultural contexts. These reports include studies conducted by PAL and other cultural resource management firms in the Vermont and New Hampshire project towns. The specific CRM reports consulted for each Project area are fully described in the corresponding technical Phase IA survey reports.

3) Histories, Maps, and Photographs

Primary and secondary histories and historical maps and atlases of the Project towns in the Connecticut River Valley were examined to assess changes in land use, to locate any documented structures, and to trace the development of transportation networks, an important variable in the location of post-contact period archaeological sites. The specific historical town, county, and state maps reviewed for the Vermont and New Hampshire portions of the Projects are fully described in the corresponding technical Phase IA survey reports. Historic photographs of project-specific locales including the village of Wilder and the village of Bellows Falls, Vermont including Project fee-owned lands and Connecticut River shoreline before, during, and after the construction of the Wilder and Bellows Falls Hydroelectric Development powerhouses and dams were also reviewed as part of the Phase IA survey research. The University of Vermont's Landscape Change Project website, which contains 1000+ digital images of Vermont places. The website includes a quick search function that allows users to key in place names to locate historic images.

4) Environmental Studies

Bedrock and surficial geological studies provide information about the region's physical structure and about geological resources within and near the Projects. The United States Department of Agriculture (USDA) Soil Conservation Service soil surveys of the Vermont and New Hampshire portions of the Projects supplied information about soil types and surficial deposits and the general categories of flora and fauna that these soil types support. Information relating to Project operations and previous erosion studies and corresponding GIS databases for each Project preparation by TransCanada were also reviewed during the Phase IA surveys.

Field Investigations

Following the initial analysis of known sites and sensitivity provided by the archival research, field investigations were conducted to familiarize the archaeologists with the Project APE, ground-truth preliminary hypotheses concerning topography and resource potential, and collect information about project effects (including shoreline erosion). The fieldwork for all three Projects was conducted in the fall months, and as such was able to focus on the impoundment shorelines as they exist at the normal operating levels upstream of the Wilder, Bellows Falls, and Vernon dams.

The fieldwork was conducted using a combination of boat and pedestrian/vehicle survey. Portions of the Project APE away from the shoreline on fee-owned lands where known sites are reported or documented and/or potentially sensitive landforms exist were examined on foot. The field crew also surveyed along a linear transect parallel to the top of the riverbanks. This ensured visual coverage of lands within the operating range for the lands along the impoundment upon which flowage rights are held by TransCanada. Close visual inspection of the shoreline from water's edge to top of the embankments was performed particularly to identify any surface indications of Native American resources such as artifact scatters and exposed hearth/pit features eroding from the banks.

Some confounding environmental factors in the survey of the Wilder and Bellows Falls Project shorelines were the presence of vegetation and a thick layer of gray silt deposited in late August 2011 during flooding from Tropical Storm Irene. The presence of vegetation on the river banks was generally a good indication of river bank stability given the magnitude of the recent flooding events. Siltation and in some case the formation of new sand bars is somewhat more ambiguous. On the one hand it represents a net deposition of sediment in some places, which may actually provide extra protection to archaeological sites. This is especially true where it was deposited by overbank flooding and generally lacked the energy to break up the existing organic root mat. In other cases, where the silt was deposited directly on active erosional surfaces, it hampered the archaeologists' ability to observe cultural materials and features. Other observations concerning the present physical condition of the Project shorelines included the presence of artificial disturbances (e.g. recent construction, docks, landings, causeways, and bridge abutments and structures).

All of the Vernon Project shoreline was assessed from the boat. The majority of the Wilder and Bellows Falls Project shorelines were assessed from the boat, but there were instances where closer inspection required debarking. Circumstances that warranted leaving the boat included any place there was a known site or cultural materials/features were observed from the boat using binoculars, areas determined to have a heightened archaeological sensitivity based on established criteria, and areas where significant erosional surfaces could not be adequately observed from the boat. Since most of the shoreline is privately owned, feature recording was limited to light trowel scraping of visible soil anomalies or features needed to verify the presence of cultural materials. This technique served to limit the amount of disturbance that would contribute to the natural erosion of the river bank. Digital photographs and GPS coordinates were taken in lieu of detailed profiles and measurements, and no cultural materials were collected from private property. Digital photographs and GPS points were also taken of existing conditions at all known or newly discovered sites and of all features and artifacts observed in the field.

The reconnaissance survey of visible historic site locations was limited to the same close ground-surface and shoreline inspections. The documented locations of post-contact period sites, particularly those noted on nineteenth-century town maps, were specifically targeted for visual inspection.

All previously recorded and newly identified archaeological site locations within the Project shoreline and fee-owned parcels were surveyed with the aid of a Trimble

GeoXM submeter model, in combination with VDHP and NHDHR site file information and current study area maps.

Archaeological Sensitivity Assessment

Information collected during the archival research and the riverine and terrestrial field surveys was used to develop a predictive model of potential site types and their cultural and temporal affiliation. The development of predictive models for locating archaeological resources has become an increasingly important aspect of CRM planning.

The predictive model considers various criteria to rank the potential for the Project to contain archaeological sites. The criteria are proximity of recorded and documented sites, local land use history, environmental data, and existing conditions. The Project shoreline and fee-owned lands were stratified into zones of expected archaeological sensitivity to guide future land management and planning activities. A full discussion of the pre-contact, contact, and post-contact period sensitivity models used in New England is included in the corresponding technical Phase IA survey reports.

The VDHP has formulated an environmental predictive model (VTEPM) for locating pre-contact/contact Native American habitation sites within the state. Based in large part on Thomas's predictive site location model, individual environmental variables are first grouped by class (rivers and streams, wetlands, etc.) and then assigned a positive or negative numerical ranking. Using this score sheet, an area can be sensitized by determining the presence/absence of the specific variables, combining the associated scores, and comparing the total score to a predetermined valuation scale; a score of less than 32 is assessed as archaeologically non-sensitive while a score of greater than 32 is considered archaeologically sensitive. While this method is necessarily broad in scope and must be refined through careful field inspection, it does provide a preliminary indication of the archaeological sensitivity of an area. The full discussion of the application of the VTEPM to the Project shorelines and fee-owned parcels in Vermont is included in the corresponding technical Phase IA survey reports. For the New Hampshire portion of the Project, there are no state-level sensitivity maps or numerical ranking criteria. Therefore, the Phase IA surveys employed similar environmental/cultural factors included in regional predictive models to determine the archaeological sensitivity of the Project shorelines and fee-owned parcels in New Hampshire.

ATTACHMENT 33-B

Recommended APE Maps

Updated Study 33

Cultural and Historic Resources Study

RELEVANT STUDY REQUESTS

FERC-12; VT SHPO-01, -02, -03; Nolumb-01; additional information requests from FERC, and comments from the New Hampshire Division of Historical Resources (NH SHPO)

In their comments following the review of the Project PADs, FERC, the Vermont State Historic Preservation Office (VT SHPO), New Hampshire State Historic Preservation Office (NH SHPO), and The Nolumbeka Project, Inc. requested additional information about cultural resource studies that have been or will be conducted at the Vernon, Bellows Falls, and Wilder Projects as part of the overall FERC relicensing process. A meeting was held on June 7, 2013 with those and other interested parties to discuss the initial draft of the cultural resources study plan, and yielded clarification and additional information about those requests. The following were identified as the primary issues that the study plan for cultural resources must address:

- completion of consultation to determine the Area of Potential Effect (APE) for the Projects
- information about cultural resources investigations that have been carried out to date, including Phase 1A archaeological surveys and historic architectural resource determinations of National Register of Historic Places (National Register) eligibility
- methodology and schedule for carrying out investigations to complete the identification and evaluation of archaeological sites, historic architectural resources, and traditional cultural properties (TCPs) within the APEs

STUDY GOALS AND OBJECTIVES

The overall goal of this cultural resource study is to assist FERC in complying with Section 106 of the National Historic Preservation Act (NHPA), as amended, and its implementing regulation 36 C.F.R. Part 800. The objectives are to define the APE for the Projects; identify and evaluate historic properties, which are defined as buildings, sites, structures, objects, and TCPs that are listed or eligible for listing in the National Register (36 C.F.R § 800.16(l)(1)), within the APE; assess the potential effects of the relicensing of the Projects on historic properties pursuant to 36 C.F.R. § 800.5; and resolve any potential adverse effects through the development of Programmatic Agreements (PA) in accordance with 36 C.F.R. § 800.6. The work will be conducted within the framework of the Section 106 process and will be carried out in close coordination with the consulting parties.

~~In their study requests, FERC, the VT SHPO, NH SHPO, and The Nolumbeka Project, Inc. identified existingof (TCPs) additional information needs and study requests related to the Wilder, Bellows Falls, and Vernon Project operations in relation to historic and archaeological resources located within the Area of Potential Effects (APE) defined for each project. This study addresses those information needs. The goal of this study is to determine the potential effects of the projects on archaeological and historic resources that are listed in, or eligible for, inclusion in the National Register of Historic Places (National Register).~~

~~The objectives of this study are to:~~

- ~~define the APE for archaeological resources in both written and graphic form for the three projects; and~~
- ~~present the proposed treatment of cultural resources including archaeological sites beyond the previously completed Phase IA archaeological reconnaissance surveys.~~

~~More specific objectives and requirements were specified as requests for additional information from FERC, and comments and study requests from the VT and NH SHPOs and The Nolumbeka Project, Inc., in Greenfield, MA. They are indicated below:~~

~~FERC~~

~~FERC requested additional information but specified that the response be included in the form of a study plan.~~

~~Phase IA archaeological reconnaissance surveys have been conducted to identify known sites and to identify areas of archaeological sensitivity where documented and previously unrecorded sites are likely to exist within the Wilder, Bellows Falls, and Vernon Project APEs. FERC requests additional information regarding the definition of the project APEs used in the Phase IA archaeological surveys as well as information regarding further proposed identification and evaluation surveys for archaeological sites within the project APEs. Specifically, FERC requests including the following elements in the study plan for cultural resources:~~

- ~~Provide documentation that the APE defined for each project 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. Include a record of consultation with the Vermont and New Hampshire SHPOs, including SHPO concurrence with the APE, and other interested parties, including Native American tribes or organizations that may attach religious and cultural significance to the project lands regarding the APE or a proposal to complete such consultation~~

~~as a component of the study. Include the APE definition and a detailed map showing all aspects of the APE, including designations of land ownership.~~

- ~~Include the techniques for carrying out the Phase IB investigation, in addition to any other methods (if needed) by which other cultural resources that may be directly or indirectly affected by the projects will be inventoried. 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.~~

- ~~Develop and include a process for evaluating the National Register eligibility of all cultural resources identified during the field inventory stage, and afterwards, through additional second season field investigations (if necessary), including a strategy for examining, testing, or excavating cultural resources. This process should take into account applicable guidelines and standards promulgated by the Vermont and New Hampshire SHPOs. Include follow-up site evaluations to determine National Register eligibility in the Historic Properties Management Plan (HPMP) if determinations cannot be made in the first or second field season.~~

- ~~Elaborate on the methods that will be used 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.~~

- ~~Include in any study report:~~

    - ~~a background section on previous work in and around the APE;~~

    - ~~a culture history of the research area;~~

    - ~~definition and map of the APE;~~

    - ~~methods used for the archival research and field pedestrian survey and how the APE was systematically inventoried;~~

    - ~~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 ownership, associated artifacts, existing and potential effects, and National Register eligibility status);~~

    - ~~results of National Register evaluations for all cultural resources located within the APE; and~~

    - ~~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. Consult with involved parties and~~

~~submit National Register evaluations to the Vermont and New Hampshire SHPOs for concurrence.~~

- ~~Put a statement that an HPMP will be prepared in consultation with the involved parties and a draft HPMP will be filed along with the preliminary licensing proposal, and a final HPMP with the final license application. 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. The HPMP will be prepared in accordance with 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. The final HPMP will be attached to the Programmatic Agreement(s) to be prepared for the project by FERC.~~

- ~~Provide a schedule for carrying out all of the various tasks involving the cultural resources study, including the filing of draft and final reports and HPMPs.~~

- ~~Provide estimated costs associated with the various tasks in the study, along with the costs of report production and crafting the HPMP.~~

~~VT SHPO~~

~~The VT SHPO has the following comments and study requests for cultural resources.~~

- ~~Provide the Phase IA archaeological reconnaissance survey reports prepared for the Wilder and Bellows Falls projects for their review and comment as soon as possible.~~

- ~~Provide clarification on the delineation of the project APE, specifically in regard to the projects' operation on the destabilization of the riverbank, which is sufficient to bring all terrace margins and adjacent areas within the APE.~~

- ~~Conduct Phase IB site identification within all archaeologically sensitive areas and potential site locations that are activity eroding in the Wilder and Bellows Falls Projects.~~

- ~~Conduct Phase II site evaluations of all currently recorded archaeological sites in the Wilder and Bellows Falls Project APEs to determine their boundaries and eligibility for inclusion in the National Register.~~

- ~~Conduct Phase II site evaluation of any other archaeological site identified in the Wilder and Bellows Falls Project APEs as a result of the Phase IB survey to determine their boundaries and eligibility for inclusion in the National Register.~~

- ~~Provide a National Register Evaluation Report for the Wilder Project Hydroelectric Components.~~

- ~~Submit 2013 archaeological monitoring study report for Vernon Project, in accordance with the 2008 Vernon HPMP.~~

- ~~Conduct Phase IB site identification within all archaeologically sensitive areas and potential site locations that are actively eroding in the Vernon Project APE based on the 2013 Monitoring Report.~~

- ~~Conduct Phase II site evaluation of all known archaeological sites in the Vernon Project APE to determine their boundaries and eligibility for inclusion in the National Register.~~

~~NH SHPO~~

~~The NH SHPO has the following comments and study requests related to cultural resources:~~

- ~~Provide paper copies of the Phase IA archaeological reconnaissance survey reports prepared for the Wilder and Bellows Falls Projects for their review and comment as soon as possible.~~

- ~~Provide documentation that the identification and evaluation of above-ground historical resources has been and will be performed by qualified architectural historian(s) including the completion of survey and National Register eligibility submissions.~~

~~The Nolumbeka Project, Inc.~~

~~The Nolumbeka Project, Inc. has the following study request specific to cultural resources:~~

- ~~Perform additional comprehensive investigations, document searches, and other research and field studies and inventory and formal archaeological digs to address the project areas north up to and around the Wilder and Vernon Falls (dam) on the New Hampshire, Vermont, and Massachusetts side of the river. Organize the resultant data from these studies in a central location and make it digitally available.~~

RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS

The relevant resource management goal related to this study is to ensure the protection of cultural resources in compliance with Section 106 of the NHPA. The study will also comply with other relevant federal laws, including the National Environmental Policy Act (NEPA), the Archaeological Resources Protection Act (ARPA) of 1974 (16 USC 469), the American Indian Religious Freedom Act (AIRFA) of 1978 (42 USC 1996 and 1996a), the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (25 USC 3001), Executive Order 11593 (Protection and Enhancement of the Cultural Environment) of 1971 (16 USC 470), the American Antiquities Act of 1906, and Executive Order 13007 (Indian Sacred Sites) of 1996 (73 Federal Register 65, pp. 18293-24).

ASSOCIATION WITH OTHER STUDIES

For all three projects, the effects of project operations on historical resources that might lead to revisions to the presently defined APE, as well as an understanding of the contribution of non-project effects on the same, will rely upon the results of hydraulic modeling and operations modeling studies (Study 4 and 5), and the three erosion studies (Study, 1, 2, and 3). These studies will help to understand the spatial extent of project effects on riparian resources including historic resources typically associated with active erosion that ultimately defines the APE.

EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION

Existing Information

Archaeological Phase 1A Studies

Phase IA archaeological reconnaissance surveys have been conducted within the recommended APEs (see "Study Area and Study Sites" below) for Wilder, Bellows Falls, and Vernon Projects to identify known archaeological sites and additional areas of archaeological sensitivity where documented and previously unrecorded sites are likely to exist. The methodology employed in conducting those investigations is included in Attachment 33-A. ~~(see attachment-Phase IA survey methodology and results summary). The APEs for all three projects are currently defined as all land owned in fee simple by TransCanada and the land privately owned by others within the project boundary, upon which flowage rights are retained, that are directly affected by the operation at full pond under normal flow conditions. For the Wilder Project, the extent of project boundary is based upon full pond elevation of 385.0 feet above mean sea level (msl) at the dam; for the Bellows Falls Project, it is based upon full pond elevation of 291.61 feet msl at the dam; and for the Vernon Project, it is based upon full pond elevation of 220.13 feet msl at the dam. The Phase IA surveys were conducted for all lands within the APE as described above.~~

The Phase IA survey for the Wilder Project identified a total of 48 archaeological sites within the project boundary: 28 sites on flowage lands including river shoreline and 3 sites within fee-owned lands in Vermont; and 16 sites on flowage lands including river shoreline and 1 site within fee-owned lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Wilder PAD (pages 3-146 through 3-153). The Phase IA survey also documented 56 locations that could contain additional archaeological sites (27 in Vermont, 29 in New Hampshire) based on archival research (i.e., historical maps), five of which were identified during the Phase IA survey and assigned archaeological site numbers. The other 51 documented sites were not field-verified during the Phase IA survey. The documented sites are summarized in Table 3.12-2 (Vermont) and Table 3.12-3 (New Hampshire) in the Wilder PAD (pages 3-154 through 3-161). Of the 48 sites identified in the project APE, two are potentially eligible for listing in the National Register and one is ineligible. The National Register eligibility of the other 45 identified sites within the APE has not been determined.

The Phase IA survey for the Bellows Falls Project identified a total of 43 archaeological sites within the project boundary: 16 sites on private flowage lands, 8 sites on fee-owned lands and adjacent private flowage, and 2 sites on fee-owned lands in Vermont; and 6 sites on private flowage lands, 5 sites on fee-owned lands and adjacent private flowage, and 6 sites on fee-owned lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Bellows Falls PAD (pages 3-157 through 3-165). The Phase IA survey also documented 26 locations that could contain additional archaeological sites (12 in Vermont, 14 in New Hampshire) based on archival research (i.e., historical maps), three of which were identified during the Phase IA survey as corresponding to previously recorded archaeological sites. The other 23 documented sites were not field-verified during the Phase IA survey. The documented sites are summarized in Table 3.12-2 (Vermont) and Table 3.12-3 (New Hampshire) in the Bellows Falls PAD (pages 3-166 through 3-169). Of the 43 sites identified in the project APE, three are currently listed on the National Register, and three are eligible for listing on the National Register. The National Register eligibility of the other 36 identified sites within the APE has not been determined.

The Phase IA survey for the Vernon Project (Cherau and O'Donnchadha, 2008) identified a total of 37 archaeological sites within the project boundary: 28 on fee-owned and private flowage lands in Vermont; and 9 on fee-owned and private flowage lands in New Hampshire. These sites are summarized in Table 3.12-1 in the Vernon PAD (pages 3-182 through 3-188), and include potential site locations documented through archival research (i.e., historical maps). Of the 37 sites identified in the project APE, two are eligible for listing in the National Register, and one of these may also be an unlisted National Historic Landmark. One site is potentially eligible for listing in the National Register. The National Register eligibility of the other 34 identified sites within the APE has not been determined.

The Phase IA archaeological field investigations at the Wilder and Bellows Falls Projects documented erosion along the impoundment shorelines, upstream of Bellows Falls dam and immediately below Wilder dam. The Phase IA surveys were conducted in the months immediately following Tropical Storm Irene (August 2011), and the high flow-related erosion may have been a result of flooding associated with the storm. No high flow-related erosion was observed in the Vernon Project during the Phase IA survey, which was conducted 4 years earlier (August 2007). The archaeological investigations were not designed to ascertain the causation, extent, and mechanics of the observed erosion at the Wilder or Bellows Falls Projects.

Historic Architectural Property Identification and Evaluation

The Vernon, Bellows Falls, and Wilder Projects have previously been determined or evaluated as eligible for listing in the National Register as historic districts through a variety of surveys and other types of investigations that have been conducted over time. The following describes the primary efforts that have resulted in the identification and evaluation of those resources.

Hydroelectric Generating Facilities in Vermont Multiple Property Submission

The Vernon and Bellows Falls Projects are identified as being eligible for listing under the Hydroelectric Generating Facilities in Vermont Multiple Property Submission (MPS) (Berger 1992). The MPS documentation was prepared by Louis Berger & Associates, Inc. in 1992 and was signed by the Keeper and entered in the National Register in 2004. It provides the overall context and registration requirements for listing individual hydroelectric power facilities in Vermont that were constructed between 1882 and 1941. The Vernon and Bellows Falls Projects, which were developed in 1909 and 1928, respectively, are identified in the documentation as historic districts that are eligible for listing under the MPS, but neither has ever been formally nominated to the National Register.

Deerfield and Connecticut River Hydroelectric Projects System-wide Historical and Photographic Documentation

A full inventory of historic aboveground properties within the FERC boundaries of the Vernon, Bellows Falls, and Wilder Projects was compiled during a survey conducted by PAL in 1999 (Doherty and Kierstead 1999). The purpose of the survey was to identify and evaluate historic architectural properties within the boundaries of all the hydroelectric developments that are currently owned by TransCanada on the Deerfield and Connecticut Rivers. The survey information was used to evaluate the significance of the resources and prepare state-level written and photographic documentation that meets the standards of the Historic American Engineering Record (HAER). The documentation was intended to provide a permanent record of the historic developments and serve as a baseline for assessing the impacts of subsequent Project-related undertakings that had the potential to impact their qualities of significance. It included the development of historic context statement for the development of hydroelectric power facilities on the two rivers and the recordation of each of the hydroelectric developments, including information about all individual aboveground resources within the Project boundaries that contribute to their historical significance. Copies of the documentation for the Connecticut River Projects were submitted to the VT and NH SHPOs for transmittal to the state archives in those states and local archival repositories in the vicinity of the Projects.

Vernon Project

In 2006 TransCanada conducted a project to upgrade the generating capacity at the Vernon Project that required an amendment to the license. As the project subject to review under Section 106 of the NHPA, FERC and TransCanada consulted with the VT and NH SHPOs and other parties regarding the project's effects on historic properties. The consultation resulted in a determination that the historic architectural resources within the Vernon Project are eligible for listing in the National Register as a historic district under National Register criteria A and C at the state level in the areas of Industry, Engineering, and Architecture (Table 1). It derives its primary historical significance from being the first large capacity electrical generation facility in New England designed to deliver electricity via a long-distance transmission network. The effects of the proposed upgrade project on the historic powerhouse were resolved through the execution of a Memorandum of Agreement (MOA) that specified a variety of mitigation activities, including the preparation of a Historic Properties Management Plan (HPMP). The HPMP, which was completed and approved in 2008, specifies the treatment and management of historic properties within the Vernon Project Boundaries (Olausen and Cherau 2008).

Table 1. List of contributing resources within the Vernon Hydroelectric Project historic district.

Resource Name	**Location**	**Date**	**Description**
Dam	Connecticut River between Vernon, VT and Hinsdale, NH.	1907-1909	956-foot-long, 58-foot-high concrete gravity dam, with a spillway section that includes trash sluice gates, flood gates, tainter gates, and hydraulic flashboards
Powerhouse	West end of Dam, Vernon, VT and Hinsdale, NH	1907-1909	Rectangular, 328 feet long by 55 feet wide, Renaissance Revival-style building with a steel- frame structural system and brick exterior walls
Superintendent's House	Governor Hunt Road, Vernon, VT	1907	2½-story, wood-frame, clapboard-sided, Colonial Revival-style house with an asphalt-shingled gable roof. It was built about 1907 to house the Vernon Station's superintendent and his family
Superintendent's Garage	Governor Hunt Road, Vernon, VT	c, 1907	1-story, wood-framed, clapboard-sided, gable-roofed garage

Resource Name	Location	Date	Description
Hoister House	Governor Hunt Road, Vernon, VT	c. 1907	1-story, clapboard sided, gable-roofed, wood-frame shed. Originally house a compressed air-powered hoist used to haul railroad cars during construction of the Project. Currently used for equipment storage
Pump House	Governor Hunt Road, Vernon, VT	c. 1909	Brick-walled, one-story shed with a slate-sheathed gable roof. Built to pump potable water to the Powerhouse and the company-built employee dwellings
Crew Shack	East end of Dam, Hinsdale, NH	c. 1909	1-story, clapboard-sided, rectangular, building with an asphalt shingle roof. Provided shelter for power company personnel, particularly those working on the dam in bad weather.

Bellows Falls Project

The Bellows Falls Island Multiple Resource Area (MRA) was listed in the National Register in 1990 (Mulholland et al. 1988). The documentation covered a number of historic resources located on Bellows Falls Island that were associated with the industrial development of the area during the nineteenth and early twentieth century. The Bellows Falls Hydroelectric Powerhouse was named in the documentation as a contributing resource, but the New England Power Company, the owner of the Project at that time, objected to its listing in the National Register. In accordance with the Section 101(a)(6) of the National Historic Preservation Act, the Keeper determined the property eligible for listing and provided the appropriate notifications to that effect.

A portion of the Canal that provides water to the Bellows Falls Powerhouse is a contributing resource within the Bellows Falls Downtown Historic District, which was listed in the National Register in 1982 (Henry 1981). The boundaries of the district were drawn to exclude the Bellows Falls Hydroelectric Development powerhouse, but a portion of the Canal between Bridge Street on the south and the Green Mountain Railroad Bridge on the north is included in the district.

Other resources, including the Dam and several ancillary buildings that may contribute to a potential Bellows Falls Hydroelectric Project Historic District, were identified during the survey that PAL conducted in 1999. Table 2 provides a list of the resources that were evaluated as eligible for inclusion in the potential district.

Table 2. List of contributing resources within the potential Bellows Falls Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Dam	North Walpole, NH and Bellows Falls, VT	1927	643" long, 30" high, linear, poured concrete, gravity-type structure divided into five ogee-profile spillway sections separated by massive concrete pylons
Canal	East of Canal Street, Bellows Falls, VT	1802/1927	540' long, and 100' wide, except where it widens slightly to form a forebay immediately above the Powerhouse. The walls and floor of the canal are lined with cut granite blocks.
Power House	12 Mill Street, Bellows Falls	1927	Renaissance Revival-style, 2-story, cruciform-plan, brick-walled, steel-framed building with a concrete foundation and flat, reinforced concrete slab roofs with raised parapets
Gauge House	Intersection of Church and River Sts, North Walpole, NH	c. 1927	Rectangular, 1-story, brick-walled building with an asphalt-shingled ridge-hip roof
Crew Shack	Intersection of Church and River Sts, North Walpole, NH	c. 1930s	1-story, 3-by-2-bay, wood-frame building with a concrete slab foundation, clapboard siding, and an asphalt-shingle gable roof
Six-man Garage	South of Bridge Street, Bellows Falls, VT	c. 1875	long, narrow, 1-story, rectangular brick building built on fieldstone and concrete foundations, attached to east wall of the Canal
Line Shed	Mill Street, Bellows Falls, VT	c. 1940	1-story, square-plan, wood-frame building with a concrete slab foundation, corrugated metal walls, and a shallow-pitch, corrugated metal gable roof

Resource Name	Location	Date	Description
Red Barn	West end of Pine Street at Connecticut River, North Walpole, NH	c. 1870	Greek Revival-style, rectangular, 2-story, brick-walled, building with a fieldstone and concrete foundation and a slate-sheathed gable roof with corbeled brick cornices and returns

Wilder Project

The Wilder Project has never been formally determined eligible for listing in the National Register. The Project was included in PAL's 1999 survey and was evaluated at that time as potentially eligible for listing. The contributing resources of the potential district are identified in Table 3.

Table 3. List of contributing resources within the potential Wilder Hydroelectric Project historic district.

Resource Name	Location	Date	Description
Powerhouse	351 Wilder Dam Road, Hartford, VT	1950	Colonial Revival-style, rectangular, 183' long, 46' wide, 60' high, six-by-one-bay, two-story building with a high concrete foundation, brick-clad, steel-frame walls, and a slate-sheathed gable roof.
Dam	Wilder Dam Road, Hartford, VT; Rte 10, Lebanon, NH	1950	2,900' long earth and concrete dam, consisting of a 2,100' long earth fill structure and a 680' long, 59' high, linear, poured concrete gravity-type structure with an ogee-profile spillway.
Old Visitor's Center	Rte 10, Lebanon, NH, south end of Wilder Dam	ca. 1950	Rustic-style, 1-story, cruciform-plan building with a concrete foundation and an asphalt-shingled gable roof.
Garage	Wilder Dam Road, Hartford, VT	ca. 1950	40' by 120', wood-framed, one-story building with a concrete slab foundation, and corrugated metal gable roof and siding

Resource Name	Location	Date	Description
Oil Storage Shed	Wilder Dam Road, Hartford, VT	Ca. 1950	1-story, rectangular, two-by-one-bay, steel frame building with a concrete slab foundation, pressed metal clapboard siding, and a corrugated metal gable roof

NEED FOR ADDITIONAL INFORMATION

~~Although developed to specifically address historic resource effects associated with the 2006 Vernon license amendment for replacement of Units 5–8, a Memorandum of Agreement stipulated:~~

1. ~~historic documentation of the Vernon powerhouse;~~
2. ~~video documentation of the historic equipment removal;~~
3. ~~development of an HPMP for the project that includes:~~
    a. ~~steps to determine the extent of any project-related potential effects and further measures to manage identified sites and sensitive areas within the project APE.~~
    b. ~~measures may include Phase IB site identification; and~~
    c. ~~Phase II site evaluation for sites and sensitive areas identified through monitoring as undergoing active effects from project operations and/or maintenance or threatened by proposed project activities including recreational enhancements and uses.~~

    ~~The HPMP also includes measures for the treatment of unanticipated cultural materials and human remains that could be discovered within the APE over any new license term.~~
4. ~~Phase 1A archaeological investigations of the entire APE, similarly described above as all lands within the project boundary, both fee-owned and land owned by others affected by the project;~~
5. ~~salvage of historic generating equipment; and~~
6. ~~dispute resolution process~~

~~All the above have been completed except for 3.c, which is an ongoing requirement. The next cycle of archaeological monitoring for the Vernon Project is scheduled for 2013.~~

FERC has requested that a complete inventory of historic properties within the Wilder, Bellows Falls, and Vernon Projects be completed through Phase IB identification surveys and NRHP evaluations to be conducted during first and second season field investigations. The VT SHPO specifically requested that the Project APE for Wilder, Bellows Falls, and Vernon be enlarged to include all terrace margins and adjacent areas where active erosion is destabilizing the riverbanks within the Project corridors. Pending the definition of the Project APEs by FERC in consultation with the SHPOs and Native American tribes, particularly in relation to project operations and erosion, Phase IB archaeological surveys and Phase II evaluation studies through second season field investigations, if necessary, will be conducted. The need for Phase IB survey for the Vernon Project will be determined following the scheduled 2013 Archaeological Monitoring Program as described in the 2008 Vernon HPMP. The identification of TCPs will be conducted by Native American tribes who have identified themselves as having a traditional connection to the Project corridors.

PROJECT NEXUS

Activities related to the operation and maintenance of the Wilder, Bellows Falls, and Vernon Projects over the license term have the potential to affect cultural resources that are eligible for listing in the National Register. Phase IB archaeological site identification and Phase II archaeological site evaluation studies will identify National Register eligible archaeological sites that may be directly or indirectly affected by project operations and maintenance activities. Similarly, a National Register evaluation of the historic hydroelectric components of the Wilder Project will complete the identification of historic above-ground properties. The inventory of TCPs, including sacred landscapes will be compiled by Native American tribes, specifically the Narragansett Indian Tribe, who will partner with the Nolumbeka Project Inc. as their primary researcher. The information obtained from archaeological site and above ground historic property identification and evaluation studies as well as TCPs will be used to assess the potential effects of the relicensing of the three projects on cultural resources.

In the event that FERC, in consultation with the VT and NH SHPOs and Native American tribes, determines that the relicensing has the potential to cause adverse effects on historic properties, the information will form the basis of continued consultation to resolve the effects. The product of that consultation will likely be a Programmatic Agreement (PA) developed for each of the projects that stipulates actions that will be taken to avoid, minimize, or mitigate the adverse effect. One of the key provisions of the PAs will be the development of new HPMPs for the Wilder and Bellows Falls Projects and the revision of the existing Vernon HPMP.

STUDY AREA ~~AND STUDY SITES~~

The study area for cultural resources corresponds to the APEs established pursuant to 36 C.F.R § 800.4(a)(1). The term *Area of Potential Effects* means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking (36 C.F.R § 800.16(d)).

The recommended APEs for all three projects are defined as all land owned in fee simple by TransCanada and the land privately owned by others within the project boundary, upon which flowage rights are retained, that are directly affected by the operation at full pond under normal flow conditions. For areas where potential erosion has been identified during Phase 1A archaeological field investigations (see below) the recommended APE extends 10 meters inland from the top of the river bank. For the Wilder Project the extent of project boundary is based upon full pond based upon elevation 385.0 feet msl at the dam; for the Bellows Falls Project, it is based upon full pond based upon elevation 291.61 feet msl at the dam; and for the Vernon Project it is based upon full pond elevation 220.13 feet msl at the dam.

The recommended Project APE map sheets (USGS 7.5 minute topographic quadrangles) for the Wilder, Bellows Falls, and Vernon Projects are included as Attachment E to the document "Responses to Commission Staff's Identification of PAD Deficiencies, Requests for Additional Information and Status of Study Reports" which is being filed simultaneously with FERC. Copies of those maps are attached here as Attachment 33-B.

The proposed APE for Vernon Project relicensing was described in the Vernon Phase IA archaeological report submitted to the VT SHPO and NH SHPO on April 10, 2008. The proposed Vernon APE was also described in the Vernon HPMP submitted to the VT SHPO and NH SHPO on October 21, 2008. The NH SHPO concurred with both the Phase IA report findings and recommendations and the HPMP for Vernon in letters dated May 22, 2008, and December 2, 2008. No responses were received from the VT SHPO. The APE defined through consultation with state SHPOs and Vernon Project's HPMP cover all aspects of current and future potential project effects on cultural and historic resources within the project boundary. TransCanada believes that the present APE, together with the HPMP, including the ongoing monitoring and management responsibilities, adequately addresses project effects.

The recommended APE for Wilder and Bellows Falls Project relicensing was described in the Phase IA archaeological reconnaissance survey methodologies submitted to the NH SHPO on September 29, 2011, as part of the NH SHPO's Request for Project Review. On October 11, 2011, the NH SHPO concurred with the project APE definition and the survey methodologies provided in the Phase IA methodology Request for Project Review Forms prepared prior to the Phase IA survey fieldwork. The VT SHPO was notified similarly of the proposed APE in the

Phase IA archaeological reconnaissance survey methodologies on November 9, 2011. No response or comments were received.

Based upon the collective results from the yet-to-be-completed hydraulic modeling and operations modeling studies (Study 4 and 5), together with the erosion studies (Studies 1, 2, and 3), a revision in the APE is possible. The recommended APE recognizes the potential for project effects associated with bank erosion and includes such active areas by extending the area 10 meters inland from the top of the river bank.

The final determination of the APE Consultation among FERC, the VT and NH SHPOs, Narragansett THPO, and other parties invited to participate in the Section 106 process, will be conducted during the summer of 2013. Based on this consultation, the FERC will make a final determination of the APEs for the Vernon, Bellows Falls, and Wilder Projects.

METHODOLOGIES

~~Relicensing of the Vernon, Bellows Falls, and Wilder Projects constitutes a federal undertaking that is subject to review under Section 106 of the NHPA, and its implementing regulation 36 C.F.R. § 800. As such, the following methodologies for supplying requested information and studies are devised to facilitate the Section 106 consultation process that must be concluded prior to the issuance of the licenses.~~

Review of Bellows Falls and Wilder Project Phase IA Archaeological Reconnaissance Survey Reports

~~The proposed APE for Vernon Project relicensing was described in the Vernon Phase IA archaeological report submitted to the VT SHPO and NH SHPO on April 10, 2008. The proposed Vernon APE was also described in the Vernon HPMP submitted to the VT SHPO and NH SHPO on October 21, 2008. The NH SHPO concurred with both the Phase IA report findings and recommendations and the HPMP for Vernon in letters dated May 22, 2008, and December 2, 2008. No responses were received from the VT SHPO. The APE defined through consultation with state SHPOs and Vernon Project's HPMP cover all aspects of current and future potential project effects on cultural and historic resources within the project boundary. TransCanada believes that the present APE, together with the HPMP, including the ongoing monitoring and management responsibilities, adequately addresses project effects.~~

~~The proposed APE for Wilder and Bellows Falls Project relicensing was described in the Phase IA archaeological reconnaissance survey methodologies submitted to the NH SHPO on September 29, 2011, as part of the NH SHPO's Request for Project Review. On October 11, 2011, the NH SHPO concurred with the project APE definition and the survey methodologies provided in the Phase IA methodology Request for Project Review Forms prepared prior to the Phase IA survey fieldwork. The VT SHPO was notified similarly of the proposed APE in the Phase IA archaeological reconnaissance survey methodologies on November 9, 2011. No~~

~~response or comments were received. The proposed recommended APE for Wilder and Bellows Falls (and Vernon) will be confirmed in consultation with the VT SHPO, the NH SHPO, and Native American Tribes as part of the submittal of the Phase IA archaeological reconnaissance survey reports. The APE will be included in the HPMPs to be prepared for the Wilder and Bellows Falls Projects and in the revised Vernon HPMP as well as in the PA for each project.~~

~~Based upon the results from the hydraulic modeling and operations modeling studies (Study 4 and 5), together with the erosion studies (Studies 1, 2, and 3), a revision in the APE is possible. However, based upon the fact that the current APE recognizes the potential for project effects associated with bank erosion and includes such active areas, there does not appear to be an overwhelming argument to reconsider the APE at the present time and until a more definitive determination is made relative to project effects on erosion and historic resources.~~

Phase 1A reports for the Wilder Project and Bellows Falls Project were submitted to the VT and NH SHPOs, and the Narragansett Indian Tribal Historic Preservation Officer (THPO) on May 29, 2013. Phase 1A reports for these projects together with the 2008 Phase 1A report for the Vernon Project were also submitted to FERC on July 1, 2013. The Phase IA report for the Vernon Project was provided to the Narragansett Indian THPO on June 19, 2013. The draft reports include copies of all SHPO consultation to date. The submittal of the final reports will follow the draft review. ~~The 2013 historic resources monitoring report for the Vernon Project will be provided to the SHPOs and FERC before December 31, 2013.~~

Vernon Project 2013 Monitoring Program/Update of Phase 1A Archaeological Reconnaissance Survey Report

The archaeological monitoring program, as described in the Vernon HPMP (Olausen and Cherau, 2008:25-26), will be implemented by qualified archaeologist(s) assisted as needed by a geologist, soil scientist, forester, and/or engineer with physical, geotechnical, or hydraulic experience pertinent to riverine hydraulics, reservoir operation and erosion, depending on the condition of the sites and locales to be visited. The monitoring program will include a physical inspection of previously identified archaeologically sensitive shoreline areas and sites with the goal of updating the initial Phase IA archaeological survey report prepared by PAL in 2008 (Cherau and O'Donnchadha 2008). Native American Tribal representatives will accompany the archaeologists during this fieldwork, if so desired, in order to collect existing conditions data on TCPs, including sacred landscapes, during the visual inspections.

Should erosion or other threats to sensitive areas and/or sites be identified during the monitoring, a Phase IB identification survey of the affected areas will be conducted (see Methodology described below). For the known National Register eligible sites or other sites subsequently identified as eligible for listing in the National Register, any identified threats will be addressed through controls or other measures designed to preserve their integrity. Threats that cannot be checked or otherwise resolved may require mitigation through the implementation of a Phase III archaeological data recovery program. The findings of the monitoring effort will be presented in a stand-alone report that will be submitted to FERC, VT SHPO, NH SHPO, and Native American tribes.

Phase 1B and Phase II Archaeological Investigations

As determined in consultation with FERC, the SHPOs, and Native American tribes, Phase IB surveys will be conducted in the Wilder, Bellows Falls, and Vernon APEs to locate and identify known and undocumented archaeological resources in areas of active erosion or other identified project-related impacts. Phase II field evaluations will be conducted, as needed, to determine the NRHP eligibility of identified archaeological sites. Phase IB survey will be completed during the 2014 field season. Phase II site evaluations, if necessary, will also be conducted in the 2014 field season. Phase IB survey and Phase II methodologies will be reviewed and approved by the VT and NH SHPOs prior to the start of fieldwork. The survey methodologies will be designed and implemented in accordance with the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the National Historic Preservation Act of 1966, as amended, and related regulations (36 CFR 800); the VDHP/SHPO's *Guidelines for Conducting Archeology in Vermont* (final adoption June 2007); and the NHDHR/SHPO's Archaeological Standards and Guidelines.

Native American Tribal representatives will be notified of the Phase IB and II schedules and will, if so desired, accompany the archaeologists during the fieldwork in order to collect data on identified Native American sites and TCPs including sacred landscapes.

Phase IB Identification Surveys

Phase IB identification surveys will be conducted in archaeologically sensitive areas where active erosion was identified during the Phase IA surveys including the 2013 monitoring program for Vernon. These archaeologically sensitive areas will include the borders of active shoreline erosion up to 10 meters (33 feet) back from the top of the embankments. Bordering areas on private property that were not included in the Phase IA surveys will initially be subjected to a complete walkover with close ground surface inspection to assess existing conditions and the presence of visible cultural materials. The results of the walkover survey will inform the locations of Phase IB subsurface testing designed to locate and identify archaeological deposits including small sites that may be present. The Phase IB identification surveys including additional walkover and subsurface testing will be conducted in consultation with the VT SHPO and/or NH SHPO. For the purposes of this proposal, Phase IB survey will be conducted in archaeological site and sensitive areas where direct project impacts are occurring, and as identified during the Phase IA surveys and depicted on the Appendix B maps included in the Phase IA survey reports.

The Phase IB subsurface testing will be conducted in the form of shovel test pits. All Phase IB survey test pits will measure 50-x-50-centimeters (cm) in size and will be placed at 10-meter (m) intervals along transects, and at 2.5 and 5-m intervals in test pit arrays where potentially significant cultural materials are identified during the initial testing. The exact placement (e.g., 10 m from the edge of the riverbank to cover erosional undercutting of the soils) and amount of test pits in each archaeological site and/or sensitive area will be determined following the consultation and agreement on the Wilder, Bellows Falls, and Vernon Project APE definition and Phase IB identification survey methodology.

If access to private property is needed for the additional walkovers and subsurface testing, landowner permissions will be obtained by TransCanada prior to the start of fieldwork. No fieldwork will be conducted on private lands where landowner permission has not been obtained by TransCanada. The correspondence relating to landowner permissions will be included in the Project survey files.

All test pits will be excavated by shovel in arbitrary 10-cm levels to sterile glacial subsoils. All excavated soil will be screened through ¼-inch hardware cloth and remaining cultural material will be collected. Soil horizons/profiles will be recorded using Munsell soil descriptions for each unit. Cultural material and samples will be bagged and labeled with provenience information. Digital photographs will be taken of the Project APE areas subjected to subsurface testing. Test pit soil profiles will be photographed if they contain potentially significant cultural features, soil anomalies, and/or structural remains. All test units and cultural deposits will be located using GPS technology and plotted on USGS 7.5 minute topographic maps and project plans.

All cultural materials, including those that may be identified by Native American tribal representatives, collected during the Phase IB surveys will be returned to the PAL facility in Pawtucket, Rhode Island for laboratory processing and analyses. These activities will include: cleaning, identification, and cataloging of any recovered cultural materials; analysis of spatial distributions of cultural materials; and map and graphics production.

Phase II Site Evaluations

Should potentially significant archaeological deposits be identified during Phase IB subsurface testing, then additional testing in the form of Phase II evaluations will be conducted during the 2014 field season, if needed. The Phase II evaluations will consist of the excavation of shovel test pits (50-x-50-cm) and larger units (primarily 1-x-1 meter) for each identified site area. The shovel test pits will be used to determine the archaeological site boundaries along with natural landforms, historic and/or modern structures/features, and artificial (disturbed) elements. The larger units will be hand excavated to examine cultural material concentrations and/or features (e.g., fire pits, hearths, privies) and inform on the age and internal configuration/complexity of the site. This information will be used to assist in a determination of the site(s)' significance and their eligibility to meet the criteria for listing in the NRHP.

The exact placement and amount of Phase II testing at each identified site area will be based on the results of the Phase IB survey. The Phase II excavation and recordation procedures will follow those established above for the Phase IB survey subsurface testing.

Archival research including land evidence records and local town histories will be conducted as needed for any potentially significant post-contact period sites. The research will be used to refine archaeological site boundaries in relation to historic property divisions and assist in applying the NRHP criteria of eligibility to these resource types.

If NRHP eligibility determinations for identified archaeological sites cannot be made during the first and second field seasons, the need for follow-up site evaluations to determine NRHP eligibility will be included in each Project's HPMP.

~~No Phase IB site identifications and/or Phase II site evaluations are proposed at this time for any of the three projects. Current project operations are not identified as resulting in effects on the identified archaeological sites and sensitive areas. The observed erosion at the Wilder and Bellows Falls Projects is identified as being the likely result of high flow from flooding associated with Tropical Storm Irene in August 2011. The Phase IB site identification surveys requested by the VT SHPO along all terrace margins and adjacent areas above the 385.0-foot contour line at Wilder, above the 291.63-foot contour line at Bellows Falls, and above the 220.13-foot contour line at Vernon are for the most part outside the project APE on private properties where TransCanada does not have permission to access or conduct intrusive subsurface investigations.~~

~~The archaeological monitoring program of the project APE areas as presently defined (see above) for all three projects is deemed sufficient to identify and manage effects that future project operations that may have on significant archaeological resources within the project APE. Archaeological monitoring programs for identified sites and sensitive areas have been successfully used following Phase IA archaeological reconnaissance surveys at both the TransCanada Hydro Northeast Deerfield Hydroelectric Project in Vermont and Massachusetts and the Fifteen Mile Falls Hydroelectric Project on the Connecticut River in Vermont and New Hampshire.~~

~~Should Phase IB site identifications and/or Phase II site evaluations be determined necessary at the Wilder, Bellows Falls, or Vernon Projects as a result of the archaeological monitoring program in consultation with the VT SHPO and NH SHPO (as applicable), the investigations will be conducted according to the applicable federal and state regulations and guidelines. The archaeological surveys in Vermont will be conducted in accordance with the Vermont Division for Historic Preservation (VDHP)/SHPO's Guidelines for Conducting Archeology in Vermont, dated June 2007, final adoption). In New Hampshire, the archaeological surveys will be conducted in accordance with the New Hampshire Division of Historical Resources (NHDHR) Archaeological Standards and Guidelines. In addition all~~

~~surveys will meet the standards and guidelines set forth by the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation and Section 106 of the NHPA.~~

TCP Identification Survey

The identification of TCPs including sacred landscapes will be conducted by Native American tribes who have identified themselves as having a traditional connection to the Project corridors. To date, the Narragansett Indian Tribe has indicated a traditional connection to the Vernon, Bellows Falls, and Wilder Projects in the Connecticut River Valley. The Narragansett Indian Tribe will partner with the Nolumbeka Project Inc. as their primary researcher for the Projects. The identification of TCPs will involve a review of previously conducted historic and archaeological studies in the Project corridors including the Phase IA archaeological surveys and visual inspections of the three Projects. The visual inspection of the Vernon Project will be conducted concurrently, if so desired, with the 2013 archaeological monitoring program. Visual inspections of the Bellows Falls and Wilder Projects are anticipated be conducted by the Tribe in 2013. The identification of TCPs will continue during subsequent 2013 and 2014 Phase IB identification and Phase II evaluation surveys conducted in all three Projects.

The research, visual field inspections, and Phase IB survey and Phase II evaluation field monitoring will result in the generation of a TCP inventory and electronic database by the Narragansett Indian Tribe. The database will be used and augmented by the Tribe as part of its commitment to Section 106 consultations during the life of the Project license agreements.

Survey and Evaluation of Historic Architectural Resources

The objectives of the survey of historic architectural resources will be to provide an assessment of the existing condition of all resources that were previously identified in the 1999 survey conducted by PAL, identify any other potentially significant resources within the APEs, and evaluate the significance of resources that have not yet been formally determined eligible for listing in the National Register. The work will be conducted in the following manner.

The historic architectural survey and evaluation will be carried out by a team consisting of an architectural historian and industrial historian who meet the Secretary of the Interior's Professional Qualification Standards (36 CFR part 61 Appendix A). The initial phase of the survey will consist of a review of available sources and documentation regarding the history of the hydroelectric projects. The review will include visits to the offices of the Vermont Division for Historic Preservation and New Hampshire Division of Historical Resources to review inventory records and other relevant files they may contain.

The field survey will consist of walkover of the lands within the Project APEs. The team will visit each of the previously identified resources and document any other resource that appears to be 50 years of age or older. Information about the current appearance, including the setting, physical condition, and character-defining architectural features of the resources will be recorded. High-resolution digital photographs will be taken of each resource. Additional photography will include general context views that show the resources in relation to one another and their surroundings. A photo log will be kept and the locations of the views will be recorded on a base map.

Upon the completion of the field investigations, PAL will analyze all collected data and prepare historical contexts that identify the significant themes, events, and/or people that had an impact on the historical development of the potential districts. The historic contexts and field notes regarding integrity will serve as the basis for the National Register evaluation of the district and individual resources that contribute or do not contribute to its significance. PAL will determine the areas, period(s), and level(s) of significance for the district and apply the National Register criteria for evaluation. The integrity of the resources will be evaluated to determine if the properties retain a sufficient amount of their historic appearance to be considered for listing in the National Register.

The product of the survey will be a report that provides information about previous National Register evaluations and recommendations regarding the potential National Register eligibility of resources that have not been formally evaluated. The reports will contain a narrative description of the resources identified during the survey, including information about the general setting and current physical condition. The narrative will provide a statement of integrity that addresses changes that have occurred over time.

The description will be followed by historic context statement that will provide information about the general historical development of hydroelectric facilities on the Connecticut River during the early twentieth century and other themes, if any, that may apply to resources identified in the field.

The recommendations section of the report will include the results of the National Register evaluation for the potential Wilder and Bellows Falls Hydroelectric Project Historic Districts and any updates of the Vernon Hydroelectric Project Historic District, which has previously been determined eligible for listing in the National Register. Recommendations will include a narrative statement of significance that will define the applicable National Register criteria, criteria considerations (if any apply), areas of significance, and periods of significance for the districts. The narrative will include a summary statement of significance that will establish the level(s), period(s), and areas of significance. Each area of significance will be supported by a statement that identifies the historical development of the district and defines the themes, trends, events, and people that are important in American history and lend the district its significance.

Other components of the report will consist of a bibliography of sources consulted and graphical information, including a map of the district and photographs of the contributing and non-contributing resources. The map will be prepared in ArcGIS format and will include the scale, north arrow, and legend. All contributing and non-contributing resources and prominent landscape features will be clearly labeled to correspond with information provided in the district data sheet. The map will also show the district boundaries and location of views corresponding to the photographs included with the documentation.

~~The evaluation of the National Register eligibility of the Wilder Project's above-ground hydroelectric facilities will be conducted by a qualified architectural historian. Project facilities will be assessed in accordance with the National Register criteria (36 C.F.R. § 63) and integrity. The findings of the evaluation will be forwarded in a report that will be sent to FERC, VT SHPO, and NH SHPO for concurrence.~~

Development of Historic Property Management Plans

HPMPs will be developed for the Bellows Falls and Wilder Projects and the existing HPMP for the Vernon Project will be updated prior to the issuance of the new FERC license. The HPMPs will govern future actions as they relate to historic properties, including standing structures and archaeological sites, within the boundaries of the projects. The HPMPs will identify the nature and significance of historic properties within the project boundaries that may be affected by project-related maintenance and operation, proposed improvements to project facilities, and public access. The HPMPs will identify goals for the preservation of historic properties; establish guidelines for routine maintenance and operation; and establish consultation procedures. They will identify the responsible TransCanada officer in charge of executing the plan and establishing procedures for training plant operators, maintenance staff, and other employees in its implementation. The HPMPs will be integrated with existing management plans, as appropriate.

The HPMP for each project will be developed according to the following principles and procedures:

- **Consultation.** The HPMPs will be prepared through a process that will involve consultation with, and input from FERC, VT SHPO, NH SHPO, Native American tribes, historic preservation experts, and other interested parties that may be identified.

- **Identification of Historic Properties.** The HPMPs will identify known historic properties within the projects and include mechanisms for the completion of identification and evaluation tasks for previously unidentified historic properties within the projects, as necessary.

- **Routine Project Operations.** The HPMPs will include a description of how historic properties, including known and predicted archaeological resources, are or could be affected by routine project operations. This discussion will include the suspected or known cause of an effect on each site or feature. The HPMPs will identify and prioritize preservation issues associated with routine project operations.

- **Protection of Historic Properties.** The HPMPs will address the continuation of routine project operations in relation to the protection of the integrity of historic properties. These operations include, but are not limited to: continued use and maintenance that affects historic properties, shoreline erosion caused by routine operations, recreational developments, other project-related ground-disturbing activities, and vandalism.

- **Mitigation of Adverse Effects.** The HPMPs will include a process for determining and mitigating unavoidable adverse effects on historic properties.

- **Discovery of Human Remains.** The HPMPs will include mechanisms for the treatment and disposition of any human remains that may be discovered, taking into account applicable Vermont and New Hampshire state laws and the Advisory Council on Historic Preservation's *Policy Statement Regarding Treatment of Human Remains and Grave Goods*.

- **Discovery of Previously Unidentified Properties During Project Operations.** The HPMPs will include a plan to deal with previously unidentified properties discovered during project operations.

  Public Interpretation. The HPMPs will specify the implement a program to provide interpretation of the historic and archaeological values of the projects to the general public.

ANALYSIS

The results of proposed Phase IB and Phase II archaeological surveys, TCP identification survey, and National Register evaluation report for historic architectural resources will be used to determine the potential for adverse effects to historic properties created by the continued operation of the Wilder, Bellows Falls, and Vernon Projects. The information on potential effects will be used as the basis for preparing the HPMPs for each of the Projects, which will guide the Licensee's actions relating to Section 106 during the term of the new licenses.

~~No new cultural resources data analyses are proposed as part of this study plan. The treatment of archaeological resources will be conducted separately as part of 2013 and future archaeological monitoring programs (see discussion below).~~

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

The archaeological monitoring/Phase 1A survey update at Vernon as well as any subsequent Phase IB survey and Phase II investigations that may be necessary will be conducted according to the applicable federal and state regulations and guidelines. The archaeological surveys in Vermont will be conducted in accordance with VDHP/SHPO *Guidelines for Conducting Archeology in Vermont*, dated June 2007 (final adoption). In New Hampshire, the archaeological surveys will be conducted in accordance with the NHDHR *Archaeological Standards and Guidelines*.

In addition, all surveys will meet the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the NHPA.

DELIVERABLES

2013 cultural resource reporting deliverables for the Wilder, Bellows Falls, and Vernon Projects are as follows.

- Final Phase IA archaeological reconnaissance survey reports for the Wilder and Bellows Falls Projects;

- Draft and Final Vernon 2013 archaeological monitoring program/Phase 1A survey update report, including information on identified TCPs by Native American Tribes.

- TCP Identification Survey, Progress Report for the Wilder and Bellows Falls Projects, based on preliminary research and visual inspections, to be provided by the Narragansett Indian Tribe.

- Historic Architectural Resources National Register Evaluation Report.

2014 cultural resource reporting deliverables for the Wilder, Bellows Falls, and Vernon Projects will follow the completion of first and second season Phase IB survey and Phase II evaluation fieldwork, research, and laboratory analyses.

- Phase IB Archaeological Identification Survey and Phase II Evaluation reports for the Wilder, Bellows Falls, and Vernon Projects. Draft report(s) will be prepared for comment by the SHPOs and Native American tribes. Each technical report will contain a description of the Project APE, cultural contexts, results of the fieldwork, and conclusions and recommendations for the treatment of identified NRHP eligible sites. The reports will each contain maps showing the Project APE, testing locations, and all identified archaeological sites. The final reports will follow the draft review.

~~TCP Identification Survey, Final Report~~s for the Wilder, Bellows Falls, and Vernon Projects, based on the results of research and fieldwork, to be provided by the Narragansett Indian Tribe.

SCHEDULE

The final Phase IA archaeological reconnaissance reports for Wilder and Bellows Falls will be submitted following the draft review by FERC, the VT and NH SHPOs and the Narragansett Indian Tribe.

The Vernon archaeological monitoring program is scheduled to be conducted in the summer of 2013. A draft report of the 2013 monitoring program findings will be prepared and filed with FERC, the VT and NH SHPOs, and Narragansett Indian Tribe within 30 days following the fieldwork, anticipated to be no later than September

30, 2013. The final report will follow the draft review and be submitted by December 31, 2013.

The Historic Architectural Resources National Register Evaluation Report will be prepared and filed with FERC and the VT and NH SHPOs by September 30, 2014.

Phase IB survey fieldwork will begin during the 2014 field season. The Phase II site evaluation fieldwork will begin continues and/or be completed in the 2014 field season. The draft reports for the first and second field season investigations will follow the completion of fieldwork and laboratory analysis, with an anticipated submittal date of August 2014. Due to the sensitive nature of the information that will be provided in the archaeological reports, they will be issued as "stand alone" documents and will only be distributed to the SHPOs, involved tribes, and FERC.

The schedule for the completion of the TCP inventory and reporting will follow the schedule established above for the archaeological survey and reports. The information on TCPs generated by the Native American tribes may be incorporated into the archaeological report narratives for both the 2013 and 2014 field season deliverables.

LEVEL OF EFFORT AND COST

The preliminary estimated cost for the study broken down by major tasks is as follows:

- Submittal of Final Wilder and Bellows Falls Phase 1A reports and SHPO and stakeholder consultation: $1,500
- Vernon 2013 Monitoring/Phase 1A Survey Update: $30,000
- TCP Identification Survey Reports for Wilder, Bellows Falls, and Vernon Projects: unknown pending input from the Narragansett Indian Tribe.
- Historic Architectural Resources National Register Evaluation Report: $~~7,500~~15,000
- Phase 1B and II investigations 2014 field seasons: unknown pending Vernon 2013 monitoring/updated Phase IA survey effort.
- Development of new HPMPs for Wilder and Bellows Falls and revised HPMP for Vernon: $50,000 to $55,000

REFERENCES

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Hubbard, M., S.G. Cherau, J. Daly, and O. Elquist, PAL. 2013. Phase IA Archaeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892), Windsor and Orange Counties, VT, and Grafton County, NH. 351 pp.

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Mulholland, Mitchell, Hugh Henry, and Giovanna Peebles . 1988. Bellows Falls Island Multiple Resource Area, Rockingham, Vermont. National Register of Historic Places Multiple Property Submission. National Register Information System Reference No. 64000888.

Olausen, S.A. and S.G. Cherau, PAL. 2008. Historic Properties Management Plan, Vernon Hydroelectric Project, FERC Project No. 1904, Vermont and New Hampshire. 34 pp.

ATTACHMENT 33-A

Phase IA Archaeological Reconnaissance Surveys

TransCanada has completed Phase IA archaeological reconnaissance surveys of the recommended APEs at the Wilder, Bellows Falls, and Vernon Projects. The Phase IA surveys were undertaken by TransCanada as the first step in the identification and treatment of significant archaeological resources to assist FERC in fulfilling its obligations under Section 106 of the National Historic Preservation Act (NHPA) of 1966 as amended. The Phase IA surveys were completed by professional archaeologists who meet the qualifications set by the National Park Service (36 CFR Part 66, Appendix C) and have at least two years of supervisory experience and two years of field experience in New England.

The Phase IA survey of the Vernon Project APE was conducted in the fall of 2007. The survey methodology and results are presented in the technical report titled *Phase IA Archaeological Reconnaissance Survey, Vernon Hydroelectric Project (FERC No. 1904), Windham County, Vermont and Cheshire County, New Hampshire* (PAL report, Cherau and O'Donnchadha, March 2008). The Wilder and Bellows Falls surveys were conducted in the fall of 2011. The survey methodologies and results are presented in the technical reports titled *Phase IA Archaeological Reconnaissance Survey, Wilder Hydroelectric Project (FERC No. 1892), Windsor and Orange Counties, Vermont and Grafton County, New Hampshire* (PAL report, Hubbard et al. May 2013) and *Phase IA Archaeological Reconnaissance Survey, Bellows Falls Hydroelectric Project (FERC No. 1855), Windham and Windsor Counties, Vermont and Cheshire and Sullivan Counties, New Hampshire* (PAL report, Hubbard et al., May 2013).

The technical reports comply with the standards and guidelines set forth by the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* and Section 106 of the National Historic Preservation Act of 1966, as amended, and related regulations (36 CFR 800); the VDHP/SHPO's *Guidelines for Conducting Archeology in Vermont* (final adoption June 2007); and the NHDHR/SHPO's Archaeological Standards and Guidelines.

Goals and Objectives

The Phase IA archaeological reconnaissance surveys were designed to inventory previously recorded archaeological sites and identify additional areas of archaeological sensitivity where documented and unrecorded sites are likely to exist within the recommended APEs for the Wilder, Bellows Falls, and Vernon Projects. This phase of survey did not include any Phase IB or Phase II subsurface investigations to locate, identify, and evaluate previously documented and undocumented sites for their eligibility for listing in the NRHP, or an assessment of existing or future project effects on any such identified historic properties within the Project APE.

Methodology

To accomplish this objective, two research strategies were used: 1) archival research, including a review of literature and maps; and 2) field investigations, consisting of a riverine and shoreline visual survey carried out from a boat, and a terrestrial walkover/surface inspection of upland (shoreline and non-shoreline) fee-owned parcels within the Projects. The field survey for private lands where TransCanada only has flowage rights included the impoundment or river channel and adjacent lands affected by the normal operating range of the Project's reservoir. The flowage rights areas were examined primarily from the boat. The field crew did not access any privately owned lands during the Phase IA survey fieldwork.

The archival research and field investigations provided the information needed to develop environmental and historic contexts for the project study area and develop a predictive model for archaeological sensitivity. Archaeological sensitivity is defined as the likelihood for belowground cultural resources to be present and is based on various categories of information: locational, functional, and temporal characteristics of previously identified historic properties in the project area or vicinity; and local and regional environmental data reviewed in conjunction with existing project-area conditions documented during the field investigations and archival research about the Project's land-use history.

Archival Research

Specific sources reviewed as part of the archival research for the Phase IA reconnaissance survey of the Wilder, Bellows Falls, and Vernon Projects include:

1) State Site Files, Artifact Collection Reports, and Town Reconnaissance Surveys

The state site files at the Vermont Division for Historic Preservation (VDHP) and the New Hampshire Division of Historical Resources (NHDHR) were reviewed to locate any known Native American and EuroAmerican sites in or close to the project lands. The VDHP and NHDHR inventories include cultural resources listed or eligible for listing in the National Register of Historic Places. Both sets of files also include an inventory of known archaeological site locations, catalogs of cultural material, and brief site summaries. The VDHP has also assembled a comprehensive survey of Vermont towns and compiled brief outlines of their historical development. Cultural contexts and artifact collection studies were reviewed in the *Journal of the Vermont Archaeological Society* and the *New Hampshire Archeologist* for data relevant to the Connecticut River Valley.

2) Cultural Resource Management Reports

Cultural resource management (CRM) survey reports previously conducted within the general Project vicinities were reviewed for relevant information concerning known archaeological sites, sensitivity models and assessments, and environmental and cultural contexts. These reports include studies conducted by PAL and other cultural resource management firms in the Vermont and New Hampshire project towns. The specific CRM reports consulted for each Project area are fully described in the corresponding technical Phase IA survey reports.

3) Histories, Maps, and Photographs

Primary and secondary histories and historical maps and atlases of the Project towns in the Connecticut River Valley were examined to assess changes in land use, to locate any documented structures, and to trace the development of transportation networks, an important variable in the location of post-contact period archaeological sites. The specific historical town, county, and state maps reviewed for the Vermont and New Hampshire portions of the Projects are fully described in the corresponding technical Phase IA survey reports. Historic photographs of project-specific locales including the village of Wilder and the village of Bellows Falls, Vermont including Project fee-owned lands and Connecticut River shoreline before, during, and after the construction of the Wilder and Bellows Falls Hydroelectric Development powerhouses and dams were also reviewed as part of the Phase IA survey research. The University of Vermont's Landscape Change Project website, which contains 1000+ digital images of Vermont places. The website includes a quick search function that allows users to key in place names to locate historic images.

4) Environmental Studies

Bedrock and surficial geological studies provide information about the region's physical structure and about geological resources within and near the Projects. The United States Department of Agriculture (USDA) Soil Conservation Service soil surveys of the Vermont and New Hampshire portions of the Projects supplied information about soil types and surficial deposits and the general categories of flora and fauna that these soil types support. Information relating to Project operations and previous erosion studies and corresponding GIS databases for each Project preparation by TransCanada were also reviewed during the Phase IA surveys.

Field Investigations

Following the initial analysis of known sites and sensitivity provided by the archival research, field investigations were conducted to familiarize the archaeologists with the Project APE, ground-truth preliminary hypotheses concerning topography and resource potential, and collect information about project effects (including shoreline erosion). The fieldwork for all three Projects was conducted in the fall months, and as such was able to focus on the impoundment shorelines as they exist at the normal operating levels upstream of the Wilder, Bellows Falls, and Vernon dams.

The fieldwork was conducted using a combination of boat and pedestrian/vehicle survey. Portions of the Project APE away from the shoreline on fee-owned lands where known sites are reported or documented and/or potentially sensitive landforms exist were examined on foot. The field crew also surveyed along a linear transect parallel to the top of the riverbanks. This ensured visual coverage of lands within the operating range for the lands along the impoundment upon which flowage rights are held by TransCanada. Close visual inspection of the shoreline from water's edge to top of the embankments was performed particularly to identify any surface indications of Native American resources such as artifact scatters and exposed hearth/pit features eroding from the banks.

Some confounding environmental factors in the survey of the Wilder and Bellows Falls Project shorelines were the presence of vegetation and a thick layer of gray silt deposited in late August 2011 during flooding from Tropical Storm Irene. The presence of vegetation on the river banks was generally a good indication of river bank stability given the magnitude of the recent flooding events. Siltation and in some case the formation of new sand bars is somewhat more ambiguous. On the one hand it represents a net deposition of sediment in some places, which may actually provide extra protection to archaeological sites. This is especially true where it was deposited by overbank flooding and generally lacked the energy to break up the existing organic root mat. In other cases, where the silt was deposited directly on active erosional surfaces, it hampered the archaeologists' ability to observe cultural materials and features. Other observations concerning the present physical condition of the Project shorelines included the presence of artificial disturbances (e.g. recent construction, docks, landings, causeways, and bridge abutments and structures).

All of the Vernon Project shoreline was assessed from the boat. The majority of the Wilder and Bellows Falls Project shorelines were assessed from the boat, but there were instances where closer inspection required debarking. Circumstances that warranted leaving the boat included any place there was a known site or cultural materials/features were observed from the boat using binoculars, areas determined to have a heightened archaeological sensitivity based on established criteria, and areas where significant erosional surfaces could not be adequately observed from the boat. Since most of the shoreline is privately owned, feature recording was limited to light trowel scraping of visible soil anomalies or features needed to verify the presence of cultural materials. This technique served to limit the amount of disturbance that would contribute to the natural erosion of the river bank. Digital photographs and GPS coordinates were taken in lieu of detailed profiles and measurements, and no cultural materials were collected from private property. Digital photographs and GPS points were also taken of existing conditions at all known or newly discovered sites and of all features and artifacts observed in the field.

The reconnaissance survey of visible historic site locations was limited to the same close ground-surface and shoreline inspections. The documented locations of post-contact period sites, particularly those noted on nineteenth-century town maps, were specifically targeted for visual inspection.

All previously recorded and newly identified archaeological site locations within the Project shoreline and fee-owned parcels were surveyed with the aid of a Trimble GeoXM submeter model, in combination with VDHP and NHDHR site file information and current study area maps.

Archaeological Sensitivity Assessment

Information collected during the archival research and the riverine and terrestrial field surveys was used to develop a predictive model of potential site types and their cultural and temporal affiliation. The development of predictive models for locating archaeological resources has become an increasingly important aspect of CRM planning.

The predictive model considers various criteria to rank the potential for the Project to contain archaeological sites. The criteria are proximity of recorded and documented sites, local land use history, environmental data, and existing conditions. The Project shoreline and fee-owned lands were stratified into zones of expected archaeological sensitivity to guide future land management and planning activities. A full discussion of the pre-contact, contact, and post-contact period sensitivity models used in New England is included in the corresponding technical Phase IA survey reports.

The VDHP has formulated an environmental predictive model (VTEPM) for locating pre-contact/contact Native American habitation sites within the state. Based in large part on Thomas's predictive site location model, individual environmental variables are first grouped by class (rivers and streams, wetlands, etc.) and then assigned a positive or negative numerical ranking. Using this score sheet, an area can be sensitized by determining the presence/absence of the specific variables, combining the associated scores, and comparing the total score to a predetermined valuation scale; a score of less than 32 is assessed as archaeologically non-sensitive while a score of greater than 32 is considered archaeologically sensitive. While this method is necessarily broad in scope and must be refined through careful field inspection, it does provide a preliminary indication of the archaeological sensitivity of an area. The full discussion of the application of the VTEPM to the Project shorelines and fee-owned parcels in Vermont is included in the corresponding technical Phase IA survey reports. For the New Hampshire portion of the Project, there are no state-level sensitivity maps or numerical ranking criteria. Therefore, the Phase IA surveys employed similar environmental/cultural factors included in regional predictive models to determine the archaeological sensitivity of the Project shorelines and fee-owned parcels in New Hampshire.

ATTACHMENT 33-B

Recommended APE Maps

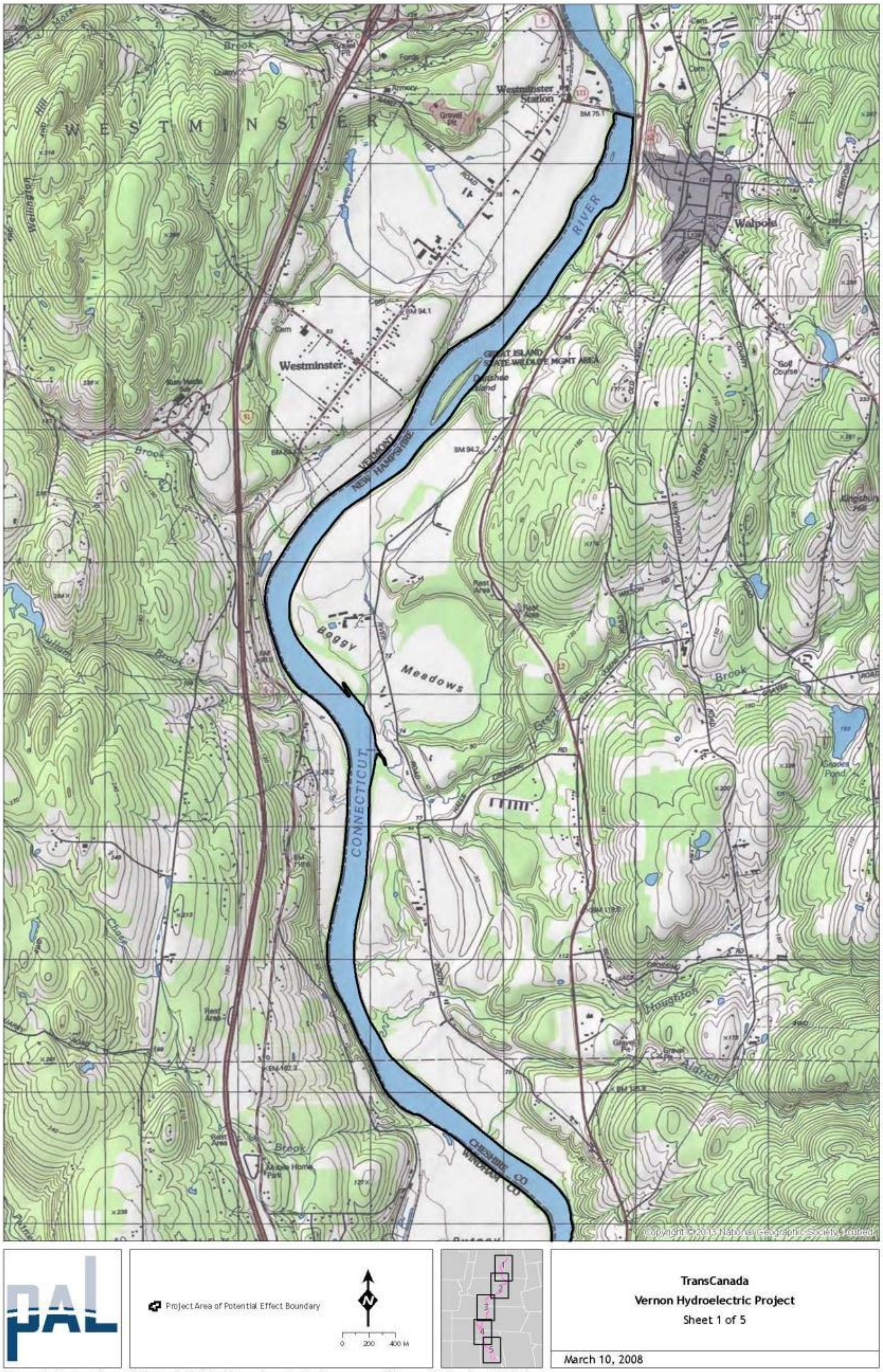

Figure 1. Project Area of Potential Effect for archaeological resources, Vernon Hydroelectric Project.

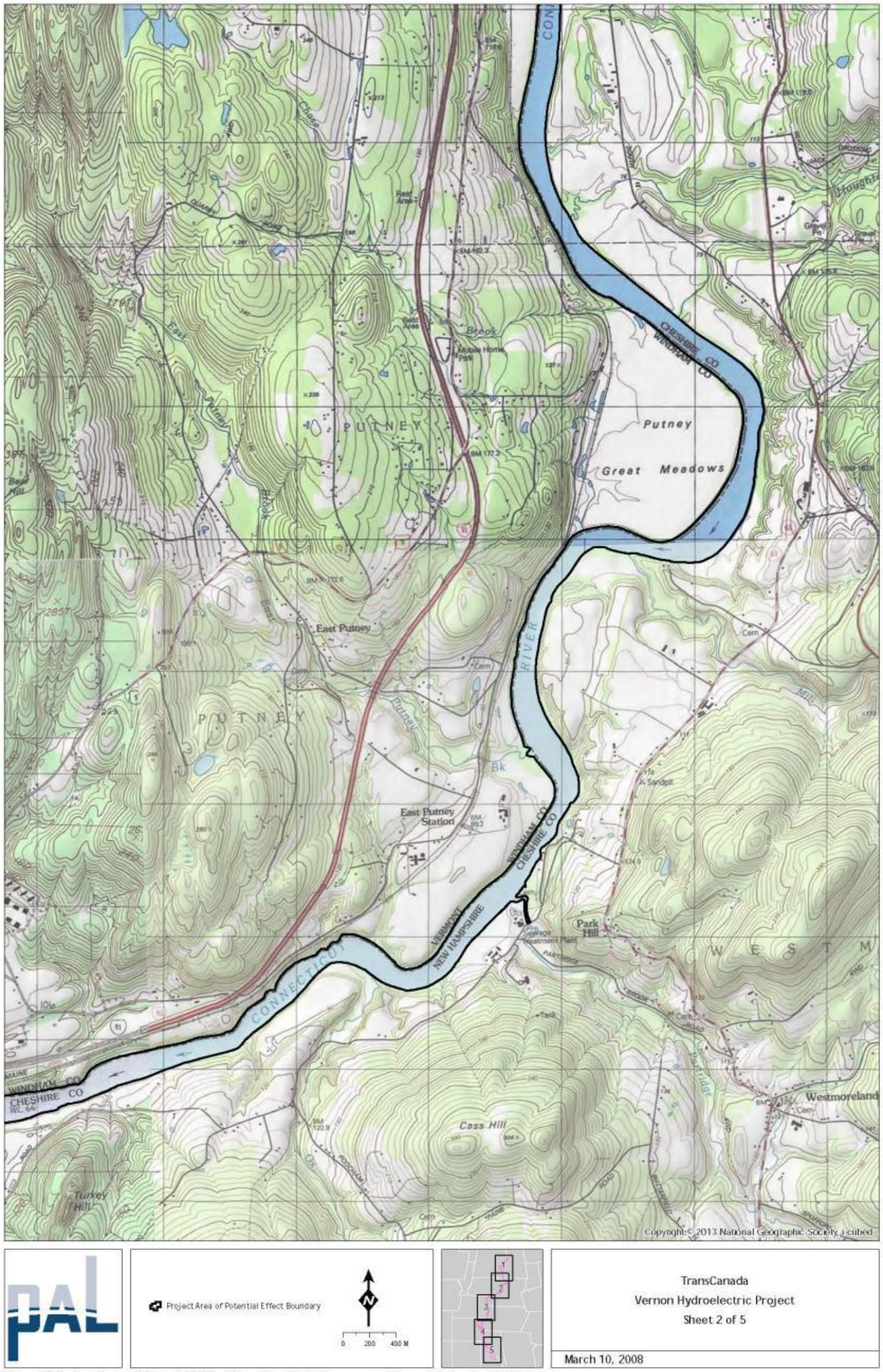

Figure 2. Project Area of Potential Effect for archaeological resources, Vernon Hydroelectric Project.

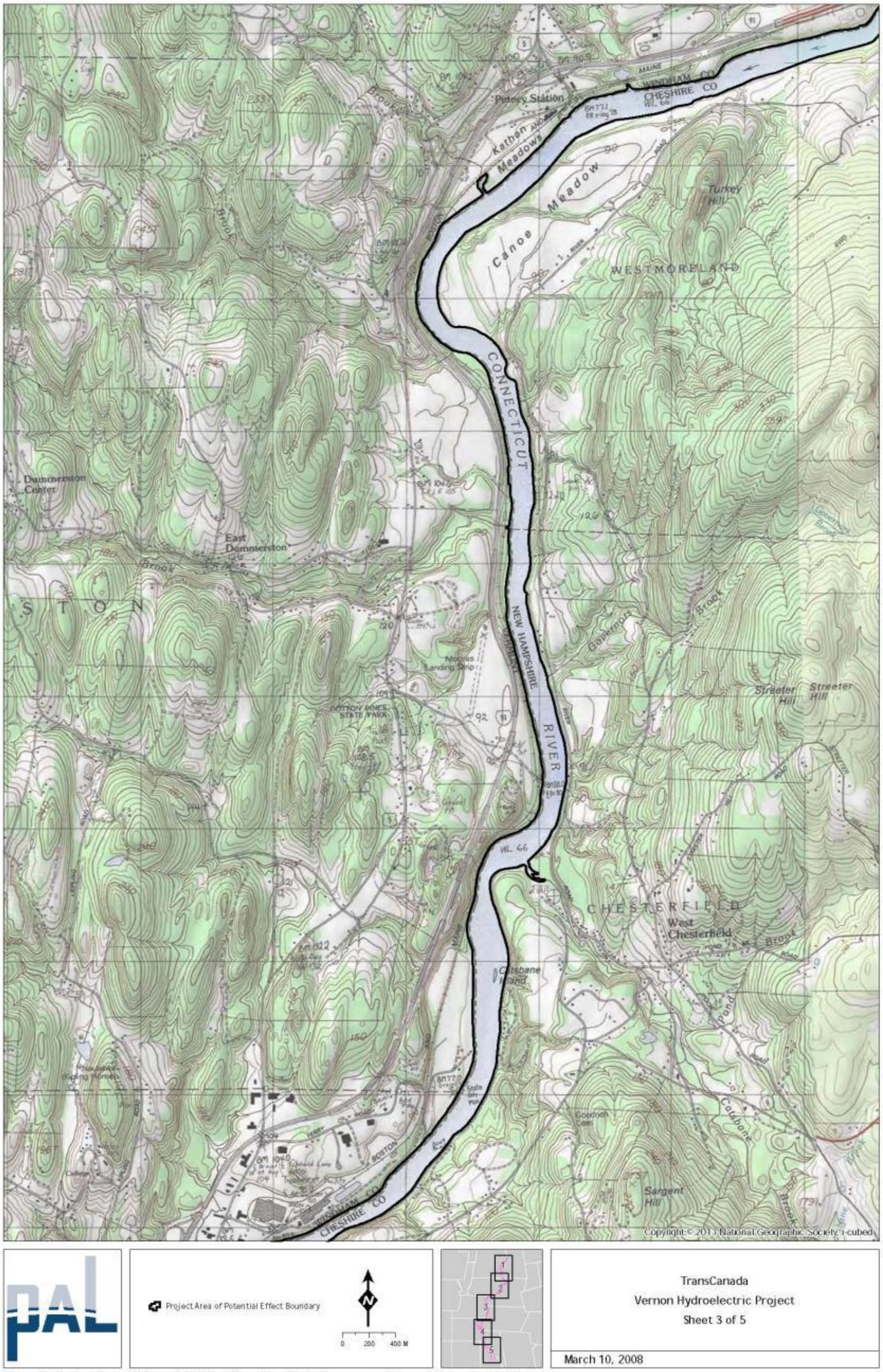

Figure 3. Project Area of Potential Effect for archaeological resources, Vernon Hydroelectric Project.

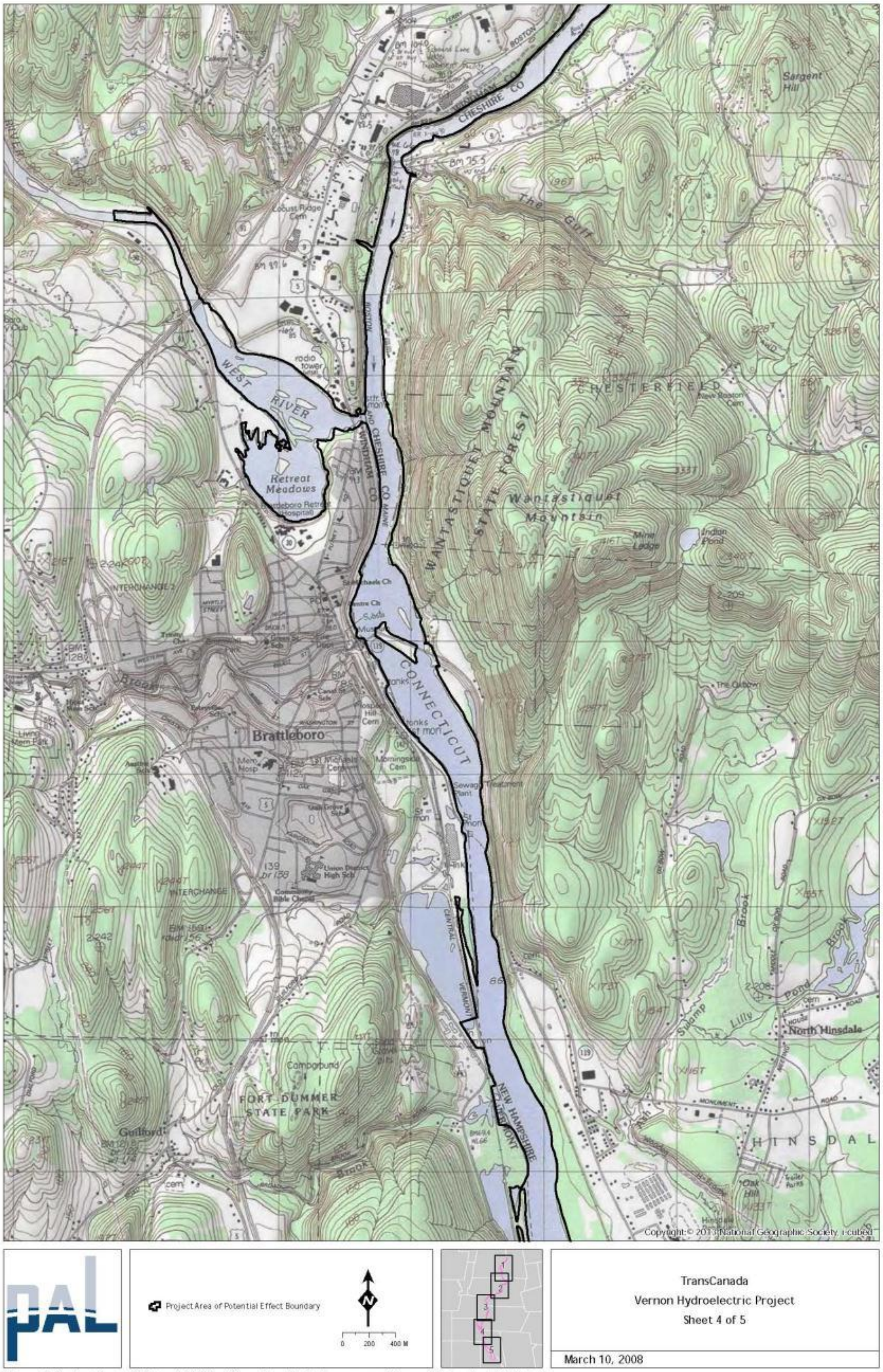

Figure 4. Project Area of Potential Effect for archaeological resources, Vernon Hydroelectric Project.

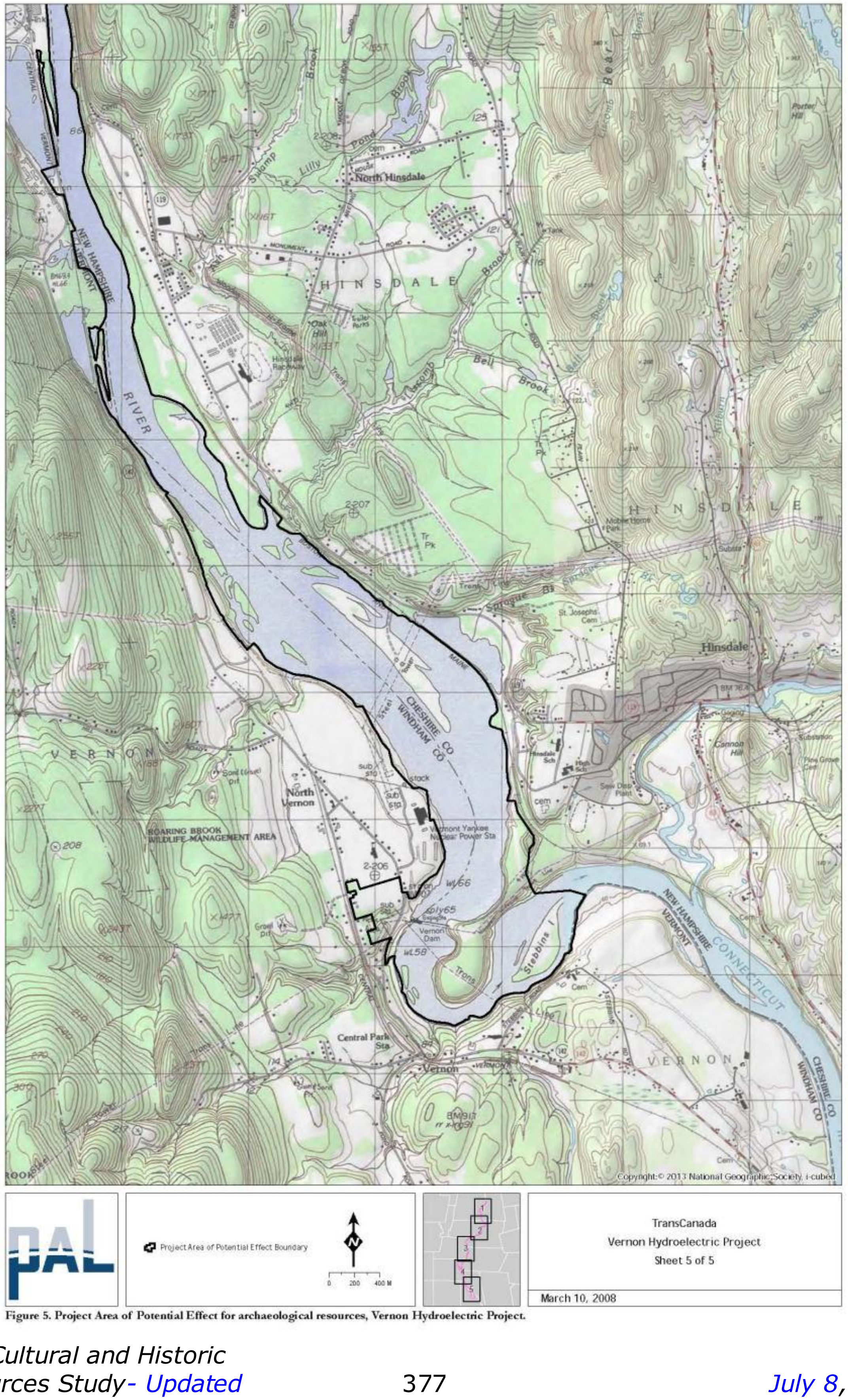

Figure 5. Project Area of Potential Effect for archaeological resources, Vernon Hydroelectric Project.

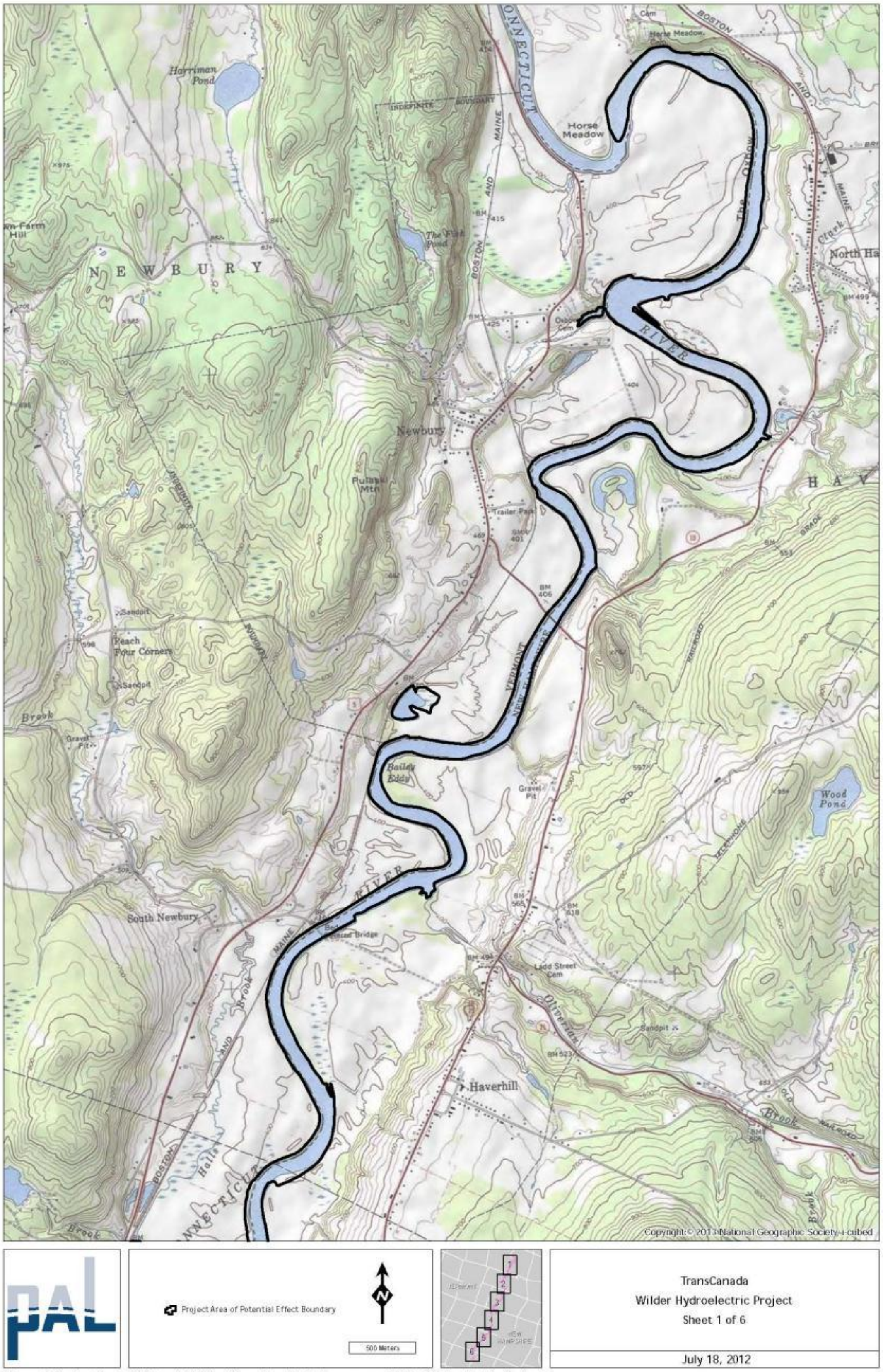

Figure 6. Project Area of Potential Effect for archaeological resources, Wilder Hydroelectric Project.

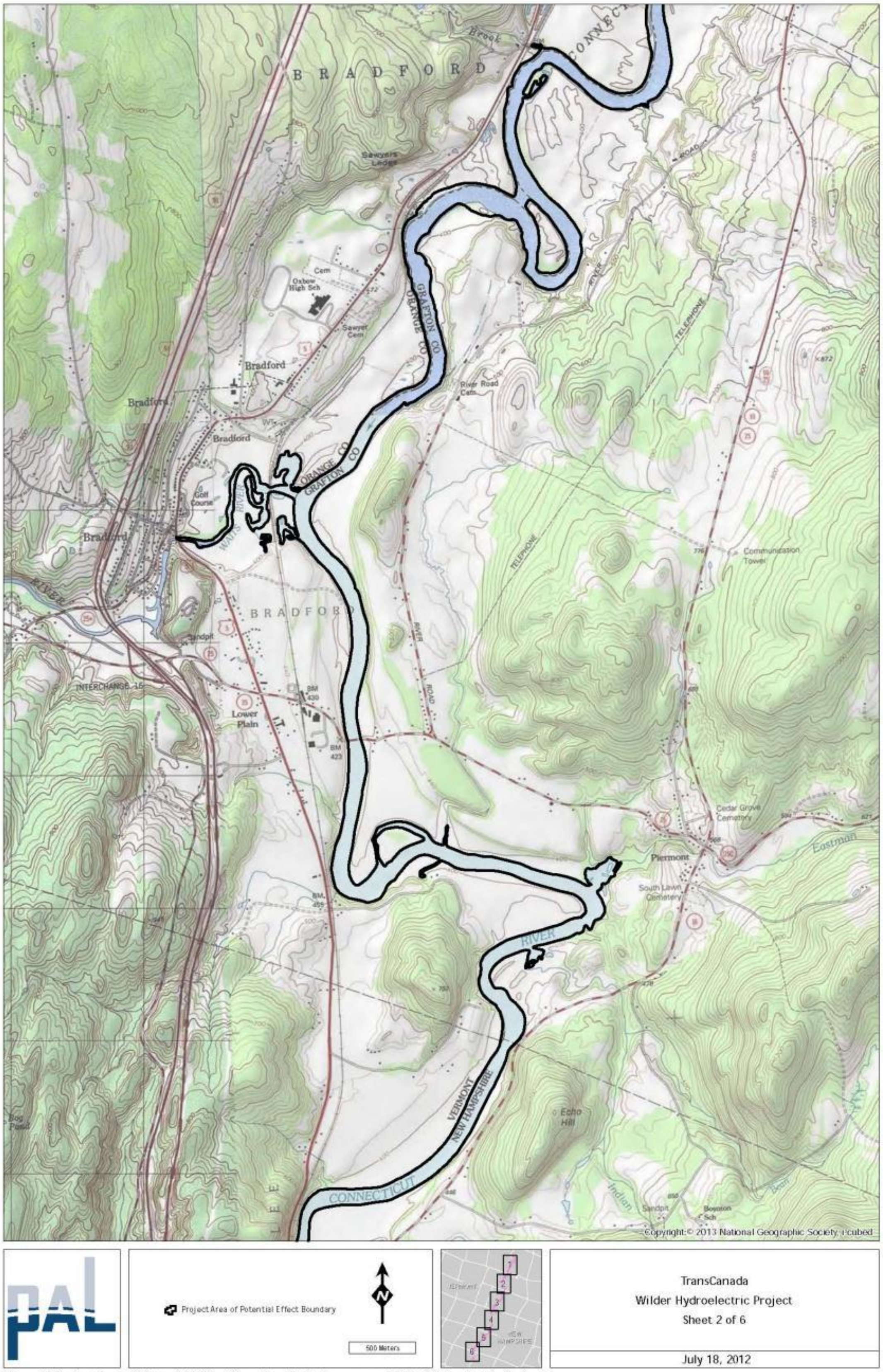

Figure 7. Project Area of Potential Effect for archaeological resources, Wilder Hydroelectric Project.

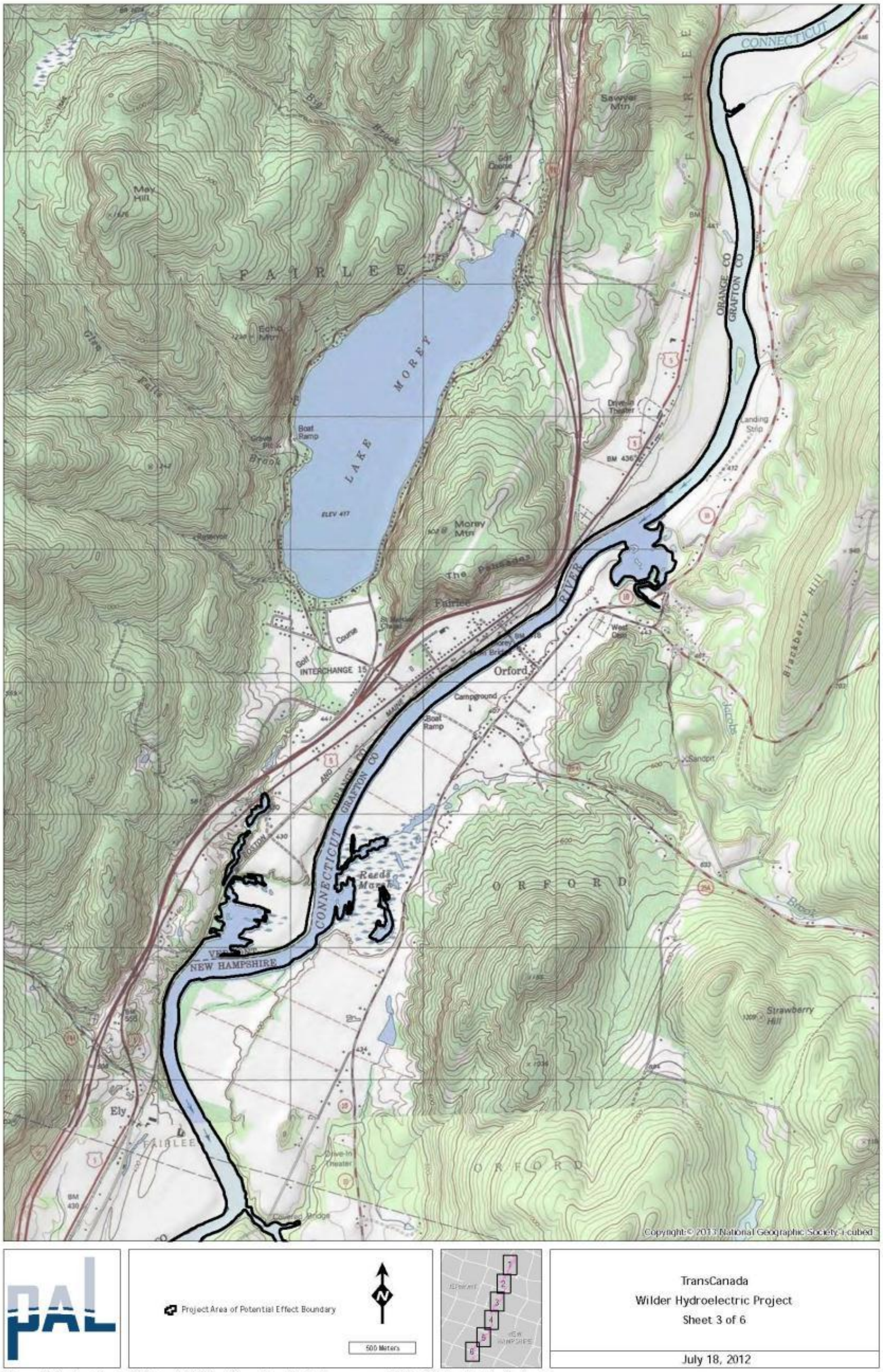

Figure 8. Project Area of Potential Effect for archaeological resources, Wilder Hydroelectric Project.

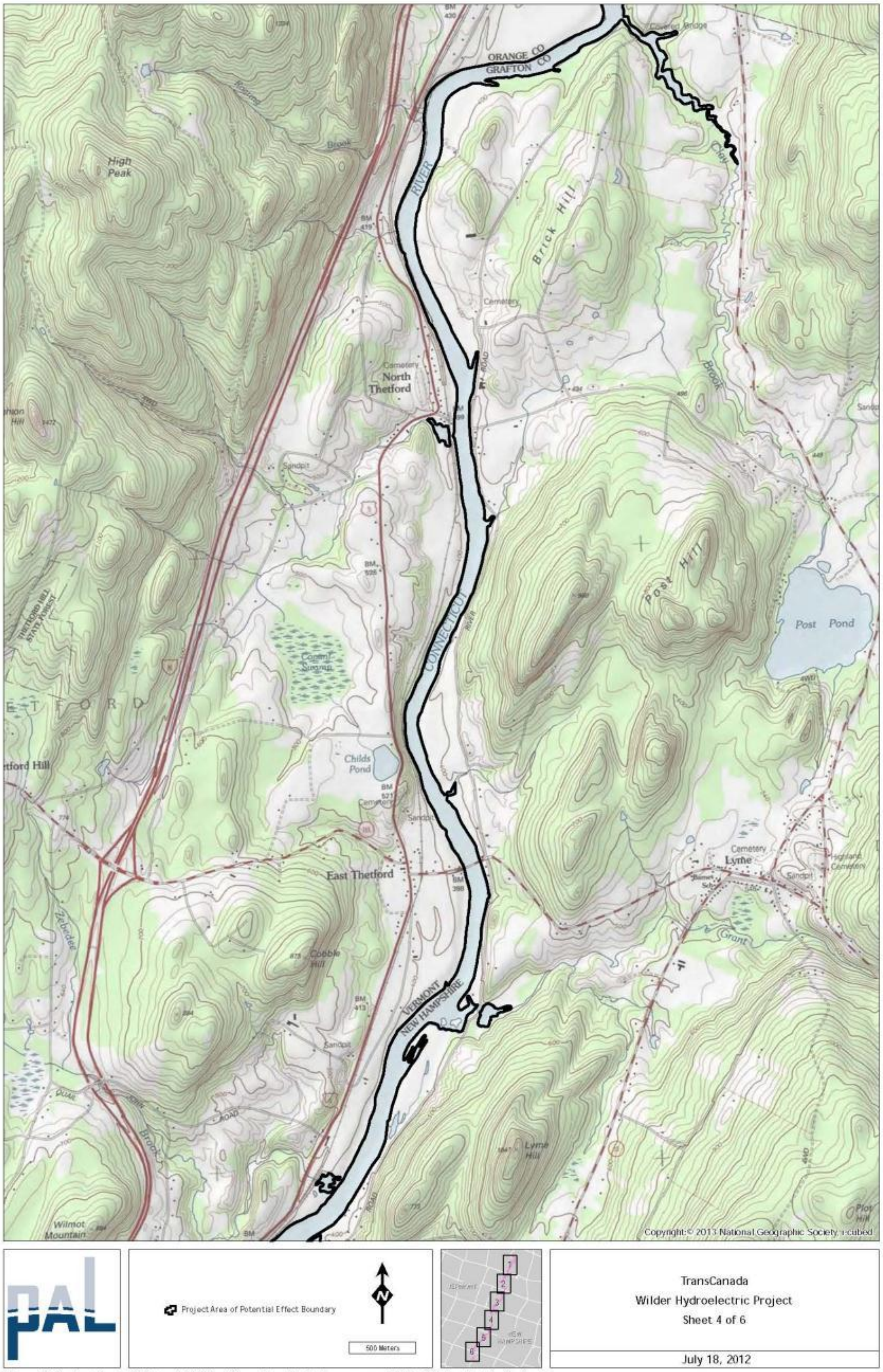

Figure 9. Project Area of Potential Effect for archaeological resources, Wilder Hydroelectric Project.

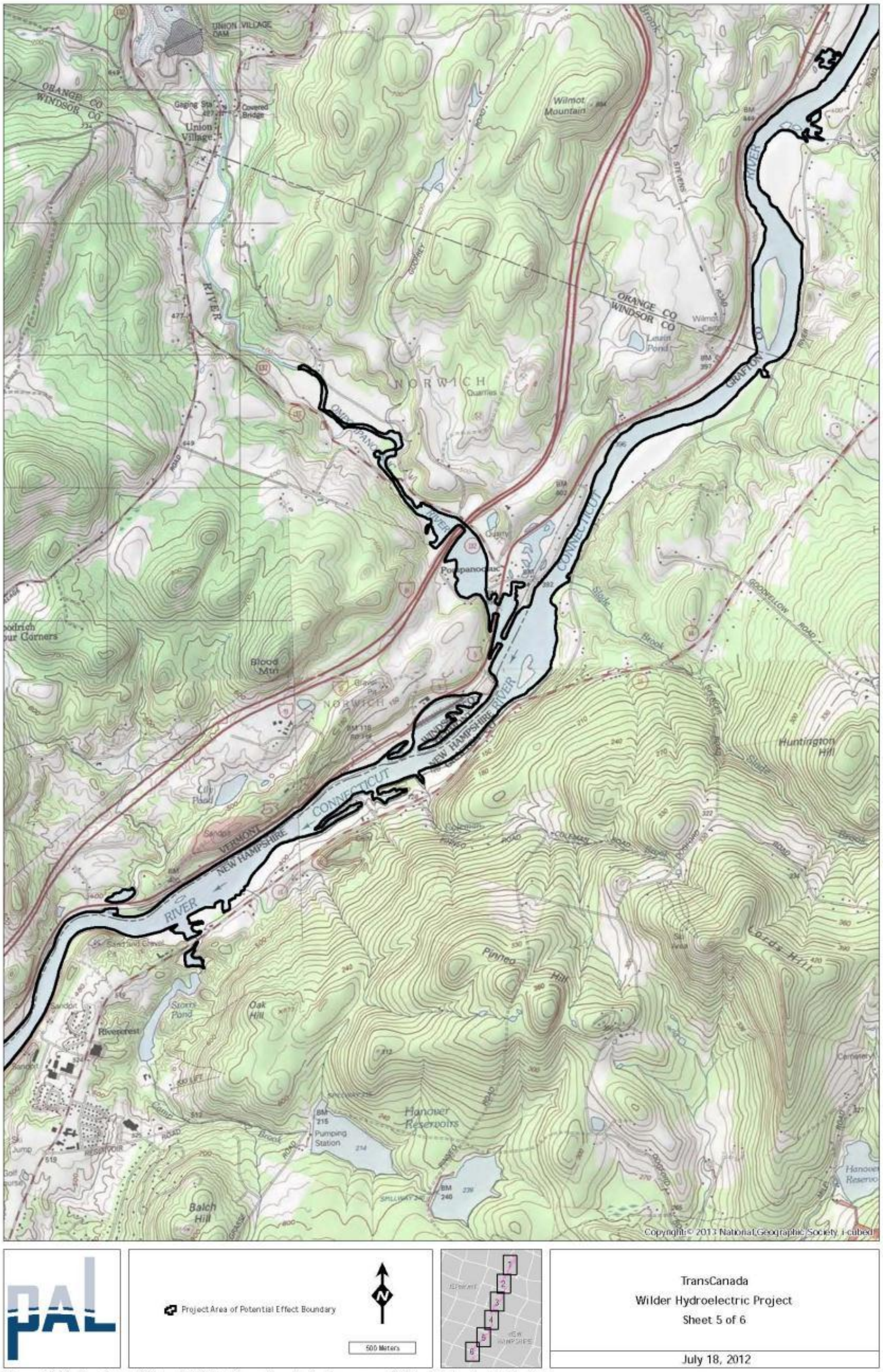

Figure 10. Project Area of Potential Effect for archaeological resources, Wilder Hydroelectric Project.

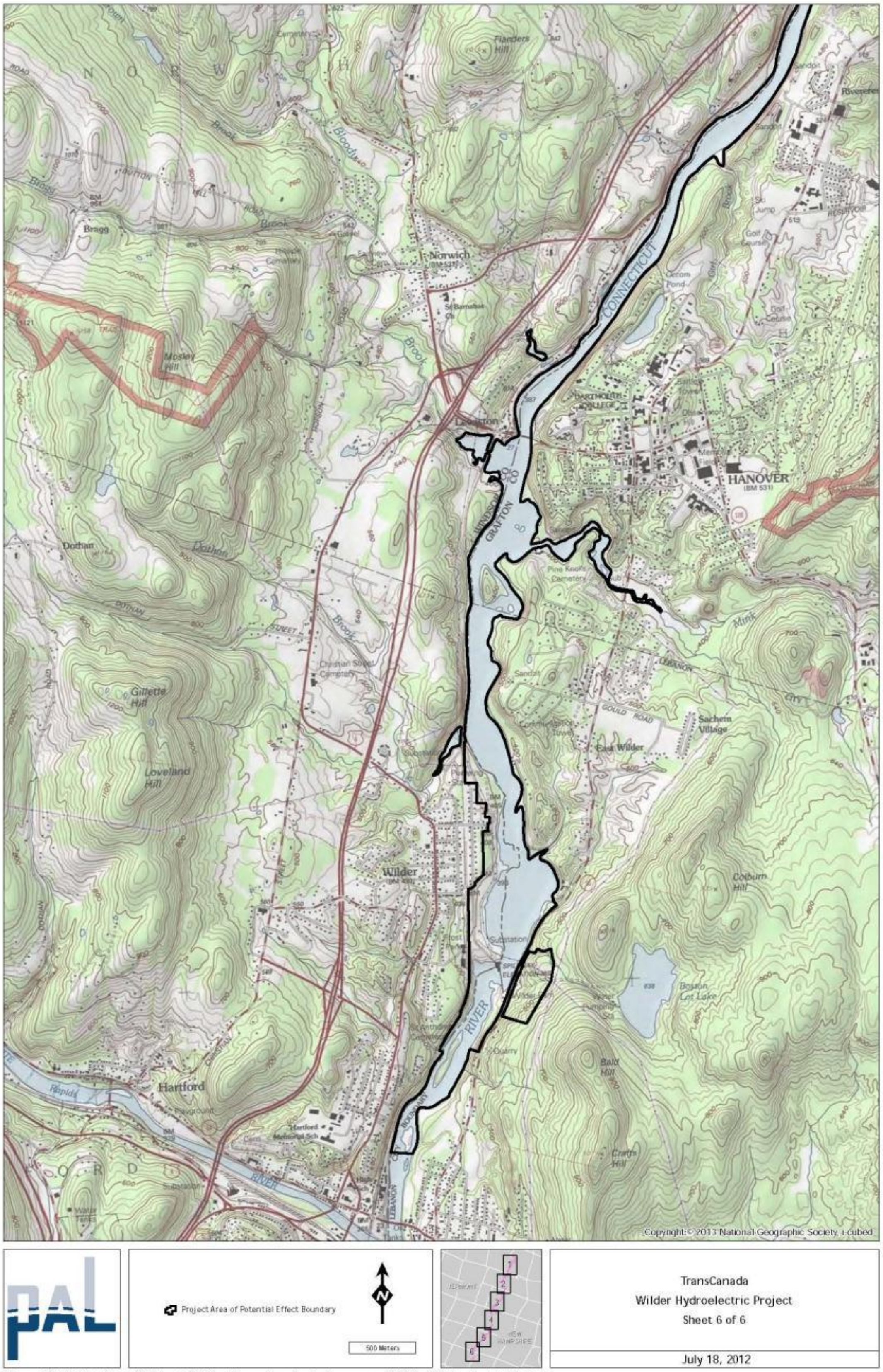

Figure 11. Project Area of Potential Effect for archaeological resources, Wilder Hydroelectric Project.

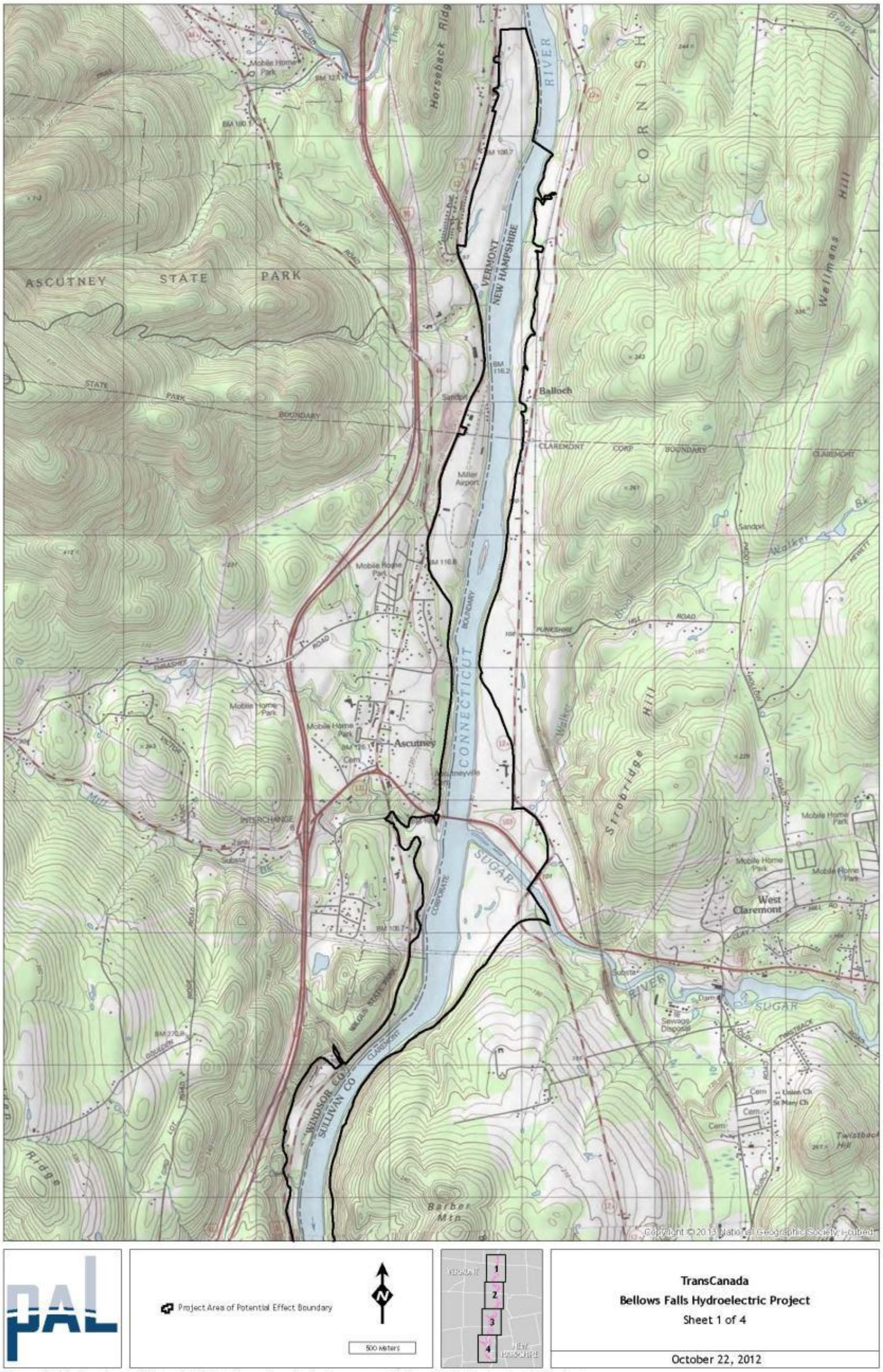

Figure 12. Project Area of Potential Effect for archaeological resources, Bellows Falls Hydroelectric Project.

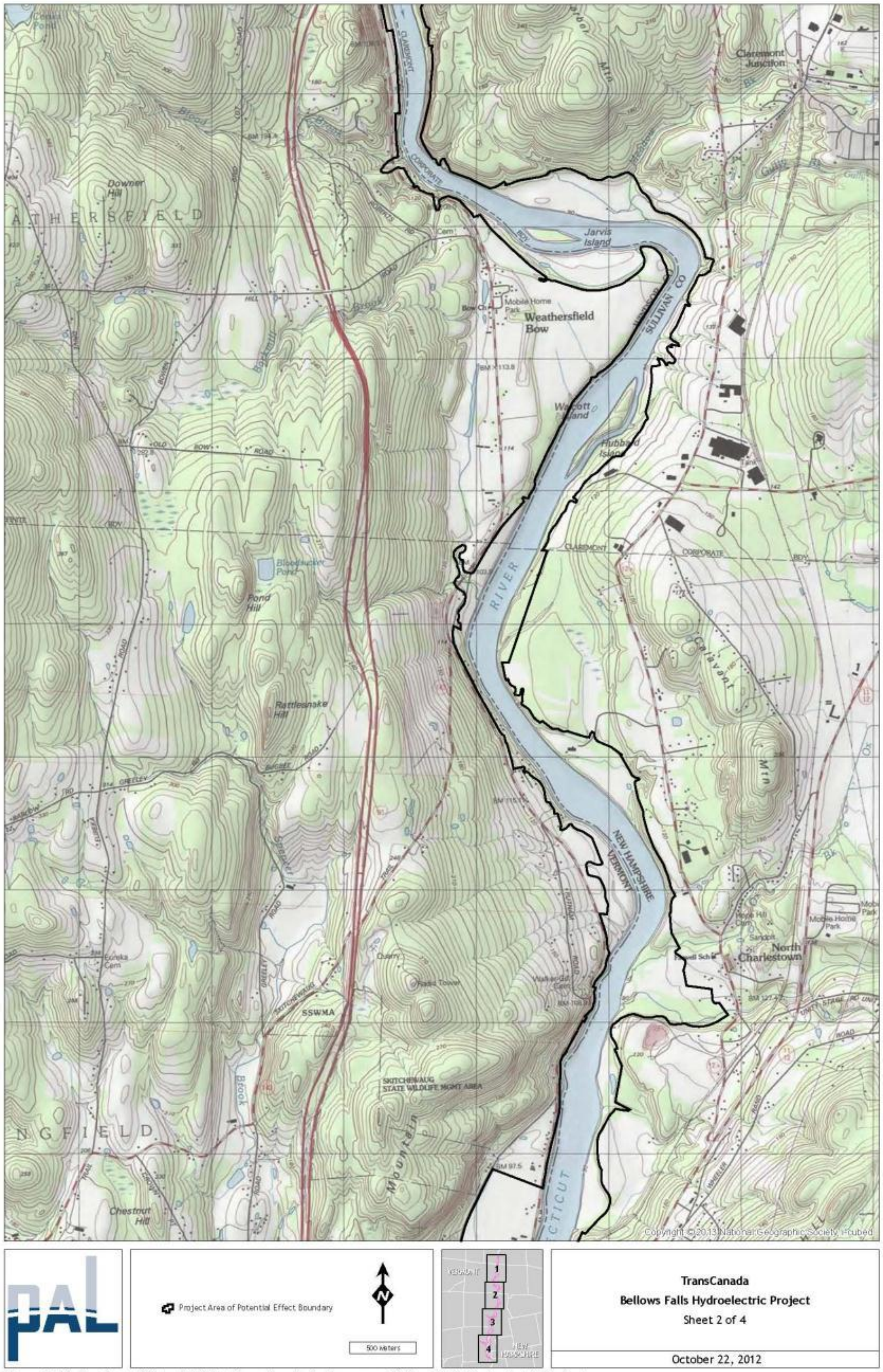

Figure 13. Project Area of Potential Effect for archaeological resources, Bellows Falls Hydroelectric Project.

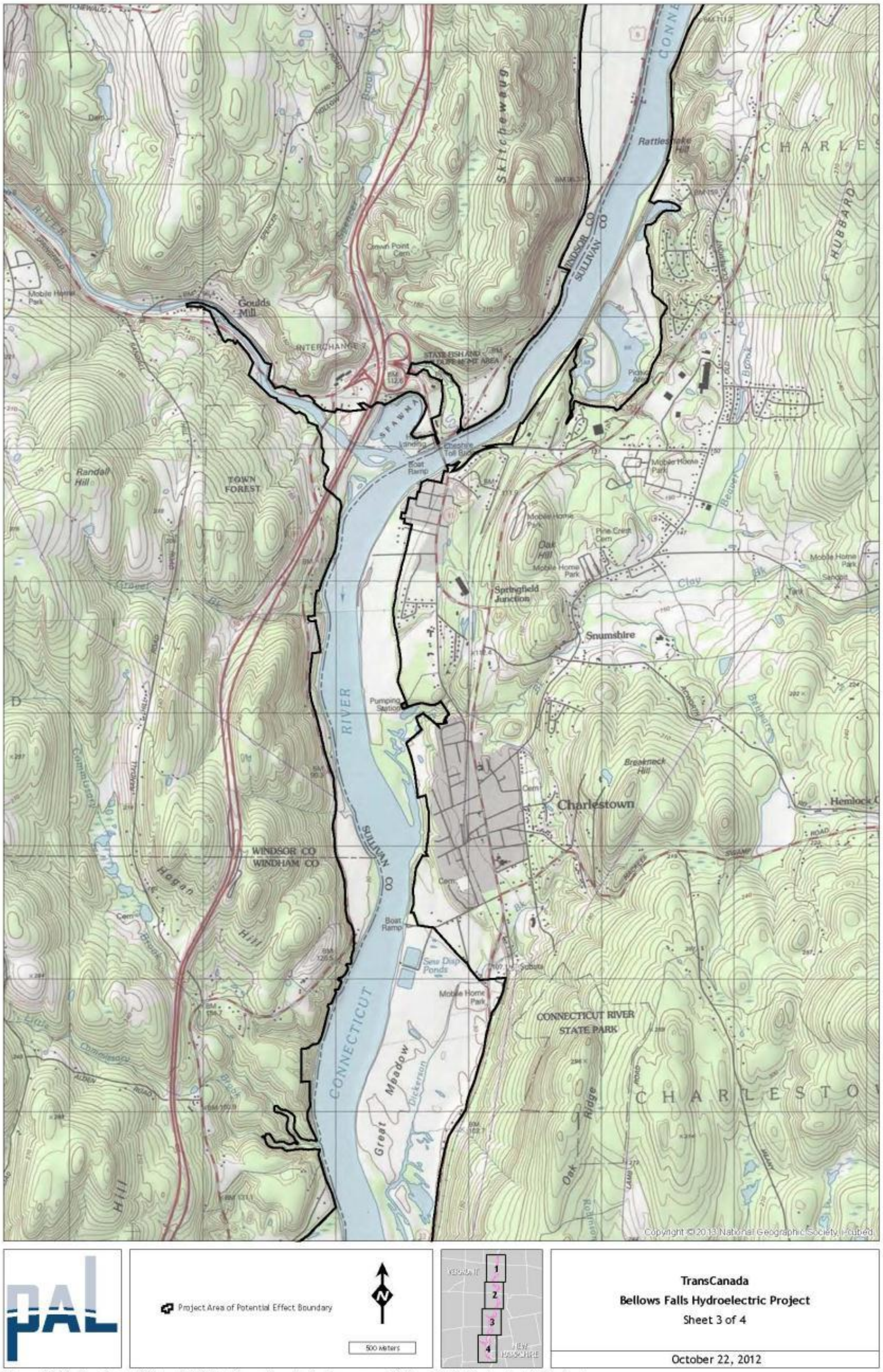

Figure 14. Project Area of Potential Effect for archaeological resources, Bellows Falls Hydroelectric Project.

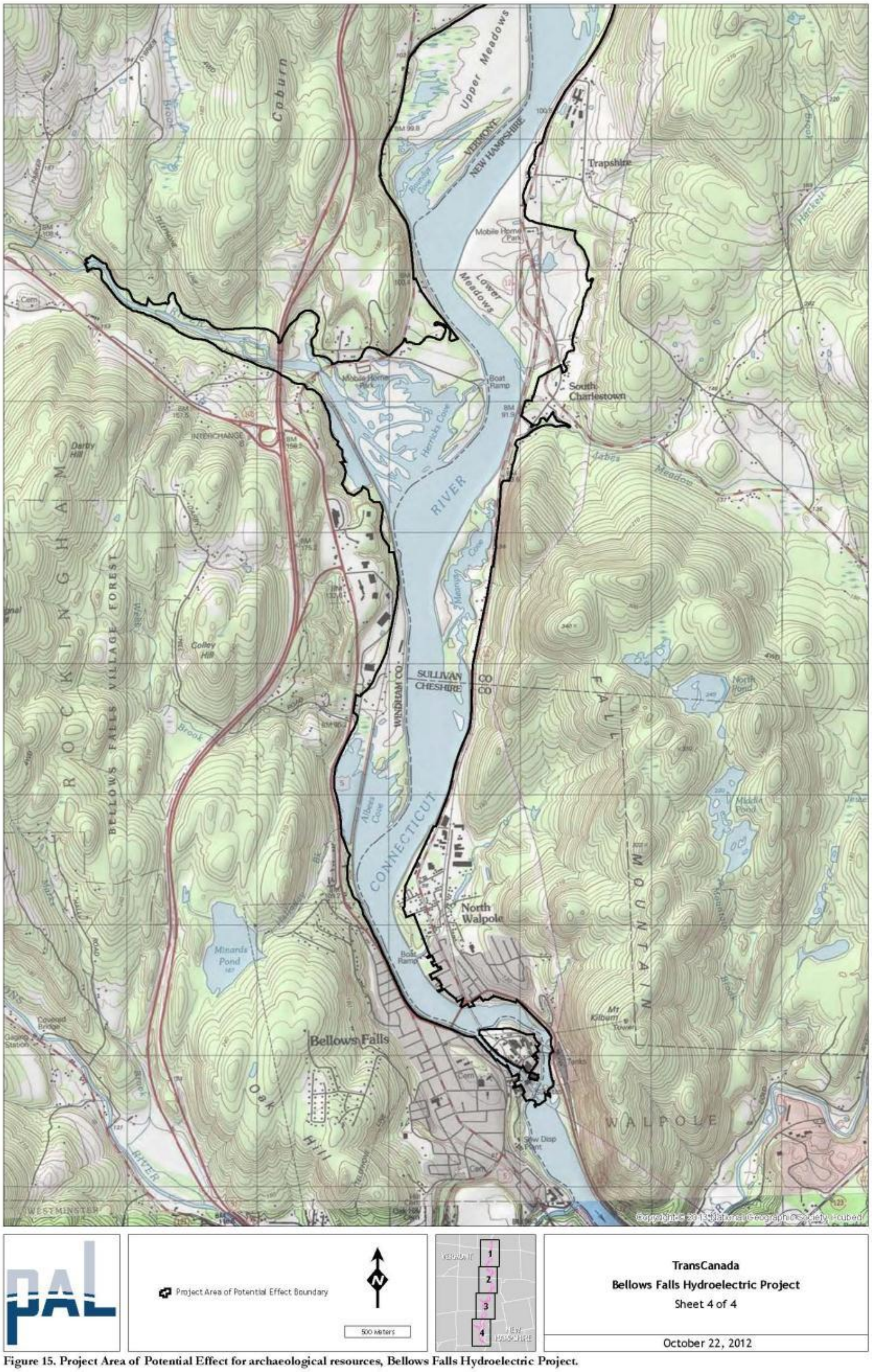

Figure 15. Project Area of Potential Effect for archaeological resources, Bellows Falls Hydroelectric Project.

APPENDIX A

SUMMARY OF STUDY PLAN MEETING COMMENTS AND RESPONSES

SUMMARY OF MEETING NOTES AND RESPONSES

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Erosion Studies Nos. 1, 2, 3

A. Erosion Monitoring: Provide more detail, clarification on process, criteria and stakeholder consultation for determination and selection of erosion monitoring sites; including number of sites, where (distribution) and identification (locations on maps, GPS, landowner, etc.) in SP		
	Process can be described but the actual sites and details on why they were chosen will not be available in time for the revised study plan	Revised SP to describe process
B. Erosion Study: Provide more detail, clarification on process and approach (step-wise) to a possible more detailed analysis of erosion.		
	This pertains to sites we determine though our current proposed studies to be significantly affected by project operations.	Will consider pending evaluation but this is potentially beyond the scope of current studies.
C. Historic Documentation of Erosion: Make an effort to reach out to landowners for specific surveys associated with riverfront property that could lead to assessments of land losses due to erosion. Contact landowners.		
	Need to identify a cost-effective process and criteria for gathering valid (licensed survey) information (e.g, target landowners, send letters, review of archival information.	Added into SP only for sites with rapid erosion, significant changes etc. to manage cost-effectiveness.
D. Historic Documentation of Erosion: Contact NCRS offices for information associated with requests for assistance from riverfront landowners. (NH NRCS contact named by stakeholders was Steve Schmidt).		
	Revise Study Plan to incorporate consultation with NCRS offices.	Revised SP
E. Erosion Monitoring: Consider changes in proposed monitoring frequency due to observations of rapid erosion or based upon event triggers (high runoff events, ice scour, spring freshet). Identify and characterize events historically, frequency; if possible tie events to erosion observations or noted changes in morphology.		
	Describe plan for how to proceed with more details where rapid erosion is identified, need to identify added cost.	Revised SP to provide process for this and for consultation and change in monitoring frequency.
F. Historical Erosion/Erosion Monitoring/Erosion Study: How are we incorporating effects of Vernon discharge on erosion? Accounting for erosion below Vernon Dam. Delineate extent of Geographic scope on a map.		
	Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island	Revised SP to include 1.5 miles below Vernon dam
G. Historical Erosion/Erosion Monitoring/Erosion Study: Need provisions in SP for including locations and descriptions and develop attribute tables of all locations cited in the three studies. Map them in a manner in which information and locations can be shared.		
	Include language in each erosion SP describing such a GIS database	Revised SP

H. Historical Erosion/Erosion Monitoring/Erosion Study: Incorporate known or established standards or terms for erosion with respect to characterizations or descriptions, causal agents and study methodologies.		
	References for methods are included in the SPs, but not sure such "standards" exist. Need to do some research to see what can be incorporated into SP or as part of studies themselves.	Revised SP to describe evaluation as part of studies, rather than developing/incorporating standards in the SP.
I. Erosion Study: In describing methodologies and analyses – indicate how and the rationale for circumstances and locations in which 2D modeling will be used to evaluate project operation effects on erosion.		
	Expand language in SP section to incorporate this request	Revised SP At specific sites where cross channel variations exist, 2D would be helpful for additional details.
J. Historical Erosion/Erosion Monitoring/Erosion Study: Expand on our deliverables associated with each of the three studies. Expand and clarify the timetable for deliverables and consultation.		
	Some of this may have been in earlier drafts of SPs and can be reincorporated into plans	Revised in SPs
K. Erosion Study: Conduct a phased-approach which could lead to more precise evaluation of erosion; if project effects are considered significant within proposed study plan scope, what additional or options for additional studies are available and warranted. Describe the process for determining need for additional studies in the study plan. Describe additional study plan options or preferences or proposal in study plan rather than leave it ambiguous. Consider a more geotechnical approach (Mudge).		
	Examine options for higher level erosion studies following the proposed study; criteria for initiating this additional analysis: significant project effect determination.	Revised SP to describe process for sites displaying greatest rates of erosion, consultation with working group along the way to identify sites for additional study if warranted, and working toward process to evaluate in more detail.
L. Erosion Monitoring/Erosion Study: Consider long term monitoring in study plans or in the future. Should be consideration in a shoreline management plan.		
	Long term monitoring and a shoreline management plan are mitigation.	This is beyond the intent of this study, but there will be permanent monuments for future study if needed. Revised SP to indicate that the results of this baseline study will help to inform potential mitigation measures.

Hydraulic Modeling Study No. 4

<table>
<tr><td colspan="3">A. Provide more detail and clarification of calibration and verification methods, process and techniques in the study plan.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP</td></tr>
<tr><td colspan="3">B. Provide more detail, clarification on process, criteria and stakeholder consultation for determination and selection of water level logger data that in part would be used for calibration and verification.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP for process and criteria for calibration, and relative to consultation for verification.</td></tr>
<tr><td colspan="3">C. Provide more detail on accuracy of data logging equipment, LiDAR, bathymetry sounding equipment. Provide more description on QA/QC methods and control.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP for LiDAR.

Data loggers and bathemetry equipment revisions are in SP No.7</td></tr>
<tr><td colspan="3">D. Provide more detail, clarification on association with other studies and goals: 1.) Data input into the hydraulic model from data collected and described in all the associated studies; 2.) Relations ships of how and methods for using the information from hydraulic model to the various resource studies to describe project effects</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP and includes a flow chart illustrating relationships – draft version included on next page here.</td></tr>
<tr><td colspan="3">E. Explain use of “Mannings N” value and how it would be used or adjusted for calibration.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP</td></tr>
<tr><td colspan="3">F. Time step clarification sought: data logging time step, model time step</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP for data-logging 15-minute time step and model time step of 1 hour, with sub-hourly time steps (in study No. 5)</td></tr>
<tr><td colspan="3">G. Provide more detail, clarity, method associated with dynamic routing. Where might this be used? Particularly at the upstream extent of the impoundment where effects are associated with impoundment fluctuations and inflow or upstream project discharge.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP</td></tr>
<tr><td colspan="3">H. Examine capabilities and opportunities to use sub-hourly time steps to evaluate more precision in certain operational conditions (likely this refers to discharge-rates of change in elevation-rate of ramp)</td></tr>
<tr><td></td><td>Consult with TC Operations on unit loading/unloading procedures and identify need for sub-hourly time steps with resource studies.</td><td>Revised SP to include sub-hourly time steps on a pilot basis to evaluate the need for this in the larger study context.</td></tr>
</table>

Operations Model Study No. 5

A. Provide more detail and clarification on the selection criteria for the specific 5 years of hydrology: 1992, 1994, 1989, 2007 and 1990 proposed. How they represent range of conditions both annually and seasonally. Clarify the hydrologic assessment that relies on 5 years; why not 40 years; provide better understanding.		
	Revise Study Plan	Revised SP for selection criteria and clarification.
B. Provide more detail and clarification on the 1.) use and purpose as well as 2.) the selection criteria associated with 2010 energy prices as pricing signals in the model. Describe the energy data set. Describe the development, validity and of the pricing data and how it reasonable to use in the model.		
	Revise Study Plan	Revised SP to include more detail and clarification.
C. Add additional definition of costs associated with model development and alternative runs; adding new structures or nodes.		
	Revise Study Plan	Revised SP to include subtasks and costs.
D. Specify routing functionality or details used in the operations model.		
	Revise Study Plan	Revised SP to provide more information.
H. (from Study 4 above) – Examine capabilities and opportunities to use sub-hourly time steps to evaluate more precision in certain operational conditions (likely this refers to discharge-rates of change in elevation-rate of ramp)		
	Consult with TC Operations on unit loading/unloading procedures and identify need for sub-hourly time steps with resource studies.	Note that this sub-hourly modeling approach process has been finalized and plan will be updated in this plan and perhaps in other plans as well. We are not proposing to do this under the normal operations modeling process, and for use in all cases. It is extremely intensive, and will only be used only in instances when it is clear that a particular resource is impacted on an hourly basis. If the models show a significant impact, we will attempt to employ this technique. This will be based upon the other habitat studies associated with flow velocity or depth has been shown to be significantly affected by project operation.

Water Quality Study Plan No. 6

A. Revise study plan to include tables similar to 2.1-1 and 2.2-1 of the 2012 Baseline WQ report. Table 2.1-1 includes a description and Lat/Long for each WQ station ("approximately" or "near").Table 2.2-1 is a summary of the type and frequency of sampling that will occur at each station. We also said we'd include a map showing approximate station locations.		
	Revise Study Plan	Revised SP and tables added. This study is intended primarily as an extension of the 2012 study for consistency, with some additional monitoring.
B. Include description of measures and tactics for QA/QC in Study Plan		
	Revise Study Plan	Revised SP based on 2012 study.
C. Include provision in the SP for uploading WQ data to the NH Environmental Monitoring Database		
	Revise Study Plan	Revised SP
D. Include provision for downloading reservoir data on the same or near approximate same date for each reservoir to the extent reasonably possible.		
	Revise Study Plan	Revised SP. We will attempt to do this to the extent possible, given the length of the impoundments and time needed to download each monitor.
E. Add or ensure WQ monitoring occurs in Bypass Flow Demonstrations for Aquatic Habitat		
	Revise WQ and Instream Flow Study No.9	This applies study No. 9 - instream flow) and is included therein. There will be several demonstration flows planned and WQ data collected. This data will be included in the WQ study.
F. Suggest season for Temperature logging to extend from April 1 thru November 15 – primarily for fish habitat concerns		

	This can be accomplished by relying on the continuously recording temperature units at all three fish ladders from early spring (after ice-out) to late fall (prior to significant freezing) as part of study 17 – Upstream Passage of Riverine Fish Species. Temperature data for 2013 will also be available from the data loggers installed as part of Study 7 – Aquatic Habitat Mapping, and additional water temperature monitoring would occur from early April through much of the summer as part of the resident fish spawning in riverine reaches and impoundments (studies, 14 and 15).	Revised SP based on this proposal. It may also be possible to obtain VY's temperature data submitted to VANR on a monthly basis as part of VY's NPDES permit. TC to contact VY and State of VT about ability to obtain data submitted to the state.
G. Collect Temperature data above VY and below to discern temperature plume		
	We propose to add water temperature monitoring at vertical and horizontal transects upstream and downstream of VY from October 1 through November 15.	Revised SP.

Habitat Mapping and Bathymetry Study No. 7

A. Note in the SP as to the ability or desire to perform the bathymetry mapping at the highest pond possible.		
	Consult with TC Operations and determine the extent possible for summer 2013.	Revised SP. We will attempt to do this based on flow/elevation changes and timing, and rain events.
B. Provide clarity and criteria for adjusting and collecting 1-foot contour bathymetry when depths are 10 feet or less from top of reservoir max elevation, regardless of whether along edge or in center of river (i.e., islands).		
	We understand the request; however adding 1 foot contour generation is a significant increase in cost and effort and we will consider alternatives to address this request in a reasonable manner. Comment: there are no data loggers for significant distances. From Wilder to Blood Brook.	Changes in SP have not been determined at this point. Noted, may add another logger in this area, and there are several extra data loggers that can be deployed. Email John R with additional ideas for placement of data loggers.
C. Provide greater clarity on substrate sampling methods, techniques; particularly in the deeper areas associated with downstream (riverine) reaches. (drag chain, copper pole methods suggested)		
	Revise SP	Revised SP
D. Note in the SP as to the ability or desire to perform the bathymetry below the dams (in riverine section) during low flow conditions, for the purpose of mapping the transition area from riverine to impoundment.		
	Consult with TC Operations and determine the extent possible for summer 2013.	Revised SP Statement added to address this in the first paragraph of the methods. Note that bathymetry is not the appropriate technique for riverine sections. See response to G below.
E. Provide more detail on accuracy of instruments, bathymetry sounding equipment. Provide more description on QA/QC methods and control.		
	Revise SP	Revised SP Added detail to QC habitat methods Added bathymetry QC detail to methods section along with reference to NOAA survey guidelines being followed
F. Consider methods to assure coverage of so-called transitional zones (areas impacted by impoundments and discharge – sometimes exclusively and other time concurrently). Expressed desire to map under impoundment conditions (high pond) and map as riverine (low flows).		
	Consult with TC Operations and determine the extent possible for summer 2013.	Revised SP as noted above

G. Deeper areas in the riverine habitats below the dams may require additional methods to acquire bathymetry. Please identify methods that will be considered as well as those that cannot be used and explain merits or issues associated with each. Identify criteria or decision making (when and why) that will drive the decision to use a particular method.		
	Identify options – may not be practical to do.	SP clarified Bathymetry was limited to the impoundment sections as the equipment to conduct that work needs to be mounted on an appropriate survey vessel and should not be bouncing around in riverine sections with limited access and/or shallow water obstacles. Mesohabitat mapping will be conducted as part of the instream flow study (No.9) and this work will occur in the riverine sections.

Channel Morphology and Benthic Habitat Study No. 8

A. Explain the selection process for tributaries and assessment locations in the SP.		
	Revise Study Plan	Revised SP to clarify that the process will include stakeholder involvement.
B. Suggestion that we include: Cold, Saxton's River, Williams, Mascoma and White		
	Revise Study Plan	Revised SP
C. We should include a quantification of embeddedness of the gravel with particular attention to habitat suitability.		
	Revise Study Plan	Revised SP - EPA rapid bioassessment protocol will be used and study plan revised to reflect this.
D. Provide more detail, clarification on process, criteria and stakeholder consultation for determination and selection of tributaries		
	Revise Study Plan	Revised SP

Instream Flow Study No. 9

A. Include (study) "riverine" reach below Vernon in the riverine instream flow study.		
	Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island	Revised SP
B. Habitat versus Persistence must be accounted for in the study [plan].		
	Revise Study Plan	Revised SP
C. Analysis of time series impacts and fluctuating flows analysis should be done for more than just benthic habitat – should include riverine reaches. Clarify in the SP as this is our intent using HSI's and operations model.		
	Revise Study Plan	Revised SP
D. Include suite of immobile, immature life stages in the study. Mentioned were: macro invertebrates; eggs; small fish; sea lamprey; long-nose dace;		
	Revise Study Plan	Revised SP to include Tesselated darter and Dwarf wedgemussel
E. Include Tessellated Darter to the species list. Associate this study with Study 12 specific to this fish.		
	Revise Study Plan	Revised SP
F. Clarify process and consultation which will be used to determine Instream Flow Study Transects. Proposed transects need not be included in SP, only the process associated with final determination.		
	Develop consultation process – proposing transects, agency consultation, field visitations and final determination. Include timetable for conducting this. How this will be done based upon habitat mapping results?	Revised SP
G. Dual –flow analysis - if it was inherently proposed, provide greater clarity as to that being the intent. If it was not proposed, consider. Indicate or describe proposed flow levels if appropriate.		
	Review approach and revise Study Plan if appropriate.	Revised SP – as related to immobile life stages. This is the most effective way to do it, and it has been used before on other instream flow studies.
H. Indicate whether or not a HSI criteria meeting is being proposed in the Consultation and Selection process. If so indicate when this would take place along with a general timetable for all steps in the process outline above.		
	Revise Study Plan	Revised SP
I. Clarify process and consultation which will be used to determine Habitat Suitability Indices (HSI). Proposed HSIs need not be included in SP, only the process associated with final selection.		
	Develop consultation process – developing HSIs, proposing them, agency consultation, meeting and final determination. Include timetable for conducting this.	Revised SP - HSI likely to be those used for TF project and will be selected this winter in consultation with the working group.
J. Overall Schedule and timing and processes in determination of HSI curves and transects could be more clearly defined and presented in the SP.		
	Revise Study Plan	Revised SP

Fish Assemblage Study No. 10

<table>
<tr><td colspan="3">A. Suggest standard sampling methodology (VANR gave reference to refer to) for future comparison, randomized/replicate sampling at each location. Goal to improve ability to draw inference and reduce sampling error.</td></tr>
<tr><td></td><td>Will review the reference. We use EPA standardized method. We will look for any updates in that protocol also.</td><td>Revised SP for methodology. Stratified random sampling design now being considered.</td></tr>
<tr><td colspan="3">B. Consider randomized/replicate sampling at each location. It is better to have data to draw inference on. Reduces sampling error. [K Kennedy]</td></tr>
<tr><td></td><td>Will consider</td><td>Revised SP to reflect this approach – see response to comment A</td></tr>
<tr><td colspan="3">C. Beneficial to have analysis incorporate size category, and a measure of variance in that. Requests coefficient of variation to compare across different gear types. CV < 20 are desirable.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP.</td></tr>
<tr><td colspan="3">D. Include turbidity in WQ data collection and specify time of day for electrofishing (or include time of day as a covariant)</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP.</td></tr>
<tr><td colspan="3">E. Specify the time of day or night for each sample and be sure to include it as a co-variant in the analysis.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP. see response to comment D</td></tr>
<tr><td colspan="3">F. Include turbidity in the WQ sampling at each sample location</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP.
see response to comment D</td></tr>
<tr><td colspan="3">G. 2 hour gill sets at night are preferable to the proposed 24 hour sets – to reduce "fish gilling" mortality or injury. FL using trapnet for deeper water. Trawl for deeper waters similar to darter sampling we propose.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP to rely on 2 hour gill net sets. These will be done at night to increase likelihood of catch. 2 hour sets will reduce mortality and satisfy the VT fisheries request to do so.

Study No. 10 will rely primarily on boat electrofish with supplemental gill/trap netting. We are not proposing additional trawl sampling but will incorporate results from Study No. 12 (darter trawling).</td></tr>
<tr><td colspan="3">H. Review study requests for methods (gear), temporal variation (day or night) etc.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP to clarify in methods section to explain gear use including conditions that must be met to use a particular type of gear and what time of day that gear would be used.</td></tr>
<tr><td colspan="3">I. Specify electrofishing locations particularly with respect to setbacks and side</td></tr>
</table>

	Revise Study Plan; Clarify and provide detail as needed	Revised SP methods section to provide more detail on fish sampling in setbacks vs. mainstem areas.
***J. Eagles –if using trapnets, consult w/ FWS on gear types and impacts on eagles. Get a permit for activities. Would gill netting also be a concern? Probably not if at night*.**		
	If use of trap nets are specified, address this and revise Study Plan	Revised SP.
K. Think through on study design to be sure it meets variety of goals, methodology, data collection, temporal etc, gear types to develop sampling design.		
	Revise Study Plan	Revised SP. See comment A. Following discussion with Katie Kennedy and review of FL plan and associated references have modified our approach.
L. Is there sampling in the setbacks or just mainstem? If so, specify method. Fyke nets may be appropriate method in those locations. Clarify in plan		
	Clarify sampling in setbacks and shallows; specify method in plan. Consider sampling in locations even if not fluctuating enough to impact spawning (in that study).	Revised SP. Setbacks that occur within one of our randomly selected segments will be sampled to the point that equipment can operate and area is still within the influence of project operations.
M. Capture assemblage below Vernon Dam		
	Revise plan to sample below Vernon to a location just below Stebbins Island. Utilize any VY data available	Revised SP. Added an additional stratum (Vernon to downstream end of Stebbins Island (1.5 miles)). Will be sampled following same methodology used in other locations. Will need to review publically available VY data as part of study.
N. Commit to a repetitive study year or season if conditions are abnormal? [K Kennedy] – one way around those drawbacks (eg. drought) is to sample outside of the project to reflect "natural" conditions and not on the project.		
	We will rely on ILP regulations for anomaly conditions requiring additional year, as applicable to all studies.	No changes in SP, consultation will be ongoing for all studies. Progress reports and study reports will be prepared and shared for comment.
O. Need scientific collecting permit from VT F&W for fishing in VT water. Also in NH		
	Specify in SP that we will secure all necessary permits for study	Revised SP. Sentence added to plan in Schedule section

American Eel Survey Study No. 11

A. Study Plan should specify bait material, options for such.		
	Revise Study Plan	Revised SP.
B. DS passage prescriptions should not be based on this result; a watershed survey should be done to provide data for passage prescription.		
	We disagree; any requirements for DS passage should be based upon evidence of eel in the project requiring passage due to the degree of unknowns in terms of life stage behavior and variability.	Revised SP to clarify TC position and study scope limited to mainstem.
C. Consider MacKenzie sampling approach to potentially acquire more definitive results. Consider improving sample design. See "robust" comment below.		
	1. Identify what this is (inquire with K. Kennedy); 2. Revise Study Plan if needed	Revised SP for random selection of transects, but not including MacKenzie method. Discussed with Katie Kennedy. Similar approach to Study No. 10. Five different strata.
D. Expand surveys into the tributaries and associated water bodies; at least to the base of the tributary barriers.		
	We disagree; any requirements for assessing project operations on the eel population should be based upon evidence of eels in the project either in terms of presence in the project or requiring passage. This strikes TC as a study to develop management goals and objectives and provide more information on the population rather than project effects. Consider locating surveys at the tributaries of noted interest but within the portions affected by project operations. Revise Study Plan as necessary	Revised SP to include tribu taries within the influence of projects that are within the random transects.
E. Design plan to accommodate a robust sample within the project affected areas including repeated samples or visits over the time period associated with the study.		
	1. Consider how this might work and the criteria for making a determination of where and how many visits or repeated samples. 2. Revise Study Plan as necessary.	Revised SP. see comment C above
F. Setting up the Hydro acoustics array at Vernon would support this study.		
	Noted. HA option addressed in Shad Migration Study No.22	No change in SP – for a variety of reasons (in study No. 22), hydroacoustics is not appropriate at Vernon. The study objective is to look at run-timing, not population.

G. Comment on tagging, loosely associated with Study No. 19 (Downstream eel passage). Is TC tagging yellow eels, or willing to? TC monitor in impoundments and VT would take over when eels entered VT tribs.		
	Will we be monitoring movement in project waters using fixed and mobile tracking? Revise plan to clarify above and that we can provide tag information to agencies.	No changes in this SP (No.11). We are not proposing to tag/track eels in this study, which is in situ sampling of abundance and distribution only. See study No. 19 section.

Tessellated Darter Survey No. 12

A. Consider (Hertzog et al) trawling in reverse from stern How not to lose sample, capsize boat, etc		
	Will look at that method, as conditions apply. Habitat mapping this summer will allow getting together in the fall with agencies based on habitats found to identify sites. Will utilize "bevy" of techniques as appropriate.	No changes made in SP, field staff have extensive experience under a range of conditions and are aware of the hazards of trawling.
B. All sampling design comments from Study No.10 Assemblage study (randomization, temporal, etc) apply to this study.		
	Consider this in a possible study design revision.	Revised SP for sampling strata as in studies No. 10 and 11. Still will sample at known Dwarf wedgemussel sites.
C. 2nd paragraph mis-interpreted the agency request (e.g. definition of effects), since study design as is, adequately covers the requests.		
	Will delete if this makes sense or is not critical	Revised SP - deleted.
D. Include turbidity measurements in the WQ sampling at sampling locations.		
	Revise Study Plan; Clarify and provide detail as needed	Revised SP - added

Tributary and Backwater Fish Access and Habitats Study No. 13

A. Clarify the timing of the initial survey /field assessment of all setbacks and tributaries as being Early August – September (2013???), with follow-up survey in 2014 of the selected subset.		
	Revise Study Plan	Revised SP.
B. Clarify criteria for selecting tributaries and setbacks, describe anticipated consultation process with working group.		
	Revise Study Plan	Revised SP.
C. Discuss depth at mouth of tributary or setback that would trigger concerns relative to fish movement (i.e., depth barrier).		
	Revise Study Plan	Revised SP. 1 foot or less at low water, based on the 2013 aquatic habitat mapping study No. 7 results using pressure transducers so that the range of operations is defined.

Resident Fish Spawning in Impoundments Study No. 14

No comments on SP		
		Revised SP. A few minor edits to methods section to make sure a few points were standardized between this SP (14) and SP15

Resident Fish Spawning in Riverine Sections Study No. 15

A. Add detail on egg trap placement and sampling protocol; SP needs further definition. [is there a need for consultation with stakeholders?]		
	Revise Study Plan	Revised SP methods section edited to add more detail on egg trap construction and the criteria we will initially use to identify potential sampling spots.
B. Include (study) "riverine" reach below Vernon in the resident fish spawning in riverine study.		
	Based on study meetings, all applicable studies will include approximately 1.5 miles downstream of Vernon dam to lower extent of Stebbins Island	Revised SP to include downstream of Vernon approximately 1.5 miles
C. Longnose Dace should be added to the list of species, if identified in part through the fish assemblage study.		
	Revise Study Plan	Revised SP - added
D. Salmonids should also be included; noting if and where spawning occurs.		
	Revise Study Plan	Revised SP - added

Sea Lamprey Spawning Assessment No. 16

A. Rick's comment in describing plan, that this is not in the plan		
	Revise plan to state putting out pressure transducers if we find spawning areas	Revised SP.
B. Clarify that non-telemetered areas (based on physical habitat) and we find redds will be monitored.		
	Revise plan to include what we do when we go to these habitat sites and find redds. Do we then treat them the say way as others? Also clarify the number or "up to how many additional" physically identified redds we will also monitor. See comment D below	YES. Also other spawning studies we will focus on shallow areas and will look at them. Revised SP to clarify that we will monitor as many as we can within reason/limitations.
C. Use of habitat data – if half go to tributaries and/or scatter, that doesn't lead you to more than that fish.		
	May have to find some by plane if needed and they go up tributaries.	Revised SP.
D. Need to identify how many redds you'd measure – specify level of effort to represent adequate sampling and habitat variability. Analysis is subjective so need a lot of redds to get adequate information		
	Clarify in plan - we will count all redds and then subsample.	Revised SP.
E. Tagging should be representative of migration timing – cover the entire season. USGS has been pit-tagging at Holyoke and receivers at TF and Vernon, may provide some info to help inform rates/timing.		
	We won't take the first 20. The goal is to try and select tagged fish throughout the migration period. Clarify and revise plan.	Revised SP. Clarified to spread fish tagged out over different periods
F. What is the scale of the effects analysis? Per redds? Per colony per habitat unit.		
	Will be based on what we find – but will be broad representation of what we find. Specify scale of effects analysis in the plan.	We will try to do per colony/grouping within each habitat, will report everything found. Will locate and record depth of all. Could also randomly select which ones are capped. Revised SP to clarify.
G. Let agencies know if fish move out of the area, so they can be tracked in the states.		
	Will do, add this into plan – will provide/share codes of our tags with states.	Revised SP.
H. [Lael] Refer to Gallagher – standard methods for changes in habitat over period they are actively spawning. Record % embeddedness when evaluating substrate etc. sedimentation within redds (impact on the resource).		

	Specify in plan – once we find redds, additional field work every day in daylight with photos, also will have turbidity data. Also add embeddedness. (see 4th paragraph on p.113 of PSP) in the event of no telemetered fish leading us to that spot, will still look in suitable habitats.	Revised SP. Clarified, but not sure of the Gallagher reference, need a citation in order to review that.
I. Operations data collected at redds? Capture various operational conditions		
	Clarify and add detail on operations data collected and how at redds – may locate pressure transducers; measure velocity and depth at time of observation and link to discharge/elevation at station or other means of estimation of flow. Coordinate with TC Operations to understand what is going on operationally while in daily surveys of redds. Indicate how we will attempt to observe redds under varying flow conditions	Revised SP with clarifications.

Upstream Passage of Riverine Fish Species Assessment No. 17

A. Fish Ladder Operational monitoring: ***a. Will you record the number of times etc that the fishways get blocked? Check often enough to ensure that ladders operate correctly for the study.*** ***b. [J Warner] – maybe get FWS engineers, station staff, study staff together to identify the visual effects of things blocking the fishways.*** ***c. Or periodically shut down to check ladders.***		
	We don't want to shut the fishways unless they really get blocked. TC will work with station staff to set up an inspection schedule/protocol. Perhaps seasonal shutdown – after spring run and after fall run. Revise plan as needed	Revised SP. Sampling will occur during the open water period (ice-out until freezing temperatures make it infeasible). TC will develop an in-house protocol for station personnel to assess ladders for blockages on a weekly basis. If a significant blockage is suspected, TC can shut down and address either after the spring or summer periods.
B. Use of VT's Salmonsoft licenses; Receive training and orientation from VT; set-up at Wilder		
	Clarify and confirm in Study Plan: • Confirm use of Salmonsoft licenses held by VT. • Determine hardware or additional software needs. High processing speeds for software. • Develop set –up system for Wilder	Revised SP. Added use of VT licenses to SP, added cost to purchase of 3 laptops that can handle the salmon soft software transferred from VT (minimum of a dual core computer running at 2.0 ghz with a suitable video capture device, a minimum of 2 GB of RAM, running Windows XP (preferred) or Windows Vista. The recommended video board is the Plextor PX-AV200U)
C. High turbidity events that preclude seeing fish via Salmon Soft - and record those events. Turbidity doesn't allow Salmon soft to capture the frame if there is movement in the ladder. Sun can trigger salmonsoft and small light directly into window for nighttime is useful too.		
	Specify in plan – 24 hour Salmonsoft usage. Consider the experience from Vernon to ensure the best data collection. Could use the 2nd camera side-by-side. FL will share their experience downstream to help study design. VANR can provide protocol.	Revised SP. Added text to specify 24 hour coverage. Added text saying we would operate 2nd non salmonsoft camera during turbid periods after rain events. Added text saying TC can confer with VT and FL to install proven design improvements for limiting sun and night time interference.

<table>
<tr><td colspan="3">D. Salmonsoft was designed for upstream. If one fish goes upstream and on that goes downstream at the same time, Salmonsoft can cancel out each other.</td></tr>
<tr><td></td><td>There are work-arounds in the software. Identify methods to address this and enable both up and down counts.

Clarify and specify procedure in revise SP accordingly</td><td>Revised SP.

Added text saying TC would confer with FL and VT to learn about getting net counts from Salmonsoft</td></tr>
<tr><td colspan="3">E. 1-year study may limit identification of early and late season species use (walleyes for example). How early will you open the ladders? If see fish moving early and late, it might be important to define those time frames.
[K Kennedy] – can record temp, flow, elevation etc at the time of first and last seeing fish. Then license conditions could be based on date and/or those conditions</td></tr>
<tr><td></td><td>We expect to be able to get ladders open as soon as reasonably possible and run as late as reasonably possible or when it appears as if no use is observed.

Will need to develop a monitoring protocol in real time rather than wait until season is over to observe and process salmon soft information.

Clarify this and revise the SP</td><td>Revised SP.

Clarified in SP:
Ladders will open as soon as logistically possible (i.e.no ice).

We will record operational parameters.

Monitoring of video files/analysis of data etc. will occur throughout the study, not at the end of the study.</td></tr>
<tr><td colspan="3">F. Page 122, schedule says April date.</td></tr>
<tr><td></td><td>Correct this in the SP. NOTE – will need to coordinate with CRASC and FWS on fishway inspections early at all projects, not just Vernon.

Will periodically check in with agencies on status, especially if there are issues that arise.

Revise Study Plan</td><td>Revised SP.

Revised SP to reflect the open water period (ice-out until freezing temperatures make it infeasible)

Sentence added to indicate TC will coordinate fishway inspections with agencies to ensure timely start to monitoring.</td></tr>
<tr><td colspan="3">G. Will Salmon Soft software run 24 hours continuously?</td></tr>
<tr><td></td><td>Clarify if this is what we are aiming for in SP.

If there is some unforeseen reason why this becomes a problem, we will immediately notify agencies and stakeholders.</td><td>Revised SP.

Clarified 24-hour monitoring. Added a few sentences at end of methods saying TC will be in contact with agencies and if our proposed methodology is not working well, will seek alternate approaches in consultation.</td></tr>
<tr><td colspan="3">H. Consider setting up trial at Wilder in 2013</td></tr>
<tr><td></td><td>We will consider this as an option based on VT work in 2013, but no revision expected in Study Plan</td><td>No change in plan.</td></tr>
<tr><td colspan="3">I. Consider using 2013 recording data for training on species Identification.</td></tr>
</table>

	We will consider this and indicate in Study Plan if needed.	Revised SP. added

American Eel Upstream Passage Assessment Study No. 18

<table>
<tr><td colspan="3">A. Revise Study Plan schedule: monitor with night surveys and eel traps in the first year to identify potential locations for temporary upstream passage devices, install and test those sites in the second year. Include an element of stakeholder consultation prior to passage device deployment.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP to reflect a two year approach
Year 1 – systematic surveys – visual searches and eel pots
Year 2 – following consultation with agencies after year 1, temporary eel passes will be installed at appropriate locations where suitable eel concentrations were detected.</td></tr>
<tr><td colspan="3">B. Comment that the minimum number of pots should be 10.</td></tr>
<tr><td></td><td>1. Unclear as to how many we are proposing. Is this per project? Up and downstream? Is this a critical item? Discuss with TC prior to revising SP
2. Clarify number to potentially address this concern.
3. Revise Study plan as necessary</td><td>Revised SP.
We are proposing to fish at least 10 pots per project. Clarified SP to indicate that this is 10 pots at each Project and they are placed in areas DS of the dam</td></tr>
<tr><td colspan="3">C. Study design should account for and document re-captures though some sort of marking of eels prior to releasing them.</td></tr>
<tr><td></td><td>Revise Study plan as necessary</td><td>Revised SP.
Rather than marking yellow eels (some of which have the potential to be very small and difficult to mark), SP has been edited to have eels captured in eel pots during year 1 passed over dam – similar to approach for temporary eel traps during year 2. This will alleviate agency concerns over recaptures impacting estimates of eel congregations below projects</td></tr>
<tr><td colspan="3">D. Study Plan should include consideration for a smaller mesh size associated with traps and specify such.</td></tr>
<tr><td></td><td>Revise Study plan as necessary</td><td>Revised SP.
Reviewed available literature pertinent to mesh retention of eels and agree with agencies. Have modified SP to propose the use of 1/8 " mesh which will greatly increase retention of smaller eels</td></tr>
</table>

American Eel Downstream Passage Assessment Study No. 19

A. In SP, discuss pros and cons of PIT and radio telemetry for this site and this study, provide rational for choosing not to include PIT.		
	Revise Study Plan to explain the rationale and experience for choosing radio telemetry and not PIT technology.	Revised SP to describe rationale.
B. Consider survival studies through spill gates in the scope of the study.		
	1. What are the gate passage options for eels specific to projects including gate operation priority and flow in terms of how they operate – bottom or surface; minimum flow or gate opening etc. 2. Is there literature on adult eel gate passage survival? 3. Consider an assessment methodology that would reach a consensus as to whether or not additional survival studies would be necessary in a second study season.	SP clarified as follows: TC expects gate passage survival to be high in general. As part of the route selection study, we will consult with TC Operations on gate structures operations to evaluate potential gate-specific issues. We are not aware of literature on gate passage, but can review as part of the study. We could consider gate survival evaluation if the route selection portion of the study indicates that a significant proportion of fish use the spillways and if sufficient numbers of fish are available (see C below). We will consult with the aquatics working group on the need for potential changes to the scope of the study and/or an alternate desktop methodology to assess this.
C. Sample size per turbine types appears low – consider boosting sample size per unit type		

	1. Evaluate the additional scope and cost. 2. Revise Study Plan as necessary and provide rationale.	SP clarified as follows: The survival sample size in the study plan is the same as requested by the resource agencies (including survival through all passage routes). It appears that agencies realize that a large number of eels would likely not be available, so they specified 50 for each project. By limiting survival to just turbines and not gates, the number of fish per turbine type is increased. We also believe that the number of tags and effort required to capture higher numbers of fish (if available) for survival studies would be cost-prohibitive. We propose to use the preliminary route selection data to focus allocations of fish for turbine survival (and gate survival if appropriate - see B above). For example if 60% of the fish in the route selection study use turbines 1-4 (a single turbine type) at Vernon then 60% of the allocated 50 eels for that site would be tested through one of those turbines
D. To what extent will the study incorporate the results of the radio-tag (RT) monitoring results (route selection, movement activity, preferences, or lack thereof) and the survival analysis portion of this study? Will or should the RT results determine the scope or distribution of survival study distribution?		
	Revise Study Plan as necessary and provide clarity on the process or linkage.	Revised SP to clarify – see also comments B and C above.
E. Study plan should reflect radio tagging releases to coincide with the mid-September thru early October period.		
	Revise Study plan as necessary.	Revised SP. Field study will be conducted late August through mid-October.
G. [from Study 11 discussion] Comment on tagging, loosely associated with Study 19 (Downstream eel passage). Is TC tagging yellow eels, or willing to? TC monitor in impoundments and VT would take over when eels entered VT tributaries?		

	Will we be monitoring movement in project waters using fixed and mobile tracking? Revise plan to clarify above and that we can provide tag information to agencies.	Revised SP for clarity. This study and requests were for silver eels only. We are not proposing to tag yellow eels. Manual monitoring is already included in the plan along with fixed stations. Revised SP to share tag information with agencies in addition to sharing with FL.

American Eel Downstream Migration Timing Assessment Study No. 20

A. Include potential American eel observations noted during Study 17 in the information and assessments presented within Study 20		
	Revise Study Plan to reflect that observations and timing from Study No. 17 will be documented in Study 20	Revised SP. Included that observations from study 18 – upstream eel passage, study 17 – resident species upstream passage (may have incidental eels) and study 11 – eel survey will be used to supplement and inform this study
B. Consider extending scope of the study into the tributaries of the CT River.		
	TC does not intend to expand the geographic scope of this study to include an assessment of American eel in tributary waters. TC considers this expansion to be a request to perform species management analyses rather than a study to determine the effect of project operations on American eel migration timing.	No change in the plan. This is a desktop study only, no field work is involved.
C. Revise the study plan objectives and goals when stating that because so few eels were captured above the dam, state "in the mainstem" because there may be many eels in tributaries and lakes.		
Clarify this in the study plan		Revised SP.

American Shad Telemetry Study No. 21

A. In SP identify what the goal and differences this study contains versus the Study in 2012 conducted by USGS with TC support. Identify why we believe the 2012 data that has not yet been processed, used with the results of this study may provide a good picture of Shad movement up to Vernon and through Vernon and in particular the near-field behavior monitored in this study.		
	Revise Study Plan	Revised SP.
B. What is the number of tagged shad necessary to reduce signal collisions? Is there a maximum? By releases groups or by total? Consider with respect to early, mid, and late season spawners.		
	Examine options for accommodating this. Revise Study Plan if necessary	Revised SP: The draft SP included 40 tags, agencies had suggested 100 and the plan has been revised accordingly.
C. Conservatively, TC should not count on radio tagged shad from Turners Falls.		
	Not a critical element in TC's study, but duly noted.	Revised SP for 100 tags. We still plan to try to get FL frequency info.
D. Better describe and illustrate the telemetry layout:, receivers locations, tracking coverage areas, fish ladder wiring and monitoring locations – both up and downstream. Identify all fixed receiver sights below Vernon, at Vernon and upstream of Vernon.		
	Revise Study Plan	Revised SP. Figures added to plan (see below) and layout clarified.
E. Study should be designed to reflect the entire shad run. Collecting and releasing shad from the early, middle and late run. Timing and breadth of the run should be captured. ***Potential data points to assess these periods include: historical returns - data and trends; real-time monitoring or actual counts at Holyoke; real-time temperature monitoring (First Light? and TC or Holyoke); good and active communication between TC and fishery agencies.***		
	Will consider and revise Study Plan as needed.	Revised SP: Unless 2012 data (when analyzed) indicates otherwise, we expect to tag 1/3, 1/3 and 1/3 in early, mid and late season, respectively. Consultation/communication with agencies is already part of the SP. Will monitor Holyoke to define early, middle, and late is.
F. Consider Mortality Tags vs what we are proposing.		

<table>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>Revised SP to include temperature/mortality tags.</td></tr>
<tr><td colspan="3">G. Provide better clarity, process, consultation and decision making associated with reviewing 2012 and possibly 2011 USGS study data to determine ultimately the final No. of tags, monitoring locations, source of fish and release points.</td></tr>
<tr><td></td><td>1. Better delineate the steps and time table
2. Propose criteria for decision making – this might be modified in the final SP following additional consultation (could add a comment in the revision to that effect)
3. Revise Study Plan</td><td>Revised SP.

Expanded section on 2012 data review, including consultation after 2012 data is analyzed. We do not intend to review the 2011 data.</td></tr>
<tr><td colspan="3">H. Include elements to better assess the impact on shad migration potentially caused by the Bellows Falls operation – both movement and spawning. Consider multiple fixed receiver locations below Bellows Falls.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>Revised SP.

Added one monitor in Bellows Falls bypassed reach and one monitor in the Bellows Falls tailwaters - see Figure 21-2.</td></tr>
<tr><td colspan="3">I. Numbers of radio tagged fish released as "late season" representatives may need to be greater than numbers of the previous early and middle representative fish due to inherent late season mortality or fatigue in order to capture a reasonable sample population size to observe.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>Revised SP
Unless 2012 data (when analyzed) indicates otherwise, we expect to tag 1/3, 1/3 and 1/3 in early, mid and late season, respectively.
The increased number of fish proposed (in B above) should alleviate this concern.</td></tr>
<tr><td colspan="3">J.
a. If we use Holyoke fish and release them or some of them above TF would we be able to detect their potential downstream movement at TF?

b. Describe in the SP how we could coordinate and share tag specifications: tag codes, pulse rates, frequencies, receivers with FL to reduce signal collision and expand tracking network and numbers of overall tagged fish for both studies.

c. Is there any value in releasing a portion of the fish into the canal or below TF as well as above TF?</td></tr>
</table>

	Will consider and revise Study Plan as needed.	No changes in SP at this time. a. TC and FirstLight would each be able to detect those fish within their respective studies. b. Sharing of info/tracking is included in the SP. However, it is too early for detailed discussions with FL on how that will happen, but both companies have agreed in principle to share information. c. For purposes of TC's study there is no value in this request, this should be requested of FL for their studies.
K. Consider adding language in the SP with respect to criteria or reasons that would warrant repeating all or portions of Study No.21 in a second season.		
	Will consider and revise Study Plan as needed.	No changes in SP at this time. We feel that a single study year is sufficient. An additional study year would be subject to FERC's review of the year 1 study results.
L. Non-commented revision to the SP for discussion		
	Upon further consideration, TransCanada does not believe it likely that we can adequately discern potential effects from either Vermont Yankee or Bellows Falls operations from Vernon Project effects in a meaningful way, as was originally included in agency proposed study objectives in the draft Study Plan.	Revised SP as proposed here: Since this study is intended to assess shad movement through all project and riverine waters from Vernon to Bellows Falls, the relevant revised objectives of the study are to: • assess upstream migration from Vernon dam (overall); • assess post-spawn downstream migration route selection, passage efficiency, downstream passage timing/residence and survival related to the Vernon Project.

Downstream Migration of Juvenile American Shad – Vernon Study No. 22

<table>
<tr><td colspan="3">A. Consider using hydro-acoustic (HA) assessment technology in this study. Set up an array in the forebay at Vernon to enable monitoring of the run with respect to seasonality, flow conditions, temperature conditions.</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.
We recognize the desire to evaluate all three types of turbines. This is still being considered internally and will be fleshed out in final study plan based on internal discussions.</td><td>Revised SP as proposed here:

We propose to use underwater cameras as a better alternative to hydro acoustics which have limitations including being subject to interference from underwater noise from generation and a lack of ability to distinguish between species. Cameras in bypass are a better solution for Vernon if we are just looking at timing of outmigration.</td></tr>
<tr><td colspan="3">B. We should be evaluating survival through <u>all units</u> which we currently are not proposing. (see comment C below)</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>No changes in SP at this time.

There are three types of turbines and the previous juvenile shad test Unit 10 eliminates the need to study one type. We propose to test the two turbine types that have not been tested before.</td></tr>
<tr><td colspan="3">C. Study Plan should describe Vernon operation more clearly in terms of:
1. unit priority if such exists,
2. turbine specifications
3. Operational historic hydrograph, exceedance, operational unit type statistics during out-migration period (monthly perhaps)
And how this information could be used to support our proposal on how survival studies should be defined for all three unit types.</td></tr>
<tr><td></td><td>Revise Study Plan</td><td>Revised SP as proposed here:

This could be part of this study as it has not been studied within this context before. This work could be done in 2013 and presented for consultation with the aquatics working group to determine the final scope of the study in 2014 (per B above).</td></tr>
<tr><td colspan="3">D. Study Plan should provide better linkage as to how telemetry data on route selection might be used to refine a second season study focused on empirical survival through other unit types.</td></tr>
</table>

	1. Consider how this might work and the criteria for making a determination of need for evaluating other units. 2. Together with operational analysis above, propose a metric and discuss with TC 3. Revise Study Plan to reflect this	No changes in SP at this time. We are proposing a one year study only, based on B and C above.
E. On page 158 second to last paragraph, change the word "retained" to "reported".		
	Revise Study Plan	Revised SP.
F. Consider the effect of project operations on the apparent thermal conditions associated with Vermont Yankee's (VY) discharge – particularly when they are allowed to increase the discharge temp in the fall. ***How might the Study Plan assess the impact of operations on migration of shad through the project considering the VY thermal discharge or plume.***		
	Will consider and revise Study Plan as needed. We are looking at collecting additional water temperature data downstream of the VY plume.	No changes in SP at this time. As part of temperature being monitored in several studies including Study 6 – Water Quality, we will be installing temperature monitors upstream, downstream and in the fish ladder for purposes of several studies.

Fish Impingement, Entrainment, and Survival Study No. 23

A. Provide more detail and clarification on the process and analytical methods used throughout the aspects of this study (desktop entrainment as well as EPRI survival studies that will be used as reference).		
	Revise Study Plan	Revised SP
B. SP should include quantification on mortality on a particular species population.		
	Advised in SP mtg. was that was not the stated intent of the study to develop an assessment and determination on the entire population.	Revised SP Plan clarified that study goals/objectives do not include quantification of mortality of species, but to provide a qualitative assessment of probability of entrainment/impingement and quantitative estimate of the number of individuals affected.
C. To the extent that the EPRI dataset includes American shad and American eel, cross reference it with TC's survival studies of these species (Studies 22 and 19) and use in desktop analysis.		
	Revise Study Plan	Revised SP Clarified to include EPRI results and other TC studies

Dwarf Wedgemussel and Co-occurring Mussel Study No. 24

A. Which phases or Tasks in 2013 vs 2014?		
	Clarify in SP	Revised SP Task 1 and 2 and pilot for task 4 will be done in 2013.
B. Question about Wilder riverine section.		
	We are trying to fill in the remaining gap that wasn't done in 2011 to get a full data set from which to evaluate further via tasks 2 and beyond. There is additional historical data to pull together also. Task 2 will include additional evaluation in certain locations.	Noted, no changes in plan as this is already included in the SP.
C. What is the density level required to reasonably perform the quantitative survey?		
	Clarify plan – how we would develop a quantitative survey. What criteria are critical for determining a design for a quantitative survey?	Revised SP Plan clarified that this could be part of Task 5 which cannot be fully scoped at this time, pending Tasks 1-4. Certain methods work better for low, medium, or high density populations. Until populations are characterized can't really answer this question accurately.
D. What data will you have to use to determine what project effects are, if you don't do the more detailed quantitative sampling evaluation.		
	Clarify in plan the need to do phase 1, look at population densities etc, before saying how we'd go about that. The population is what it is, if population is too low to do a study, we may still be able to glean some information, but we don't know yet.	Revised SP See C above. Where mussels are and density of populations will determine nature of quantitative sampling.
E. JR – can we add to the plan to identify the criteria or what are important elements that would drive a quantitative survey? E.g., what kind of things are critical?		
	Clarify the study plan for thought process for what will be necessary to make that determination.	Revised SP See C above
F. With regard to looking at smaller less robust populations also need to be selected.		
	Clarify the study plan. There are certain methods and analyses that work for smaller populations that are more qualitative vs. methods and analyses for larger populations.	Revised SP See C above. 2013 surveys will help to answer this question.
G. Qualitative monitoring does not preclude evaluating project effects, quantitative and habitat analysis isn't really needed. May be an ongoing monitoring over time as part of license condition. Same thing with in situ behavioral study.		

	Develop task 5 in study plan further to clarify and be more specific relative to : Instream flow study (Habitat evaluation (HSIs) don't work for mussels since they over predict where mussels would be); Hydraulic modeling, How to tease out the project operational effect, and hard to draw any kind of conclusion with small populations.	Revised SP Noted, and plan clarified that Task 5 is premature to scope at this point.
H. is there a reference population?		
	Not in the project area. There is one further north in the CT river but that area does not have daily fluctuating flows.	No change in plan

Dragonfly and Damselfly Inventory and Assessment No. 25

A. Could we incorporate an assessment of the rate of movement or climb as adults emerge and climb the banks. Try to get best observational estimate of movement while on site?		
	We can include this – keep an eye on a few individuals to see where they move (use pin flags etc).	Revised SP Depends on timing and if we find mature larvae emerging and will revisit the site.
B. Include sites upstream of Wilder impoundment for a evaluation of non-project effects versus project effects.		
	We may consider this but the baseline is the existing project not non-project. We will examine effects though our modeling and determination of operational impacts.	No change in plan, based on baseline conditions.
C. Would like to see one more riverine site		
	Revise Plan if necessary	Revised SP Added site just downstream of Vernon dam where odonates have been recorded.
D. What data will be available for site selection?		
	Study 7 –Aquatic Habitat Mapping. Will include consultation/process for determination of study sites. Clarify and revise SP	Revised SP Clarified that Study 7 and Study 27 will help and final site selection will be done in consultation with the working group.
E. Will the surveys be timed for a particular water level e.g. low elevation which can affect observations		
	We understand the concern. Will try to go out during low water, but there is some variability in water level. We will work with operations staff to try and manage that.	Revised SP
F. [M Ferguson] Define what units are being used (density, abundance)		
	Revise plan to include definitions of density and abundance	Revised SP Added in analysis section. Number/meter along transects, total counts by transect etc.
G Final study report does not include relationships between other studies		
	Provide greater clarity and detail on how other studies that relate and will inform relative to project effects (eg modeling studies, habitat studies mentioned in the plan This will be accomplished in each plan specific to the issue and then in the Environmental Report accompanying the license applications.	All applicable study plans revised as needed, based on information available at this time. Study 7, 27 for site selection. Analysis from modeling, erosion and study 7. See also Study 4 flow chart.

<table>
<tr><td colspan="3">H. Evaluate or describe emergence and barriers to emergence (structural, hard barriers, e.g., riprap)</td></tr>
<tr><td></td><td>Intent of study is to characterize the population, not to evaluate those factors.

Plan already includes observational data on bank conditions. We will not select those types of areas as study sites. Clarify plan for this.</td><td>Revised SP for clarity.

Bank conditions/stability etc included in plan</td></tr>
<tr><td colspan="3">I. What about food base for this species – can it be one of the parameters of the study</td></tr>
<tr><td></td><td>Revise plan to include as an observation.</td><td>Revised SP</td></tr>
<tr><td colspan="3">J. Would be instructive and informative to include sites outside of baseline (e.g., pre operations) and outside of project influence for reference.</td></tr>
<tr><td></td><td>We are assessing the habitats and populations that are being affected by our operations. Going outside does not inform our project effects.</td><td>No change in plan</td></tr>
<tr><td colspan="3">K. Include reach below Vernon</td></tr>
<tr><td></td><td></td><td>Revised SP

Additional site below Vernon included in plan, see C above.</td></tr>
</table>

Cobblestone and Puritan Tiger Beetle Survey No. 26

A. Will these areas be included in the survey? 3 islands, state and privately owned below Wilder dam and above where cobblestone reported in the past. And other islands in Lebanon area. Slower moving water, mouth of Mascoma – flow slows and fine silt – for potential puritan locations.		
	Make sure SP indicates these areas are within study plan area. Revise as needed	No change in plan. These sites are not specifically spelled out in plan but are within the overall study area and will be included in the study.
B. Uncertainty about whether frequent inundation might cause behavioral changes e.g., feeding patterns, burrowing stage (current inundation language in plan). Effects of repeated inundation or frequency of such versus a more natural hydrologic exposure should be examined.		
	Clarify association with hydraulic and operations model to examine exposure to inundation, frequency and whether or not this is within operational range. Revise plan for clarity on this relative to analysis	Revised SP
C. Methods: would we observe both larval and adult stages during site visits? Observations during flight period and looking for larval burrows at same time? Not sure that larval burrows would be present during adult flight		
	Clarify plan on this point about life stages.	Revised SP Plan includes 3 visits to help cover that. And both could occur at the same time.
D. Will you examine high quality suitable (but not necessarily occupied) habitat and be able to identify operational impacts, hydrologic changes. Would these become an econode with a goal of preserving optimal habitat even if no population is there now. Suggest prioritize known locations and good habitat.		
	Clarify in SP that goal is to identify suitable habitat and to link hydraulic model with locations of habitat.	Revised SP We will note locations and monitor elevations using pressure transducers as needed. However, "preserving habitat" is mitigation/enhancement not assessment of project effects and is therefore not included in the plan. We will identify and note the high quality habitat. There are many variables on the river, and we will extrapolate characteristics of known sites to other habitats, but may not be able to account for all characteristics
E. What would you do if you found PTB together with Common or Cobblestone TB?		

	Clarify this in SP	Revised SP We would immediately contact USFWS for further direction.
F. How to mark the individuals to prevent repeat counts?		
	SP will note options to prevent repeated counting; marking insects or marking burrows. Revise plan if necessary?	Revised SP We are concerned about potential mortality/injury by marking and do not believe we will find many. Mark Furgeson of VANR concurred by phone, given the other methods to be used (based on his written comments presented at the study meeting).
G. P. 189 Methods for identifying habitat –searches should also be done at low pond levels		
	Revise plan for clarity on this page 189 as to how we will access and look for suitable habitat during low flows or low water elevation conditions.	Revised SP
H. Combine with dragonfly study?		
	Our goal is to combine whatever field work we can to be as efficient as possible.	Revised SP Noted in associated studies.
I. Town of Plainfield has designated cobblestone as the town insect		
	Duly noted. Found on Burnap's island according to the town's information.	No changes in SP. Not included in plan specifically, but this will be referenced in the study report and license application as applicable.
J. Don't get side tracked by counting common beetles vs. cobblestone and puritan. Look at comparative or relative population estimate only for Common TB's.		
	Revise plan	Revised SP 1. SP clarified for non-disturbance. 2. We don't feel this is feasible to evaluate, as there is no other study we are aware of that correlates impoundment levels/flows and ice scour – no change in plan.
K. Don't disturb individuals and/or burrows, f they are laying eggs, to determine sex.		
	Revise plan to address this concern	Revised SP
L. Don't excavate additional burrows at same sites once we find 10 and excavate 1.		

	Revise plan to address this concern	Revised SP If we find 10 or more, we will excavate only 1 with goal to collect a larva for identification.
M. Will need endangered/threatened permit in Vermont (and in NH)		
	Revise plan to address this concern	Revised SP
N. Report should address how impoundments affect natural processes that affect habitat (e.g. ice scour). This might also include how operations affect natural processes downstream of dams also.		
	Revise plan to address this concern	We understand the question, but have revised the SP to look at those processes and they appear relevant we will take note.

Floodplain, Wetland, Riparian, and Littoral Habitats Study No. 27

A. Christian Marks in TNC has floodplain definitions		
	We can clarify the plan if needed. Our intent was more broadly defined. Revise SP to make that clear	Revised SP Defined for purposes of this plan. Identifying broad floodplain types (forests, modified, historic)
B. Will we geo-reference wildlife observations?		
	Clarify plan to say we will geo-reference everything we encounter (e.g., wildlife, roosting trees for eagles etc.)	Revised SP.
C. Clarify and detail the database, list and basis for identification of all occurrences of invasive species. What is the list we will use from which ID's will be made? How if subsampling habitats, how we will get adequate information on invasive species?		
	Either include invasive species list in study plan or how and when the list will be developed. (per Brett, FL used a specific list) Clarify study plan.	Revised SP Plan clarified. The prior shoreline survey picked up many invasive species locations and other available data will be used to fill in gaps for subsampled sites. We will use the IPANE 2012 list. Primarily through mapping phase but also through field observations. If we find a patch, we will GPS start/stop or create polygon. If more diffuse patch we will GPS perimeter in general. And use shoreline survey as a starting point.
D. Suggest that Lebanon NRI data and mist communities report data be included in license application. (see the email from Shelly Hatfield 06/06/13).		
		Revised SP Clarified plan in general referring to reviewing available town Natural Resource Inventories where available.
E. Identify high quality, high value natural communities and include them in the set of representative sites for site characterization (collect baseline info on species composition, diversity, richness, abundance) even if on private lands.		

	Will take this into consideration if there are any within the 200 feet of areas affected by the project.	Revised SP Will obtain 2014 database from the states and will check those areas. This study is not intending to repeat or expand the 2012 RTE study. Relative to the 200-ft area only and to the extent of hydraulically connected wetland or floodplain and prior work. The areas we want to represent are those affected by project operations, which are mostly owned by TC.
F. Include an assessment of riparian buffers or lack of buffers on TC land and any others surveyed – e.g., agricultural lands		
		Revised SP Included specifically in analysis section of plan
G. Will we include surveying of floodplains and wetlands where river has been cut down (due to erosion) and cut off or disconnected from the floodplain (not getting floodplain and floodplain access as a result).		
	Clarify in SP that they will be characterized, as will everything for at least the 200 ft.	Revised SP Will note those areas, but not looking for them specifically. They should become apparent through this study and through the erosion study. If they are historic floodplains, it will depend on what we see and what their elevations are, to determine what category they are put in (historic floodplain).
H. CT river is IBA – Important Bird Area (NH, VT and national Audubon) along the 200' above sea level contour msl. (From Weathersfield downstream.)		
	Will consider and revise plan if needed.	No change in the SP. All incidental bird observations will be noted. The IBA designation was mentioned in the PADs and will be in the license applications.
I – Identify vernal pools, esp. in relation to fowler's toad study?		

	Clarify in SP	Revised SP We are not doing an official vernal pool survey, but they will be noted from aerial photos and field work. Most of the field season will be outside of the vernal pool season, but professional judgment will be used to note them. They will be identified if within the 200' extent and to the extent of hydraulically connected wetland or floodplain of the study area.
J. Reference any RTE sites noted in the RTE study as special habitats in this Study – cross reference these two studies		
		Revised SP They will be identified if within the 200' and the hydraulically connected wetland and floodplain extent of the study area.
K. Include entire 100-year floodplain mapping?		
	No - we are not trying to do an NRI of the CT river, and not doing a mapping exercise of the whole river, we are focusing on project effects under existing project conditions only.	No plan change Focused on 200-ft buffer and wetlands and floodplains that are hydraulically connected and within the range of project influence.

Fowler's Toad Survey No. 28

<table>
<tr><td colspan="3">A. Provide more clarity on the descriptions of the habitat that will be recorded: date and time; elevation, and elevation in relation to water, proximity to water, adjacent and local vegetation, soils…</td></tr>
<tr><td></td><td>Clarify in SP</td><td>Revised SP

When we find a site we will evaluate habitat – field document conditions, elevation of pool, etc.</td></tr>
<tr><td colspan="3">B. [Jim Andrews, Reptologist, Middlebury College] written comments
1. SP study area should include downstream of Vernon, to upper extent of Turners Falls impoundment. There is a recent record of the toad there.
2. SP should include small gravelly pools along shoreline/river margins
3. Air temperature should be recorded in addition to water temp, and best above 17.8 C for calling activity.
4. May want to extend study into July vs. June due to air temperatures?
5. Continue to recommend wet road searches using FrogLoggers, wildlife acoustics. Suggest going beyond just calling surveys.
6. Consider subcontract with local biologist, eg for Stebbins road in Vernon
7. Species may be listed as state endangered by 2014 and relevant data may be available through that process.</td></tr>
<tr><td></td><td>Will consider and revise plan as needed.</td><td>Revised SP after speaking with Jim Andrews.

1. As in other studies, approximately 1.5 miles below Vernon dam will be included. The one site identified may be off project lands, but will look at it.
2. Plan clarified
3. Plan clarified
4. Plan revised
5. Included in plan as a possibility depending upon extent of habitat encountered and/or observations. If needed, we may put out recorders during period when we are not onsite.
6. Will consider, but not included in study plan.
7. Plan revised</td></tr>
</table>

C. ***1. Species preference for longer hydro-period*** ***2. SP doesn't include suitable habitat hydraulically connected to the project, irrespective of fee ownership.*** 3. ***Does plan include vernal pool decontamination?***		
	Will consider and revise plan as needed.	Revised SP. 1. Study goals include understanding of this effect, and clarify SP for recording water temperature. 2. Will consider inland areas including flowage areas that are suitable habitat and are hydraulically connected. 3. We are aware of VT (and NH) de-contamination practices and will compare to Normandeau's practices. Plan clarified.
D. Survey in Upper Meadows site - those areas that may not be directly tied hydraulically.		
	Will consider, based on suitability of habitat.	No change in plan as this area is inherently included already.
E. By the time we get out into the field in 2014; this species is likely to be listed as State endangered. – will need a public and a confidential report		
	Add public/confidential relative to potential listing of the species in the SP deliverables section.	Revised SP. Noted in the plan.

Northeastern Bulrush Survey No. 29

<table>
<tr><td colspan="3">A. MAF Comment -</td></tr>
<tr><td></td><td>Sarah mentioned in her summary that bulrush is listed in NH and VT – revise SP to state this.</td><td>Revised SP.

State designations added into plan and the need for permits acknowledged therein.</td></tr>
<tr><td colspan="3">B. Recommend shift schedule to August thru Sept for fruiting season</td></tr>
<tr><td></td><td>Revise SP for schedule and methods</td><td>Revised SP.</td></tr>
<tr><td colspan="3">C.
1. What habitat parameters will be noted, including companion species?
2. How will you identify hybrids?
3. How would you conduct surface and groundwater assessments (in SP)
4. A one year study doesn’t confirm that the species is not present, due to dormancy.</td></tr>
<tr><td></td><td>Will consider and revise plan as needed.</td><td>Revised SP.
1. Habitat parameters we will collect included – vegetation communities, substrate, evidence of disturbance, land use, surface inflows (WQ, erosion, beaver activity etc). .
2. It is a tricky plant to identify habitats for. We will focus on known habitats and try to glean information from FWS and states. We may collect specimens with collections permit. Will collect fruit and photo-document the plant.
3. This is a qualitative assessment, we are not proposing to collect water quality data, more to identify overall conditions. Goal of this data would be to understand sources and important influences of hydrologic inputs to the site.
4. We will be identifying and evaluating suitable habitat that can be used in the future.</td></tr>
<tr><td colspan="3">D. How will project operation impact assessment be conducted?</td></tr>
</table>

	Clarify Qualitative Evaluation process in Study plan; associated with hydraulic and operations model; pressure transducers (hobo's) etc.	Revised SP. Plan revised generally by reference to the modeling plans. Since bulrush was not found in the 2012 RTE study, it is unlikely that it would be found in areas impacted by flow related operations. We will evaluate that based on observations and habitat including land use, disturbances, etc.

Recreation Facility Inventory and Use & Needs Assessment No. 30

A. Define "vicinity of the project", and could additional properties be listed?		
		Revised SP. Includes inventory of the riverine sites between project boundaries. The full list of inventory sites is in the revised SP.
B. Missing sites: Within Wilder project – chambers park and cole park adjacent to each other on conservation lands that abut the river just south of Hanover town line. – have trails, picnicking and swimming. And 3 others to propose – just south of project boundary Westboro area (proposed cartop), 2 Rivers park (mouth of Mascoma with developed trail systems), and True's Landing (cartop NHFG access).		
	We will consider adding these to the SP.	Revised SP. These sites included.
C. a) Inventory form – suggest add assessment for suitability for carry in capability within the existing sites. b) What standards are being used for site condition evaluation – measuring good/fair/poor (e.g, amenities at campsites).		
	a) Revise SP b) We recognize variability among types of amenities, somewhat subjective, will document with photos.	Revised SP. inventory form updated for carry in capabilities as well as refined the site condition and human use evaluation forms
D. SP does not include areas between the projects (riverine sections), affected by project ops. Also FERC – those facilities may have unique questions.		
	We will review the list, and take input and consider adding for purposes of inventory.	Revised SP (see A above). Adjustments made to mail questionnaire to accommodate differences in those areas.
E. NHFG owns car top site at Cold River/Westminster bridge.		
	We will review the list, and take input on additional sites to revise SP.	Revised SP. All the sites in the "Connecticut River Boating Guide" have been added; mostly sites between projects.
F. Suggest – at River Park (Lebanon) requires public access (inc. planned boat launch and parking) to the river not built yet, but part of master plan with opportunity for trail network.		
	Phase 2 of SP includes use and needs assessment where this would come in.	No changes in plan. Overall process allows us to consider these in future and in study report.
G. Suggest adding ice fishing to under fishing portion of evaluation form		
	Will add to SP relative to river access.	Revised SP - forms.

H. Inventory form – add view points, pull offs etc. (e.g., CT River birding trail, wildlife watching, etc)		
	Will add to SP	Revised SP - forms.
I. Identify ownership (TC, public, private, state) on inventory form		
	Already on form.	No change in plan or forms Will also be in study report and license applications
J. Site condition form –should include evaluation of environmental conditions in place (riparian buffers, erosion, run off, etc)		
	Will add environmental conditions as one of the variables	Revised SP - forms.
K. Site condition form – include observations of over use, mis-use, etc. from the perspective of the river and its health, not the car being parked. How is access being dealt with?		
	We can try to clarify SP forms for good, fair, poor. Can add another variable of "environmental" (see J above). Add prompts for the surveyor, and add notes column.	Revised SP - forms.
L. Study should include winter/off season (ice fishing, late/early season fishing, snowmobiling, hunting etc) beyond Sept 30th (also peak foliage)		
	Will consider and revise SP as needed.	We are still looking at options to address this comment.
M. Inventory form relative to signage – including invasives, no wake zones, and other environmental impact issues.		
	"Signs" on the form refers to the inventory baseline – what signs are there now and photos. Add to form – list the signs that are present.	Revised SP - forms. Added comment via email from Lebanon about documenting public safety warning signs also will be included.
N. What about youth users?		
		Revised SP - forms. Youth will be counted, but not interviewed. Survey interview age changed from 18 to 16 as used by NHFG and SCORPs
O. Would like to see 2 year study,		
	There is a FERC requirement to review after first year. We are not currently suggesting more than 1 year, if proposing a 2nd year at this time. The process will determine if revisiting after the first year is needed.	No change in plan. Study process allows for review after first year.
P. Suggest capture other users that are not present via NGO's, towns, school groups etc. e.g., targeted surveys to known user groups (rather than random mail survey).		

<table>
<tr><td></td><td>Need to minimize bias in those surveys. Will get greater response. How do you expand that to the larger general population and what conclusions can be drawn?</td><td>Revised SP.

We are proposing a mail survey to a random set of people within the counties adjacent to the 3 projects. Firms sell mailing lists we can purchase and do a mass mailing with the option to return a hard copy (coded surveys) or log onto a version of the survey on the web.</td></tr>
<tr><td colspan="3">Q. Future use projection – would like to see some new research done related to this region</td></tr>
<tr><td></td><td>There are processes in place for this, e.g., in state SCORPs, also within rec. mgmt. plans.</td><td>No change in plan.</td></tr>
<tr><td colspan="3">R. Do any mailed surveys including the non-user of the CT river?</td></tr>
<tr><td></td><td>Will consider and revise Study Plan as needed.</td><td>Revised SP and forms.

Potential or uncommon visitor section of SP addresses that via initial letter, survey, follow-up and internet survey. Survey form revised to adjust questions relative to non-user. See P above.</td></tr>
<tr><td colspan="3">S. Suggest – from fisheries perspective, anglers using boat ramps etc.
1. List sites will be inventoried
2. Maintenance schedule for TC facilities
3. Mailing – add "are you a member of a bass tournament club"
4. Mailing – add "have fluctuating water levels ever impacted your recreation; are current fluctuations too much, enough, too little, etc" (flow and elevation)</td></tr>
<tr><td></td><td>Can describe/add these items in SP and incorporate into study.</td><td>Revised SP and forms.</td></tr>
<tr><td colspan="3">T. Provide more definition of "all activities" and groups in the SP (CRJC provided a list).
CRJC recreation plan for the river – should become part of references.</td></tr>
<tr><td></td><td>Will address these.
CRJC plan was in PAD</td><td>Revised SP.</td></tr>
<tr><td colspan="3">U. FERC suggests before next meeting –
1. SP has sentence about BF shorter portage (p 218 top paragraph) – how might this be determined?
2. User sampling – would like more detail on sampling breakdown
3. More detail on "mixed model" of mail versus internet surveys – how many sending out.
4. Traffic counters – outline which sites will and will not</td></tr>
</table>

	• Clarify process on portage alternatives (all) • Determine am/pm time breakpoints. And look to extend am/pm to account for early/late fishermen. • Will add more detail on mail/internet. • Add detail in SP to when ID of traffic counter locations can occur. • Also reference to use	Revised SP and forms. Many of these were described on the hard copy handouts which are now included in the final SP. Intent is to get a traffic counter at every site we want to interview, if the site allows for that.

Whitewater Boating Flow Assessment - Bellows and Sumner Falls No. 31

A. Sumner Falls – if flows are diminished due to RTE species, seeking mitigation elsewhere esp at BF		
	Duly noted.	No change in plan.
B. Sumner Falls – number of boaters for study/form. Level 2 assessment says 2-4 boaters would be used, but did not identify No. of boaters in Level 3.		
	Need a reasonable number of boaters. Currently says "minimum" of 2 to 4.	Revised SP. • BF on-land assessment 2-4 expert boaters (consistent w/literature) • BF on-water, single flow assessment 2-4 expert boaters (consistent w/literature) • BF on-water, multiple flow assessment 2-4 expert boaters. • Sumner Falls: interviews & on-land assessment 2-4 boaters by type (e.g,, canoe & kayak) • Sumner Falls: on-water assessment 8-12 boaters ranging from intermediate, advanced and expert.
C. Sumner Falls comment relative to flows and naming of waves		
		No change in plan This will be captured in the study report
D. Sumner Falls – based on Whittaker's methodology.		
	Will review and consider in plan.	No change in plan. Yes, Whittaker and Shelby is already referenced in the plan.
E. Bellows Falls – barrier dam should ultimately be removed. Propose as part of study, to form a subgroup to look at feasibility of removal or modification.		
		No change in plan. We are not proposing any construction, permitting or removal of the dam during this study phase. There may be many considerations for the dam positive and negative relative to other resources and we feel we can assess flows without removal.
F. Want whitewater park ultimately, need to ask someone who has done this as part of evaluation of flows – useful to evaluate early.		

		No change in plan. This is premature. We need to evaluate the need for water boating resource first, and if FERC determines that whitewater flows or a park are needed, that would be mitigation.
G. Evaluation forms – please allow AMC/NEF/AR review them and more communication with TC		
		Revised SP – forms included. Forms will be included in final SP's. Stakeholders will have many opportunities to work with TC on this process.
H. For controlled flow test, how will boaters access river? Need to take care especially at barrier dam during the test.		
	Will clarify in SP	Revised SP. We propose Bellows Falls Level 2 on-land survey of 2-4 expert boaters first to assess safety, suggest initial boat test flow. We will proceed (if possible) to on-water assessment of a single flow based on the recommendation of that group. Then, if more flows are needed we will do multiple boat trips at various flows. This is a stepwise process.
I. Other potential take outs, below BF WWT plant would lengthen the run.		
	Need to check with owners of that land. Other places include at the existing portage put in on NH side and other opportunities to take out.	No change in plan. Study Plan No.30 will look at the portage route and alternatives upstream & downstream, and will be evaluated in this Study

Bellows Falls Aesthetic Flow Study No.32

A. Survey forms (handouts) similar to those used for whitewater, suggest coordinate study with whitewater		
		No change in plan. We recognize the opportunity to leverage demonstration flows for multiple studies.
B. Add 2 key observation points at constriction points within bypass – more dynamic.		
		No change in plan. This study is for aesthetics not whitewater boating and public viewing is not available generally from these locations.
C. Specify how to advertise controlled flows?		
	Will include in study plan, along with where locations for observation will be.	Revised SP. Key observation points are identified in the SP. Study leads will convene a focus group comprised of individuals representative of different subpopulations who would likely see the bypassed reach.
D. Additional questions for survey to include aesthetics of the river bed, and other things.		
	We are focusing on aesthetics of flows but will consider additional questions relative to baseline. We will also be looking at flows for aquatics and for whitewater in other studies.	No change in plan at this time.
E. Tribal concerns over access to the river related to cultural, historical river access.		
	We are not putting anyone in the river for this study (only perhaps for Study 31, the whitewater assessment). Just identifying public viewing points. Most land around there is privately owned and TC does not have access.	Revised SP. All references to access into bypassed channel have been removed.
F. Arch Bridge is a viewing point and it gets a lot of foot traffic, and could be an observation point.		
		Revised SP. Moved key observation point 3 to the bridge.
G. Towns should be on list of interviewees		
	We need a cross section of people, not necessarily vested interested parties.	Revised SP. Process is outlined. See I below.
H. How are you going to coordinate these studies?		

	Will provide clarity and process detail on coordination of all flow studies in the SP, but not sure it will work in practice, it is more important to make each process work for each study.	Revised SP.
I. How will representatives will be chosen, particularly regional and non-local tourists. Need to be more definitive.		
		Revised SP. We want a diverse population that is representative of different types of people. Looking for 8-10 participants who represent people who would view the bypassed reach and these people need to be objective (not have personal agendas or interests or be biased for their business or town revitalization efforts, etc). TransCanada Community Relations, VANR and Rockingham Conservation Commission (study requests) will be contacted to nominate potential participants who could also nominate participants. We will use a networking approach.
J. SP includes photos and videos, and onsite observations – how will you do this?		
	We lose some detail by offsite viewing of video/photos but those will be filed as proof of the flows on those days as a component of analysis and report of study.	Revised SP. Hybrid approach: We propose to collect the photo/video from now thru the demonstration flows and organize a single offsite viewing focus group. This is the most efficient way to conduct this study. We can share photos/videos of spill events in all seasons and will get better turn out from our focus group. There will be a field component that 'shuttles' the group to the 3 key observation points for context but will not ask them to view/score flows observed in the field. It will be too difficult and unnecessary to have the same group show up multiple days in a row.
K. Questions 15, 16 of survey – relative to "which flow level" and "at which level of flow"		
	Can clarify in SP, for each key observation point and each specific flow. Need to also think about flows at dam, flows in bypass or both	Revised SP – forms.

L. Survey form – safety question – explain better.		
	Intended to gauge people's perception of safety relative to the key observation point. Clarify in the plan and survey form what we are looking for with this question.	Revised SP – forms. This question was deleted from the survey form. There is no intention to have public in the bypassed reach or create concerns for safety while viewing the bypassed reach. People are allowed to cross Arch and Villas bridge on foot. This study is not looking at safety along the portage route either.
M. Would these be seasonally adjusted flows? Icing could create icing /misting problems and unsafe conditions for pedestrians.		
	Dam safety issues are also of concern. Will consider in SP	Revised SP. Capturing spill events from now till next year should capture some winter spills w/ice & mist. These images would be used with the other images in the focus group survey.
N. There may a year round attraction where icing is aesthetic at waterfalls		
	Can consider in SP, but again there are dam safety issues.	See M. above

Cultural and Historic Resources No. 33

TransCanada Cultural Resources Study Meeting
Web Conference – July 3, 2013
Meeting notes

Attendee List attached.

The purpose of this call was to discuss the proposed Project Area of Potential Effects (APE) with the Narragansett Tribe, Vermont and New Hampshire State Historic Preservation Offices, FERC, and TransCanada. Prior to the call, all parties received a copy of the current Cultural Resources Study Plan No. 33 and maps of the proposed APE.

(NOTE: Meeting started at 11:00 am (Eastern time). These are the notes of Alison Macdougall, the Louis Berger Group, who joined the call at 11:20. These notes reflect discussions from 11:20 forward.)

Howard Clark (Nolumbeka Project) and Scott Dillon (VT SHPO Office) – There are pictographs at the mouth of the West River that are currently inundated and are being eroded as a result of the project. What is TC planning to do about this impact?

Suzanne Chereau (PAL) - Confirmed that the pictographs are present.

Scott Dillon (VT SHPO) – We are concerned about the limits of the proposed APE. If the banks are eroding and moving, will the APE adjust accordingly?

John Ragonese (TC) – Yes, the APE is flexible and will follow the edge of the banks. This is why we will be monitoring them…to determine if cultural sites are being affected by that erosion.

Edna Feighner (NH SHPO Office) – Why was no testing of eroding sites undertaken?

John - We only completed a visual Phase IA study. Testing would be done as part of a Phase IB study.

Scott – TC should probably identify and evaluate all sites within ten meters (30 feet) of the flood pool. You are proposing to do more work, but it is not clear what the Phase IB study will entail. The HPMP should be completed after the eroding sites have been tested and evaluated. VT SHPO feels strongly that the identification effort has not been completed and that just monitoring is not appropriate. More needs to be done with these sites.

Steve Olausen (PAL) – We are not planning on identifying ahead of time all potential effects that could occur over fifty years. But we have a process to continue to monitor changes so that we can then determine what to do as it happens. We did the survey, now we need to discuss what additional steps need to be done…Phase IB etc.

Scott – We want to see identification and evaluation of sites that we know are being affected by erosion right now, not after a monitoring effort.

Steve - We plan to look at that, but just haven't' done it yet. All we have done is a visual IA survey.

Frank Winchell (FERC) – I have some questions. First, has a Phase IA been done for all three projects? Did you look at all three shorelines?

Suzanne – Yes, we looked at all of the shorelines by boat. Prior to that, we did site file research to obtain info about all of the known sites so that we could look at them in the field. We called that a Phase IA survey based on NH and VT guidelines for a Phase IA study.

Scott – Your Phase IA did not include testing, so it was not a complete Phase IA.

Suzanne - We did not do an identification effort using testing. We identified visually. So no, we could not identify all sites….only those we could see without testing.

Frank - (Referring to Bellows Falls APE Sheet 3 of 4 as an example). There are areas on this map that extend away from the shoreline. Did you survey these areas on foot using systematic transects?

Suzanne - Yes, we did a complete walkover but we did not use transects. But many of the areas were inundated and we accessed only those that we could.

Scott – Did you do surface collection? It was not a complete survey if you did not do a systematic surface collection.

Frank – At some point, the maps should clearly show where you went, what you did, and how.

Steve - (Referring to "Great Meadows" on Bellows Falls APE Sheet 3 of 4 owned by TC). They went to this area…do we need to mark exactly where we walked here and where we didn't?

Suzanne – It was not possible for us to identify every site that is out there…much of that area was marshy and we could not get to it.

Frank - What is the next step then? We need to go to Phase IB. The outcome should be a comprehensive Phase 1 study that gives us a pretty good idea of what's out there, including an understanding of what's eligible for the National Register. Then the next step would be to include that information in a HPMP.

John – The project has a very limited fluctuation range. But we are currently doing studies to better understand project effects.

Scott – Do the marshy areas ever dry out?

John – No.

Joe Graveline (Nolumbeka Project) - The Phase IA study is not a valid Phase IA study because it does not address tribal interests. There was no tribal involvement in the study and your personnel had no knowledge of ceremonial areas and spiritual aspects when they did the fieldwork. You can't determine the APE absent an understanding of traditional areas.

John - The TCP aspect is another element that may need to be investigated.

Frank – TC has done a pretty good Phase IA, which is just a part of the Phase 1 study. You will need to follow through with the rest of it and may need to get above the shoreline, get a better look at erosion, and ensure that the APE covers those areas.

Suzanne – We did not go on top of the shoreline on other private lands. Just on TC lands.

John – We aren't convinced that the project is the primary cause of erosion. An erosion study is currently being done. We are identifying erosion, but we are not at the point where we will survey other private land (non TC) when erosion on those lands may or may not be project-related. Should we extend the APE 30 feet beyond the shoreline even if we don't know if the erosion is caused by the project?

Frank – We are determining an Area of *Potential* Effects (emphasis on "potential"). It is just the area where there is the *potential* for project effects. But if there is an opportunity to get on top of that shoreline and take a look around, particularly in sensitive areas, then TC should do so.

John – We do not have a right to access other private lands.

Frank – Did you make an attempt to get access to those lands to see what is there?

John – If we didn't see anything on the shoreline, but get access to lands above it, what if we see an artifact 28 feet inland?

Frank - If a site extends from the shoreline inland 28 feet, then there is a connection to what is going on at the water's edge. But if there is nothing on the shoreline and you see an artifact 28 feet inland, then there may not be a connection between that artifact and the project. You have provided some good working APE maps. As long as the systematics are in place (what else needs to be done and how), you can observe and document effects, project-related or not. At some point, you may need to at least make an attempt to get on top of the shoreline on other private property based on the results of the Phase IA. You will need a clearcut methodology. Look at the Otter Creek Study Plan. It covers what I am looking for, and what the SHPOs are looking for as well.

John – Otter Creek is a much smaller scale project. We need to meet the cultural resource goals. We did a visual survey and identified a need for more work.

Scott - From the VT SHPO's perspective, we believe the work area has been limited by TC. The Study Plan does not include appropriate testing. We would not concur with the study plan if it does not include this process. TC needs to address actively eroding areas. The Study Plan does not identify where the Phase IB will take place nor does it address Phase 2 evaluation.

Edna - The NH SHPO concurs with Scott.

John – The current study plan does not specifically identify those areas for the IB but the process is described.

Scott - The only action identified is additional monitoring. We need a process for evaluation of eroding areas.

Doug Harris (Narragansett Tribe) – Tribal historic preservation is not being addressed. There needs to be an on-site examination. The studies you have done serve you and the archaeologists, but do not serve the tribe. You need to address tribal cultural values. We need to have "hands on" and were not invited to participate in the Phase IA.

John - We understand your position and have tried to keep you involved. We are interested in the on-ground tribal perspective. The APE is what we have in front of us and will require additional work, including the tribe's view. We are trying to identify the APE so that we can adjust it based on new information. Can you give us your input in writing so that we can make sure that we address it?

Doug – The tribe works directly with the Federal Agency, but we understand that TC can do some of the consulting. But the process "gallops" forward without us and without everything in place.

John – I understand. We have had discussions and are willing to do more. But we need something concrete from the tribe.

Doug – Are you willing to set aside a block of time to go into the field with the tribe?

John – Yes, but we need to know more about what that would entail. We need costs, personnel, tribal requirements, etc. We need to know exactly what the tribe wants to do so that we can determine if we can accommodate that request.

Doug – Would TC be willing to do underwater archaeology to assess the condition of the petroglyphs? They are being affected by inundation.

John – No. We have never done scuba surveys.

Doug – To us, those petroglyphs are significant and are being affected by the project. You will have our input by the end of next week.

Steve – We have revised the Study Plan based on Otter Creek. Please look at the last paragraph of the text and let us know if it is acceptable.

> The final determination of the APE Consultation among FERC, the VT and NH SHPOs, Narragansett THPO, and other parties invited to participate in the Section 106 process, will be conducted during the summer of 2013. Based on this consultation, the FERC will make a final determination of the APEs for the Vernon, Bellows Falls, and Wilder Projects.

Frank – I have no problem with that paragraph, but will need to sit back and analyze it. The boundaries of an APE can change. We need to think of it as a "working APE." The Revised Study Plan is due on August 15. You should seek SHPOs concurrence on the APE prior to filing it.

Frank – Just a note: Some testing can be put into the HPMP to be completed post-licensing. The HPMP should discuss: (1) what's out there, (2) what's being affected, (3) a sense of National Register eligibility, (4) plans for affected sites, and also (5) the built environment (standing structures, etc.)

Frank – Because there are no tribal lands within the project boundary, we do not need THPO concurrence, but the THPO still needs to be involved. We still need SHPO concurrence though.

Attendee List

Edna Feighner	NH SHPO Office
Scott Dillon	VT SHPO Office
Frank Winchell	FERC
John Ragonese	TransCanada
Lou Thompson	TransCanada
Steve Olausen	PAL
Suzanne Chereau	PAL
Doug Harris	Narragansett Tribe
Howard Clark	Nolumbeka Project
Joe Graveline	Nolumbeka Project
Nick Ettema	FERC
Rob Quiggle	HDR/DTA
Andrew Gast-Bay	City of Lebanon
Shelly Hatfield	City of Lebanon
Alison Macdougall	The Louis Berger Group