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 Study Report

Volume I – Status Summary of all Studies

September 14, 2015

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ACRONYMS AND ABBREVIATIONS

APE	Area of Potential Effects
Bellows Falls Project	Bellows Falls Hydroelectric Project
C.F.R.	Code of Federal Regulations
cfs	Cubic Feet Per Second
Commission	Federal Energy Regulatory Commission
Connecticut River Projects	TransCanada Projects and the Turners Falls Project and the Northfield Mountain Project
DLA	Draft License Application
DO	Dissolved Oxygen
DWM	Dwarf Wedgemussel
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FirstLight	FirstLight Hydro Generating Company
FWS	U. S. Fish and Wildlife Service
GIS	Geographic Information System
HA	Hydroacoustics
HEC-RAS	Hydrologic Engineering Centers River Analysis System
HSC	Habitat Suitability Curve
ILP	Integrated Licensing Process
ISR	Initial Study Report
LiDAR	Light Detection and Ranging
MDFW	Massachusetts Division of Fisheries and Wildlife

National Register	National Register of Historic Places
NHDES	New Hampshire Department of Environmental Services
NHFGD	New Hampshire Fish and Game Department
NHNHB	New Hampshire Natural Heritage Bureau
NITHPO	Narragansett Indian Tribal Historic Preservation Officer
NOI	Notice of Intent
Northfield Mountain Project	Northfield Mountain Pumped Storage Project
NRCS	Natural Resources Conservation Service
PAD	Pre-Application Document
PSP	Proposed Study Plan
RSP	Revised Study Plan
RTK	Real Time Kinematic
SAV	Submerged Aquatic Vegetation
SD1	Scoping Document 1
SD2	Scoping Document 2
SGCN	Species of Greatest Conservation Need
SPD	Study Plan Determination
SSR	Site Selection Report
Stakeholders	State and Federal Agencies, Local Officials, Non-Governmental Organizations, and Other Interested Parties
TCPs	Traditional Cultural Properties
TransCanada	TransCanada Hydro Northeast Inc.
TransCanada Projects	Wilder, Bellows Falls, and Vernon Hydroelectric Projects
Turners Falls Project	Turners Falls Hydroelectric Project
USR	Updated Study Report

VANR	Vermont Agency of Natural Resources
VDEC	Vermont Department of Environmental Conservation
Vernon Project	Vernon Hydroelectric Project
VFWD	Vermont Fish and Wildlife Department
VY	Vermont Yankee Nuclear Power Plant
Wilder Project	Wilder Hydroelectric Project

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INTRODUCTION

TransCanada Hydro Northeast Inc. (TransCanada) is the owner and licensee of the Wilder Hydroelectric Project (FERC No. 1892) (Wilder Project), the Bellows Falls Hydroelectric Project (FERC No. 1855) (Bellows Falls Project), and the Vernon Hydroelectric Project (FERC No. 1904) (Vernon Project) on the Connecticut River in New Hampshire and Vermont. The Wilder Project, the Bellows Falls Project, and the Vernon Project are collectively referred to herein as the "TransCanada Projects." The FERC licenses for these projects were due to expire on April 30, 2018. On January 16, 2015, TransCanada filed a license amendment request, seeking a one year license extension for each of the Projects. FERC granted the request on July 22, 2015, extending the license expiration date for the three projects to April 30, 2019.

Background

On October 31, 2012, TransCanada filed with the Federal Energy Regulatory Commission (FERC or Commission) its Notice of Intent (NOI) to seek new licenses for each project, along with a separate Pre-Application Document (PAD) for each project.

FirstLight Hydro Generating Company (FirstLight) is the licensee of the Turners Falls Hydroelectric Project (FERC No. 1889) (the Turners Falls Project) and the Northfield Mountain Pumped Storage Project (FERC No. 2485) (the Northfield Mountain Project).[1] The current licenses for both the Turners Falls Project and the Northfield Mountain Project expire on April 30, 2018. On October 31, 2012, FirstLight filed with the Commission its NOI to seek new licenses for the Turners Fall Project and the Northfield Mountain Project, along with a single PAD for both projects (the FirstLight PAD).

On December 21, 2012, Commission Staff issued its Scoping Document 1 (SD1) for its National Environmental Policy Act analysis of the Connecticut River Projects. Commission Staff indicated in SD1 their intent to prepare a single environmental impact statement for the Connecticut River Projects. In January 2013 in various locations near the projects in New Hampshire, Vermont, and Massachusetts, Commission Staff held six project-specific scoping meetings and one additional scoping meeting to help identify the cumulative effects of licensing the Connecticut River Projects. On April 15, 2013, FERC issued its Scoping Document 2 (SD2), in response to verbal and written comments received at the scoping meetings as well as during the scoping process.

TransCanada received comments on the PADs as well as study requests for the TransCanada Projects from state and federal agencies, local officials, non-governmental organizations, and other interested parties (collectively,

[1] The TransCanada Projects, together with the Turners Falls Project and the Northfield Mountain Project, are collectively referred to as the "Connecticut River Projects."

stakeholders). On April 16, 2013, TransCanada filed its Proposed Study Plan (PSP) pursuant to 18 Code of Federal Regulations (C.F.R.) § 5.11(a).[2] With its filing of the PSP, TransCanada included a study request responsiveness summary, identifying each study request, the study plan responsive to the request, and the rationale for why any particular study request was not adopted. The April 16, 2013, filing also included TransCanada's schedule for study plan meetings. TransCanada recognized that a single meeting would not be adequate to clarify and discuss its PSP. Therefore, it held a series of study plan meetings and discussions regarding its study plan proposals and received extensive feedback and participation from many interested stakeholders within resource-specific working groups.

Pursuant to 18 C.F.R. § 5.12, comments on the PSP were due on July 15, 2013 (i.e., within 90 days of the filing of the PSP). During the consultation process TransCanada received, discussed, and reviewed comments on its PSP from stakeholders. In addition, in response to comments received and consultation with stakeholders through the study plan meetings, TransCanada filed with FERC an Updated PSP on July 9, 2013.

TransCanada filed its Revised Study Plan (RSP) to address the effects of continued operation of the TransCanada Projects on August 14, 2013. The RSP includes 33 individual studies and data collection efforts. The RSP reflects comments received during the study plan meetings and discussions as well as formal comments filed by stakeholders with FERC. Each of the study plans is described in detail in the RSP.

On August 27, 2013, Entergy announced plans to decommission the Vermont Yankee Nuclear Power Plant (VY) during the fourth quarter of 2014. VY withdraws cooling water from, and discharges it back into, TransCanada's reservoir for the Vernon Project. The effect of decommissioning VY will change the baseline conditions at the Vernon Project.

In a September 13, 2013, Study Plan Determination (SPD), the Director delayed issuing determinations for 20 aquatic resource studies, pending a technical meeting on the issue of VY's decommissioning; however, determinations were issued for the remaining 13 studies unlikely to be affected by VY's continued operation or decommissioning. These studies were approved with or without modifications. In addition, four requested studies were determined to be not required in that SPD (Table 1-2).

On September 24, 2014, TransCanada filed a request for clarification on specific aspects of the determination, and the Director provided clarification on those aspects in a letter dated October 22, 2013.

The VY technical meeting was held on November 26, 2013, to identify aquatic resource studies: (1) not affected by operation of VY that could be implemented in

[2] Delays caused by FERC's efiling website prevented a filing on April 15, 2013.

2014; (2) likely affected by operation of VY; and (3) that may need modification due to the decommissioning of VY.

On December 31, 2013, TransCanada submitted revisions to five study plans based on the November 26, 2013, technical meeting and on follow-up discussions with agencies and stakeholders. Minor revisions were made to the following study plans: 6 – *Water Quality*; 13 – *Tributary and Backwater Area Fish Access and Habitats*; 18 – *American Eel Upstream Passage Assessment*; 21 – *American Shad Telemetry;* and 23 – *Fish Impingement, Entrainment, and Survival*.

On February 21, 2014, the Director issued another SPD for those 20 aquatic resource studies and a “new” Vernon Hydroacoustic Study, that the SPD referred to as a “study requested but not adopted by TransCanada”. Fifteen of the 20 proposed studies were deferred until 2015 to allow for the new post-VY baseline condition. Five studies were determined to be not affected by the VY decommissioning and were approved without modification for implementation in 2014.

On March 24, 2014, TransCanada filed a request for rehearing arguing against the need to conduct the newly requested Vernon Hydroacoustic Study; however, stakeholder consultation was conducted and the requested study plan was filed on September 15, 2014. A technical meeting was held on November 20, 2014 to discuss issues surrounding the potential use of hydroacoustics at Vernon. Subsequently, on May 14, 2015 the Director issued an order eliminating the requirement to conduct the Vernon Hydroacoustic Study and approving the Updated RSP for Study 22 – Downstream Migration of Juvenile American Shad at Vernon that TransCanada had filed on February 3, 2015 (see Section 22).

During 2013 and 2014, several studies were initiated, and on September 15, 2014, TransCanada filed its Initial Study Report (ISR) and held a Study Results Meeting on September 29, 2014 and filed the meeting summary on October 14, 2014. Written comments on the ISR were received from the US Fish and Wildlife Service (FWS) and The Nature Conservancy (TNC) on November 11, 2014. TransCanada filed a response to those comments on December 15, 2014.

In 2015, studies delayed by the VY closing were initiated and several studies initiated in 2014 were continued. This Volume I of TransCanada’s USR presents a status summary of all 33 ILP studies. Additional Volumes of the ISR are being filed simultaneously as detailed in the cover letter to Volume I of this USR and in the USR Table of Contents. The Updated Study Results Meeting is scheduled for October 1 – 2, 2015 (details are provided in the cover letter to Volume I of this USR).

Summary of Consultation

TransCanada convened and/or participated in several consultation meetings and conference calls and initiated communications with the various resource working groups during the period since filing of the ISR and the ISR Meeting Summary, and the filing of this USR. Appendix A lists (in Table A-1) these consultations and includes copies of meeting and conference call notes and presentations.

One-Year Extension on Licenses

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for reservoirs and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the various resources critical WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact. If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

Updated Study Report

This Updated Study Report (USR) includes Volumes I through IV. This document, Volume I, summarizes study activities to date for all Integrated Licensing Process (ILP) studies. It briefly describes:

- Study activities to date;
- Additional work to be completed for each study;
- Study results that have been finalized to date; and
- Any variances from the RSP and/or RSP revisions (as modified in the SPDs).

Table 1-2 includes each study's applicable SPD date, implementation year, and current status.

Table 1-2. Status of all TransCanada Integrated Licensing Process studies.

Study No. and Section No. in USR Volume I	Study Title	Study Plan Determination	Status as of 09/14/2015
1	Historical Riverbank Position and Erosion Study	09/13/2013	In progress
2	Riverbank Transect Study	09/13/2013[1]	In progress
3	Riverbank Erosion Study	09/13/2013[1]	In progress
4	Hydraulic Modeling Study	09/13/2013[1]	In progress
5	Operations Modeling Study	09/13/2013[1]	In progress
6	Water Quality Study	02/21/2014[2]	In progress
7	Aquatic Habitat Mapping Study	02/21/2014	Complete, report filed March 2, 2015
8	Channel Morphology and Benthic Habitat Study	02/21/2014	Complete pending modeling results, report filed March 2, 2015
9	Instream Flow Study	02/21/2014	In progress
10	Fish Assemblage Study	02/21/2014	In progress
11	American Eel Survey	02/21/2014	In progress
12	Tessellated Darter Survey	02/21/2014	In progress
13	Tributary and Backwater Fish Access and Habitats Study	02/21/2014[2]	Complete pending modeling results, report being filed simultaneously in Volume III of USR

Study No. and Section No. in USR Volume I	Study Title	Study Plan Determination	Status as of 09/14/2015
14	Resident Fish Spawning in Impoundments Study	02/21/2014[1]	In progress
15	Resident Fish Spawning in Riverine Sections Study	02/21/2014	In progress
16	Sea Lamprey Spawning Assessment	02/21/2014[1]	In progress
17	Upstream Passage of Riverine Fish Species Assessment	02/21/2014	In progress
18	American Eel Upstream Passage Assessment	02/21/2014[2]	In progress
19	American Eel Downstream Passage Assessment	02/21/2014	In progress pending receipt of eels
20	American Eel Downstream Migration Timing Assessment	02/21/2014[1]	In progress
21	American Shad Telemetry Study - Vernon	02/21/2014[2]	In progress
22	Downstream Migration of Juvenile American Shad - Vernon	02/21/2014	In progress
23	Fish Impingement, Entrainment, and Survival Study	02/21/2014[2]	In progress
24	Dwarf Wedgemussel and Co-occurring Mussel Study	02/21/2014	In progress
25	Dragonfly and Damselfly Inventory and Assessment	02/21/2014[1]	In progress

Study No. and Section No. in USR Volume I	Study Title	Study Plan Determination	Status as of 09/14/2015
26	Cobblestone and Puritan Tiger Beetle Survey	09/13/2013	In progress
27	Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study	09/13/2013	Complete pending modeling results, report being filed simultaneously in Volume III of USR
28	Fowler's Toad Survey	09/13/2013	In progress
29	Northeastern Bulrush Survey	09/13/2013	In progress
30	Recreation Facility Inventory and Use & Needs Assessment	09/13/2013[1]	In progress
31	Whitewater Boating Flow Assessment - Bellows Falls and Sumner Falls	09/13/2013[1]	In progress
32	Bellows Falls Aesthetic Flow Study	09/13/2013	In progress
33	Cultural and Historic Resources Study	09/13/2013	In progress

1. RSP modified by FERC in the SPD issued on this date.
2. TransCanada filed minor study plan modifications on December 31, 2013.

Updated Study Results Meeting

In accordance with 18 C.F.R. § 5.15(c)(2), TransCanada has scheduled the following meeting to discuss the study results and TransCanada or stakeholder proposals, if any, to modify the study plan in light of the progress of the study plan and data collected.

October 1, 2015, 9:00 a.m. – 4:00 p.m. in the Vermont Conference Room of the Fairfield Inn and Suites, 102 Ballardvale Drive, White River Junction, VT.

If a second meeting day is required, it will be **October 2, 2015, 9:00 a.m. – 4:00 p.m.** at the at TransCanada's conference room in TransCanada's River Control Center, 255 Wilder Dam Road, Wilder, VT.

1. Study 1 - Historical Riverbank Position and Erosion Study

1.1 Introduction

TransCanada conducted this Historical Riverbank Position and Erosion Study (ILP Study 1) to assess the historical erosion and river bank movement within the Wilder, Bellows Falls, and Vernon Project-affected areas to consider the effect and contribution of project operations on erosion in a reasoned way. The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

Documentation of historical riverbank information, surveys, and photographs will provide an opportunity to quantify or compare changes over an extended period and provide a relative scale and potential quantification of erosion at various locations over time within each project along the Connecticut River. Archival mapping and information was used to identify where erosion occurred and characterize the degree of erosion that has occurred over time. The study included the following tasks.

- 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.
- Within reason, additional sources of valid (i.e., licensed survey) information on river bank changes are being sought by:
    - contacting riverfront landowners and municipalities to request maps and other relevant information;
    - speaking with NRCS personnel who have received requests for assistance from riverfront landowners;
    - conducting archival searches at state and local historical societies in instances where other data are not available; and
    - consulting with the erosion working group to explore further potential resources.

1.2 Study Progress

The study was initiated in the fall of 2013 and continued into 2014 and 2015. As of September 10, 2015, data analysis and mapping has been completed for available data through 1978. Additional data collected representing time periods since 1978 continues to be analyzed as part of Study 3 – Riverbank Erosion Study.

1.3 Remaining Activities

Comparison photographs of some sites have not yet been taken and will be obtained during the fall of 2015 as part of Studies 2 and 3, and will be incorporated into the study reports for Studies 1, 2 and 3.

1.4 Study Results to Date

Although a detailed analysis of river bank changes observed by comparing the overlaid historical aerial photographs will be conducted as part of Study 3, a visual inspection of the digitized bank lines reveal areas of significant erosion within a relatively stable river planform (i.e., meander growth has occurred with minor changes in shape and very little oxbow – meander cutoff – formation). The individual areas of significant erosion are limited in area (i.e., a single meander bend) but are not limited to a single scope (e.g., geomorphic surface/soil type) and are found throughout the study area.

Information collected from historical societies will be analyzed in detail as part of Study 3 to better understand the processes of erosion, but initial findings appear useful for identifying the locations of islands submerged with raising of impoundment levels and timing of bank stabilization projects. A comparison of digitized erosion maps from 1958 and 1979 shows how erosion locations have changed through time and where portions of the riverbank stabilized. Despite variations in location, the overall amount of erosion between 1958 and 1979 remained relatively unchanged. Digitized bank lines created from georeferenced historical aerial photographs from the 1940's, 1950's, 1970's, and 2010 (Kleinschmidt, 2011) were used to calculate the amount and rate of bank erosion along the river.

Initial analysis suggests the rate of bank erosion has remained steady or decreased through time at a majority of sites analyzed; a trend confirmed, in part, by re-photographed historical ground photographs that show bank stabilization occurring at many previously eroding sites. Further analysis as part of Study 3 – Riverbank Erosion Study is needed to confirm this trend and to project-effects on bank erosion trends in the study area.

Many landowners have provided information on past bank stabilization projects in the Wilder impoundment, including both rock and tree revetments that have been completely washed away and providing documentation of more than 50 feet of recent erosion in the past 12 years such as across from Reed Marsh in Wilder impoundment. Information gathered from river abutters will be very useful in Study 3's analysis of location, types, severity, and causes of erosion. Bank erosion documented in this way can be corroborated through the aerial photo comparisons and ongoing erosion monitoring (Study 2).

1.5 Variance from Study Plan and Schedule

There have been no significant deviations from the study plan or schedule to this point. All research related to this study was completed during 2014 and 2015. Since most of the historical data analysis is associated with Study 3 – Riverbank Erosion Study, additional analysis of the historical data (beyond that contained in the Study 1 report) will be incorporated into the Study 3 study report. This study and its use in Study 3 rely in part on the results of Study 4 – Hydraulic Modeling Study and Study 5 – Operations Modeling Study, neither of which is complete at this time.

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2. Study 2 – Riverbank Transect Study

2.1 Introduction

TransCanada is conducting this Riverbank Transect Study (ILP Study 2) to monitor riverbank erosion at selected sites in the Wilder, Bellows Falls, and Vernon impoundments and in the project-affected riverine sections below the dams. 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 are also being investigated.

The RSP for this 2-year study was modified by FERC in its September 13, 2013 SPD with the following specific changes.

- Flow values that would trigger additional non-spring runoff high-flow event surveys are flows greater than 35,000 cubic feet per second (cfs) at Wilder, 44,000 cfs at Bellows Falls, and 49,000 cfs at Vernon. To date, these triggers have not been met outside of the spring freshet and additional monitoring has not occurred.
- The study area includes an additional erosion monitoring site (for a total of 21 sites) at the Vernon dam east bank (site 02-VR01). This site is currently the subject of ongoing biennial monitoring being conducted separately from relicensing studies. The 21 sites include 10 associated with Wilder, 6 with Bellows Falls, and 5 with Vernon. The study sites were included as a GIS layer in the geodatabase filed separately on DVD as Volume VII of the ISR, TransCanada Initial Study Report Supporting Geodatabase.

The study tasks include:

- Selection of survey sites in consultation with the erosion working group;
- Establishment of full river cross sections at the sites using standard topographic and bathymetric survey methods; and
- Conducting repeated surveys, taking ground photographs, and collecting water-level monitoring data at the study sites at least four times per year for 2 years (plus any high-water event monitoring).

2.2 Study Progress

Since the fall of 2014, progress has continued on several study tasks.

- Erosion monitoring at the 21 sites was conducted in September 2014, November 2014, May 2015, and July 2015 in addition to the 3 previous rounds of monitoring between November 2013 and July 2014.
- All erosion monitoring sites and water level loggers were tied into local benchmarks by completing an RTK survey.
- All 7 rounds of monitoring, to date, have been overlayed on cross sections to chart changes through time; ground photographs from each monitoring round have also been compiled and provide visual confirmation of changes documented with cross sections.
- While the erosion monitoring is completed on only one bank, a full river cross section has been surveyed at all 21 monitoring sites to document bathymetric conditions that may reveal potential causes of erosion. Only ten of the 21 full river cross sections had been completed when the 2014 Progress Report was submitted.
- Stratigraphic descriptions of bank sediments have been drafted and will be used in conjunction with water level monitoring data to determine if heterogeneities in the banks that might lead to preferential zones of bank weakness are frequently submerged and exposed.
- Water-level monitors were removed for the winter in November 2014 and redeployed at or near each monitoring cross section in July 2015. The monitors are recording water levels at 15-minute intervals and are downloaded during each round of periodic monitoring.

2.3 Remaining Activities

Most activities are nearing completion at this time but remaining activities include:

- At least one more round of monitoring will be completed in September 2015.
- Retrieval of water level loggers upon completion of monitoring.
- Data for all monitoring rounds will be compared to document any changes that occurred during the monitoring period.
- Data from water-level monitoring will be processed and elevations linked to stratigraphic columns to identify possible links to erosion.
- Preparation of the study report detailing the amount, timing, and possible causes for erosion at the 21 monitoring sites.

2.4 Study Results to Date

A comparison of the monitoring data to date shows noticeable bank recession at three of the 21 monitoring sites. One site, 02-B01 (Lipfert site), showed bank recession between 2014 and 2015 with approximately 4 feet of erosion at the top of the bank over that period (Figure 2-1). Two sites that showed significant bank recession from 2013 to 2014, Great Meadow (02-B07) and Bellevance (02-W03) have not shown marked erosion since May 2014 (Figures 2-2 and 2-3).

To ensure accuracy in surveying, pin flags were placed at each survey point, so if no change occurred between monitoring rounds, the exact points could be resurveyed rather than introducing minor errors by surveying slightly different points along the same cross section line. The pin flags have reduced artifacts from being introduced in the surveying process, allowing for more definitive results as to where even minor changes of the banks are occurring.

2.5 Variance from Study Plan and Schedule

Work completed since the 2014 ISR has been completed on schedule and according to the RSP.

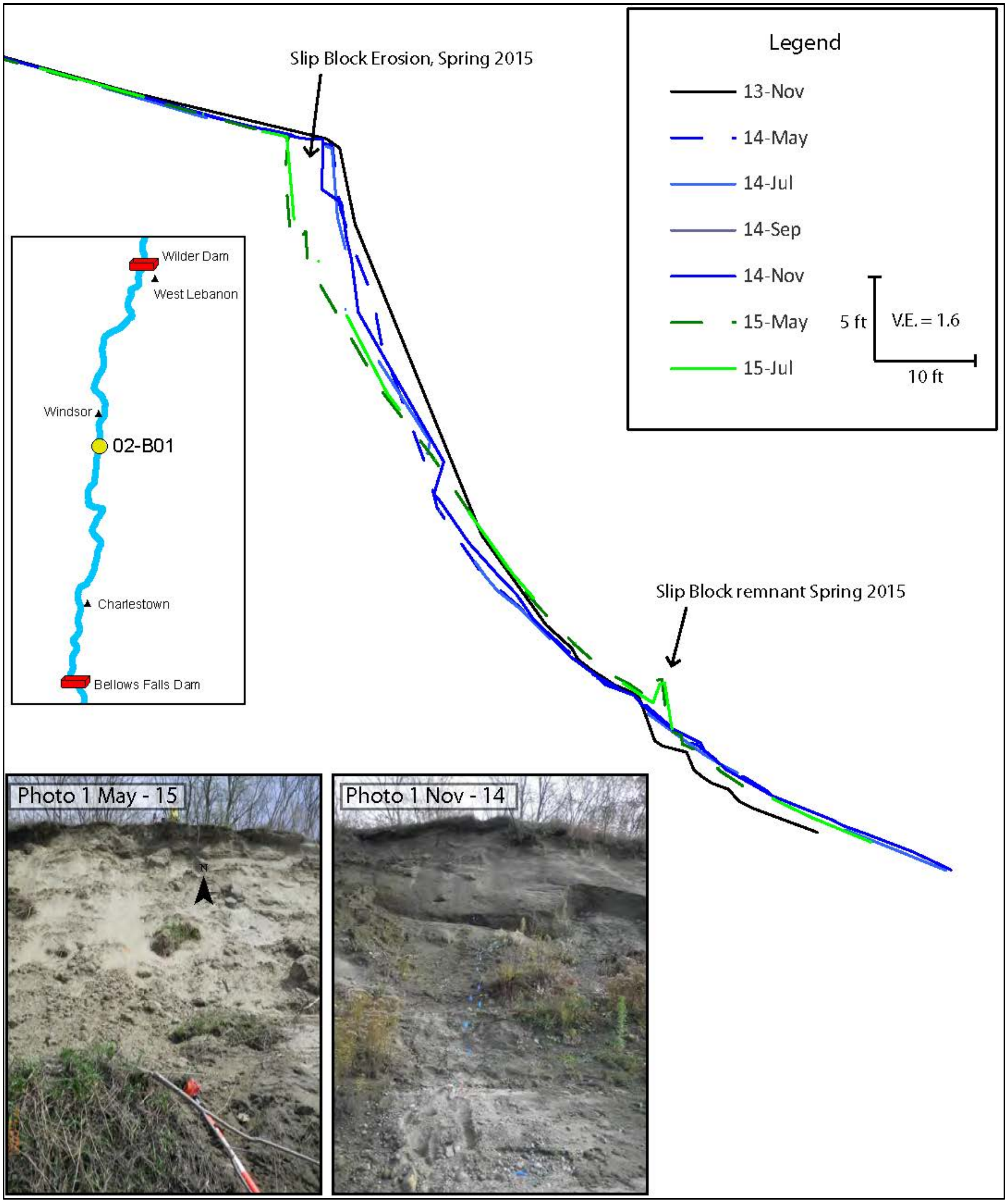

Figure 2-1. Site 02-B01 changes in bank 2014-2015.

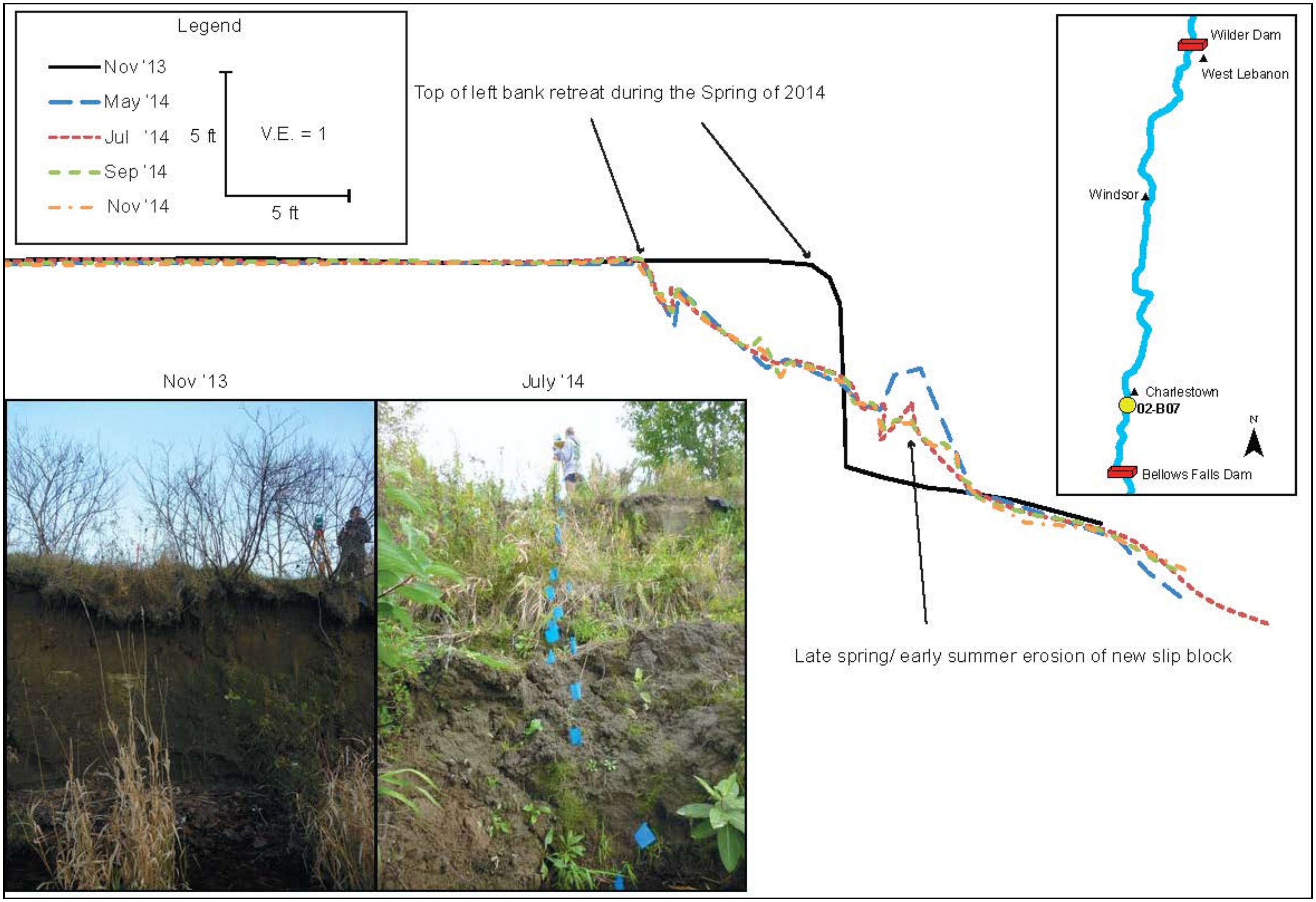

Figure 2-2. Site 02-B07 bank changes 2013 – 2014.

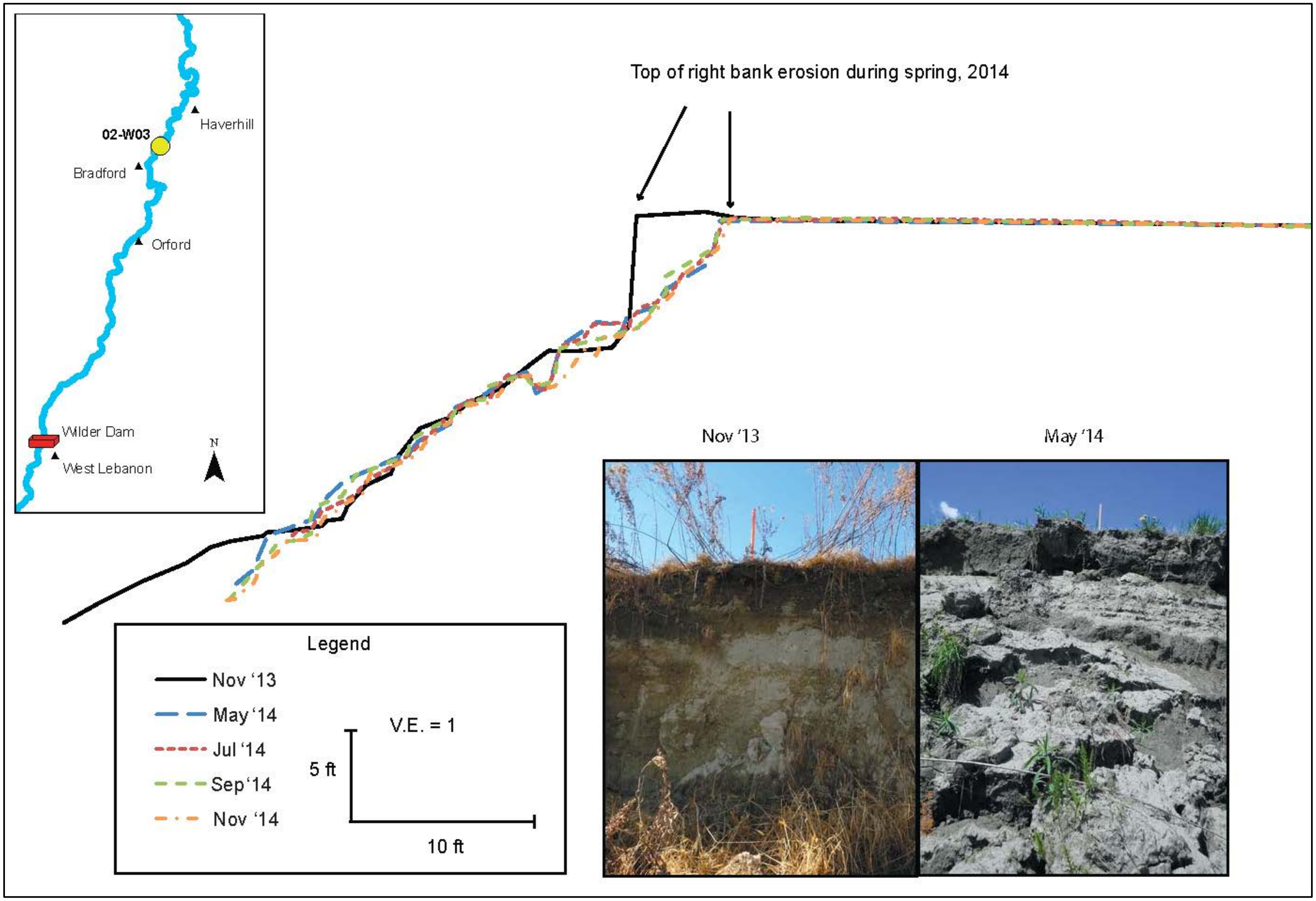

Figure 2-3. Site 02-W03 bank changes 2013 – 2014.

3. Study 3 – Riverbank Erosion Study

3.1 Introduction

TransCanada is conducting this Riverbank Erosion Study (ILP Study 3) to provide baseline data relative to erosion in the Wilder, Bellows Falls, and Vernon 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, and slips);
- Ascertain the likely causes of erosion (e.g., high flows, groundwater seeps, eddies, and water-level fluctuations related to project operations); and
- Identify the effects of shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat).

The RSP for this 2-year study was modified by FERC in its September 13, 2013 SPD with the following specific change.

- The study's analysis will include a correlation of visible indicators of erosion with project-caused water-level fluctuations at the 21 transect locations established in the Riverbank Transect Study (Study 2).

3.2 Study Progress

Since the fall of 2014, progress has continued on several study tasks.

- Completed mapping of bank erosion, bank armoring, bank composition and other features along nearly 300 miles of bank.
- Digitized location of erosion based on earlier mapping efforts (e.g., Simons et al., 1979).
- Extracted information on bank height, bank composition, and other features from LiDAR data.
- Creation of GIS shapefiles from mapping and LiDAR data extraction to show bank erosion, bank height, and other channel features.
- Creation of data sets regarding valley constrictions and tributary inputs to be compared with locations of erosion.
- Creation of GIS shapefile of where riparian vegetation is present on riverbanks.

- Meetings with landowners to collect information on bank erosion and previous bank stabilization projects.
- Re-photographed historic ground photographs of erosion sites.
- Comparison of amounts of erosion with previous maps of erosion.

3.3 Remaining Activities

Most activities are nearing completion at this time but remaining activities include:

- Survey of characteristic sites to document patterns and rates of erosion by resurveying previously surveyed locations.
- Completion of re-photographing historic ground photographs (also related to Study 1).
- Analysis of mapping data to determine tendency of erosion to occur in specific settings (e.g., valley constrictions, outside meander bends).
- Review of hydraulic and operations modeling (Studies 4 and 5) and bathymetry (from Study 7) to identify potential causes of erosion (e.g., areas of high shear stress values).
- Preparation of the study report.

3.4 Study Results to Date

Erosion mapping shows approximately 12 percent of the riverbanks in the study area are actively eroding. This level of erosion is roughly unchanged from earlier mapping completed in 1958 and 1979. While the amount of erosion is roughly the same, the location of erosion appears to have changed considerably.

3.5 Variance from Study Plan and Schedule

There have been no deviations from the study plan or schedule to this point. However, this study relies in part on the results of Study 4 – Hydraulic Modeling Study and Study 5 – Operations Modeling Study, neither of which is complete at this time.

3.6 Literature Cited

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

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.

4. Study 4 – Hydraulic Modeling Study

4.1 Introduction

TransCanada is conducting this Hydraulic Modeling Study (ILP Study 4) to derive hydraulic indices and parameters such as water surface elevations and flows across the study area and at locations of interest identified in other resource studies ("econodes"). The results of the hydraulic model will on its own, or in conjunction with the Operations Modeling Study (Study 5), inform the other studies, thereby permitting evaluation of the effects of project operations on aquatic, terrestrial, and geologic resources. The objectives of this study are to:

- Develop relationships between water levels and flows throughout the project impoundments and affected downstream reaches; and
- Provide information regarding specific relationships at econodes of interest to the Operations Modeling Study (Study 5).

The RSP for this study was modified by FERC in its September 13, 2013 SPD with the following specific changes.

- Consult with the New Hampshire Department of Environmental Services (NHDES) and the U.S. Fish and Wildlife Service (FWS), (and presumably, with the Vermont Agency of Natural Resources [VANR]) to establish a process and schedule for selecting the appropriate number and locations of velocity transects, and the appropriate range of calibration flows, and file that information with FERC by December 12, 2013. TransCanada requested, and FERC subsequently approved, an extension of time for that filing.
- File a modified study plan that details the process for selection of velocity transects and calibration flows in consultation with the agencies.

TransCanada filed the modified study plan on March 28, 2014, and on April 9, 2014, FERC issued a letter approving the modified study plan.

4.2 Study Progress

As of August 31, 2015, the following tasks have been completed.

- The preliminary HEC-RAS model was set up and refined to include new and revised cross-sections that correspond with key resource locations of interest associated with Studies 7, 8, 9, 13, and 24.
- Operations modelers (Study 5) provided daily hydrology flow data, hourly impoundment water surface elevations, and hourly project flows from the operations model.

- Hydraulic modelers received preliminary LiDAR data, bathymetry and water-level logger data sets from Aquatic Habitat Mapping (Study 7). The preliminary HEC-RAS model was set up using these data.
- TransCanada provided hourly project discharges and impoundment water surface elevations for McIndoes, Wilder, Bellows Falls and Vernon Projects in 2013 and 2014 to establish project flow and water level boundary conditions in the hydraulic model.
- The hydraulic model terrain and bathymetry were refined based on transect and bathymetric survey data collected between August 2014 to 2015 as part of Studies 2, 7 and 9.
- The GIS files used to develop the hydraulic model cross sections were updated with new and revised econode locations for data collected between August 2014 and 2015.
- HEC-RAS model cross section locations were refined upon completion of July 2015 transects for Study 9.
- TransCanada conducted ILP Study 4 Modeling Consultation with FWS, VANR, and NHDES by conference call on July 20, 2015 (Appendix A) to discuss selection of velocity transects for hydraulic model velocity comparison and to discuss model calibration. Hydraulic modelers participated in this conference call.
- Hydraulic modelers refined hydraulic model setup, and performed model calibration and validation using USGS gage data, and Study 2 and Study 7 level logger data.
- Operational pulses were preliminarily modeled in HEC-RAS to develop travel time for consideration in operations model routing.

4.3 Remaining Activities

Upon receiving velocity data collected for the Instream Flow Study (Study 9), average velocities computed by the HEC-RAS model will be compared with Study 9 observed velocities. The comparison will be performed at a total of six transect locations: one in each of three riverine reaches (Wilder, Bellows Falls, Vernon), two in impoundments (Wilder and Bellows Falls), and one mainstem USGS gage (USGS 01154500 Connecticut River at North Walpole, NH).

Upon receiving FirstLight hourly flows and impoundment levels for 2013 and 2014 (Northfield Mountain pumped storage and Turners Falls Dam) modeling downstream of Vernon Dam can be completed.

Upon receiving up-ramp down-ramp flows from the operations modelers for 5 scenarios over a 24-hour period each, hydraulic modelers will perform sub-hourly HEC-RAS model runs. Hydraulic modelers will provide the sub-hourly time-series flows and water surface elevations to Studies 3, 8, and 9.

Upon receiving a range of discharge and reservoir elevation conditions from the operations modelers, the hydraulic model will be used to develop hydraulic indices and parameters (i.e., family of rating curves) at econodes of interest. The rating curves will be distributed to various resources studies and a pre-screening of project effects will be conducted – identifying whether or not normal project operations can affect the particular resource. Normal project operation is within non-spill flow ranges below the projects and within the operating range of reservoir elevations. The rating curves will also be provided to the operations modelers (Study 5) for further analysis of project effects on resources that could be affected using various hydrology's and alternative operating scenarios . A final report will be developed to present the methods, analysis and results of the hydraulic model study.

4.4 Study Results to Date

None at this time.

4.5 Variance from Study Plan and Schedule

The primary variance in the study schedule is related to delays of numerous aquatics studies as a result of the announced closure of VY in accordance with FERC's February 21, 2014 SPD.

As discussed at the ISR Meeting on September 29, 2014, and a study consultation conference call on July 20, 2015, the HEC-RAS hydraulic model set up was delayed to July 2015 awaiting final availability of the digital elevation data and refinement of the terrain and bathymetry collected between August 2014 and August 2015 as part of Study 2, Study 7 and Study 9.

Flow and water surface elevation data for model calibration was changed from three flow events (wet, dry, normal) from operations model hydrology data (back-routed daily flows) to two flow events (operations and spill) based on 2014 flows and water surface elevations from USGS gage data (15-minute time step) and TransCanada project discharges and impoundment levels (hourly). This change was discussed during the consultation call.

Water level logger data used for model calibration/validation was also collected in 2014 (in addition to 2013 as indicated in the RSP). Study 2 level logger data collected in 2014 was used for model calibration in addition to three USGS gages on the Connecticut River. Study 7 level logger data collected in 2013 was used for model verification.

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5. Study 5 – Operations Modeling Study

5.1 Introduction

TransCanada is conducting this Operations Modeling Study (ILP Study 5) to develop an operations model for the Wilder, Bellows Falls, and Vernon Projects 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 the three projects and identified areas of interest (econodes).

The RSP for this study was modified by FERC in its September 13, 2013 SPD with the following specific change (as clarified in FERC's October 22, 2013, letter in response to TransCanada's September 24, 2013, request for clarification on the determinations for several studies).

- The study plan report (rather than the study plan) must demonstrate the appropriateness of TransCanada's 5-year representative hydrologic subset, show how the selected years are representative of the longer hydrologic record, and document why carry-over storage does not need to be considered in the model.

5.2 Study Progress

The Vista DSS™ operations model has been set up for TransCanada's base case operating conditions. Work on enhancing model functionality for complex habitat index relationship has started.

5.3 Remaining Activities

The remaining activities associated with this study will be implemented in accordance with the RSP in 2015 in the following order of activities.

- Integration of hydraulic parameters from Study 4 by updating the operations model with econode locations and associated rating curves and routing parameters;
- Re-run the base case operations with the updated model; and
- Refinement to the model, including:
  - Definition of econode indices, which is a relationship between a parameter of interest at the econode (such as a fishery habitat index) and the state of the water resource at that time (river flow and/or water level);

- Finalize enhancement to model functionality for complex habitat index relationship following full implementation of the numerous related resource studies; and
- Analyses of new scenarios once related studies and the numerous resource studies are more fully implemented (including those delayed until 2015).

5.4 Study Results to Date

None at this time.

5.5 Variance from Study Plan and Schedule

The only deviation from the RSP and schedule to this point is related to delays of numerous aquatics studies as a result of the announced closure of VY in accordance with FERC's February 21, 2014 SPD. Those study delays will delay development of many econode indices (from Study 4) upon which this study relies for evaluation of various alternative operational scenarios.

6. Study 6 – Water Quality Study

6.1 Introduction

TransCanada is conducting this Water Quality Study (ILP Study 6) in 2015 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 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 whether the projects are meeting state water quality standards.

The RSP for this study was modified by TransCanada in its December 31, 2013, filing, based on stakeholder agreement from the Vermont Yankee (VY) technical meeting, with the following specific change.

- Elimination of the continuous temperature monitoring transect in the Vernon forebay (due to VY's announced closure in 2014).

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

The study consists of temperature and water quality monitoring at 16 stations in the Connecticut River and at 10 stations in major tributaries (Figure 6-1). All field activities are summarized in Table 6-1. There are three study periods. During the spring (April through May) and during the fall (October through mid-November), water temperatures are to be monitored at all stations using deployed temperature loggers. During the summer (June through September), a wide range of data are to collected through deployed loggers (for temperature only) and multisondes (for temperature, DO, specific conductivity, pH, and turbidity), instantaneous water column profile monitoring, and water sampling for nutrient and chlorophyll analyses. The summer period also includes a 10-day low-flow monitoring event during which additional temperature loggers and multisondes are to be deployed. The field program is scheduled to be completed in mid-November 2015. The data analysis and final report are scheduled to be completed by March 1, 2016.

6.2 Study Progress

Completed study components to-date consist of the following:

- Site review and selection of monitoring locations for tributary and upstream-of-impoundment sampling locations (November 2014).
- Development of a Site Selection Report (SSR) and Sampling & Analysis (S&A) Plan for review and approval by NHDES and Vermont Department of Environmental Conservation (VDEC). NHDES provided written comments on the plan on March 23, 2015 as well as information on 7Q10 flows via email on March 24, 2015. VDEC

indicated that staff had no comments on the plan. The plan was subsequently revised and provided to agencies on April 29, 2015 (filed as Volume II.A of this USR with site locations included as a GIS layer identified as "TC_06_StudySites_2015" in Volume II.I of this USR).

- The field program commenced with the first temperature logger deployed at a tributary station on March 24, 2015. Deployment at the other tributary stations and the Connecticut River stations was delayed into April and May. Due to the cold winter, the Connecticut River and most of the tributaries were frozen well into April. In addition, late melting of the ice resulted in high flows that were too hazardous for field work at some stations (forebays, tailrace, and Bellows Falls bypassed reach). The stations were visited intermittently to monitor ice cover, to be ready for field work as soon as conditions allowed. In addition, the field team was in constant communication with TransCanada Operations regarding flow conditions. Since ice-out and flow conditions varied, the dates of first deployments of temperature loggers varied accordingly for individual stations. Dates of first deployments of the temperature loggers are included in Table 6-1.

- The more intensive summer period of the field program commenced during the first week of June at most Connecticut River stations. The exceptions were the stations in the Bellows Falls and Wilder tailraces and the Bellows Falls bypassed reach where multisondes were installed later than specified in the S&A plan due to continued high flows and spill conditions in early June. Deployment at those three stations occurred on June 10 (Bellows Falls tailrace), June 18 (Bellows Falls bypassed reach), and June 19 (Wilder tailrace).

- The 10-day low-flow study component was initiated at the end of August (Figures 6-2 and 6-3). This component required flows at less than 3 times 7Q10, and water temperatures preferably around 23ºC. Instruments were installed in the three impoundments on August 19 – 20 at Bellows Falls, August 21 – 22 at Wilder, and August 23 – 24 at Vernon.

- The instruments for the 10-day low-flow study component **were** removed between September 9 and 14, **2015** resulting in a total of approximately 20 days of deployed equipment for this study component. This period between the end of August and the beginning of September was considered the best opportunity to achieve both low flow and high water temperature conditions, as specified in the S&A plan. While mean flows over a 10-year period show that the months of August and September typically have the lowest flows, water temperatures start to decrease in September as shown in the 2012 water quality monitoring study.

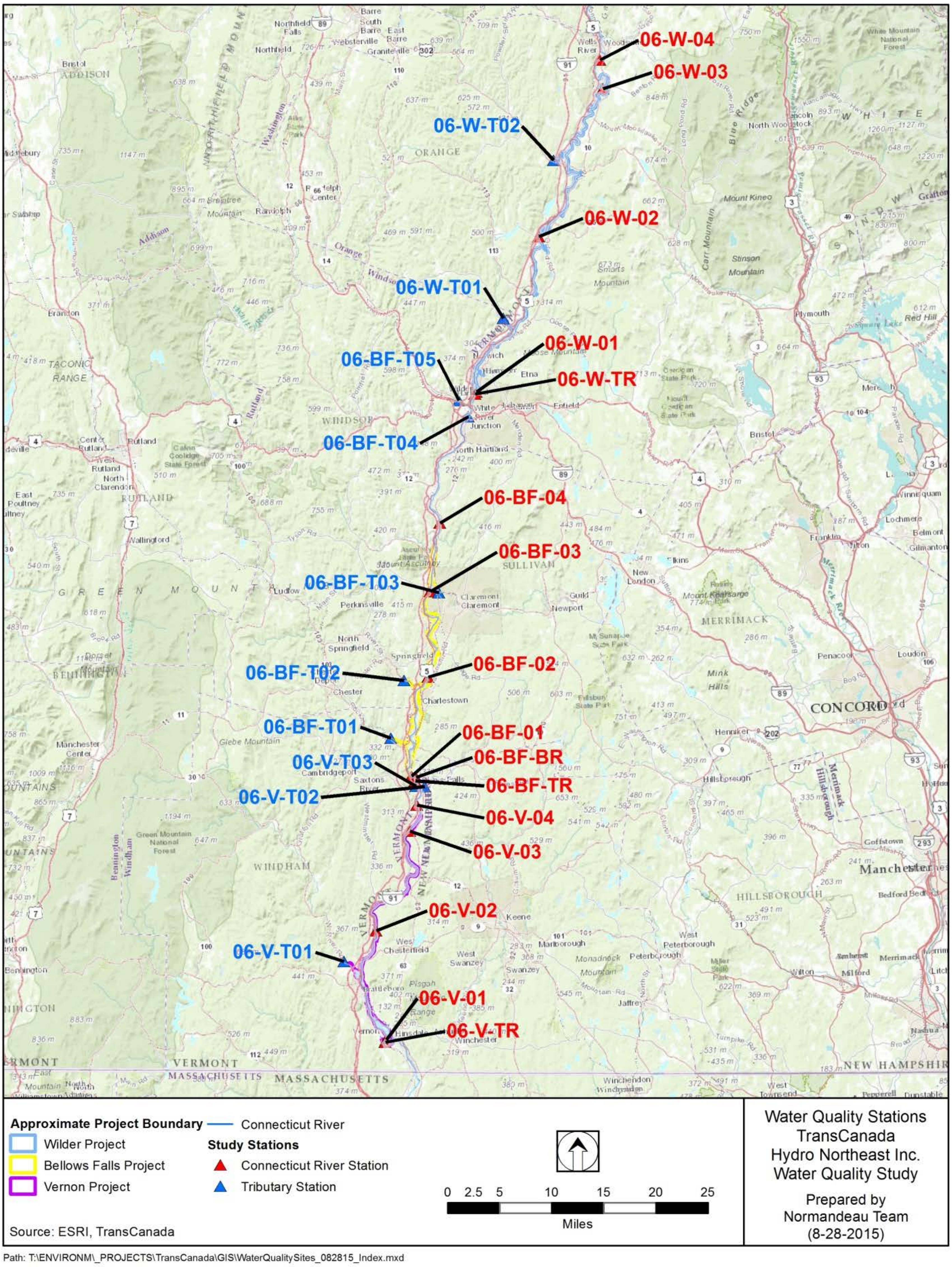

Figure 6-1. Overview of study area and water quality stations.

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Table 6-1. Study 6 Water Quality - Field Program

					Week of… (Monday)							
					Mar 30 to May 25		May 30 to Sep 28					Oct 04 to Nov 09
					Deployed		Deployed			Instanta-neous		Deployed
Station ID	Wilder	Bellow Falls	Vernon	Location	Temp. sonde	Date of First Deployment	Temp.	Temp Transect (1)	Multisonde (2)	Vertical profile (3)	Water Sample Core	Temp.
Connecticut River												
06-W-04	■	□	□	upstream	●	1-May	●	7Q10	7Q10	●	□	●
06-W-03	■	□	□	upper imp.	●	1-May	●			●	□	●
06-W-02	■	□	□	mid-imp.	●	1-May	●			●	□	●
06-W-01	■	□	□	lower imp.	●	7-May	□		●	●	●	●
06-W-TR	■	□	□	tailrace	●	7-May	□	□	●	●	□	●
06-BF-04	□	■	□	upstream	●	29-Apr	●	7Q10	7Q10	●	□	●
06-BF-03	□	■	□	upper imp.	●	29-Apr	●			●	□	●
06-BF-02	□	■	□	mid-imp.	●	29-Apr	●			●	□	●
06-BF-01	□	■	□	lower imp.	●	8-May	□		●	●	●	●
06-BF-BR	□	■	□	bypass reach	●	13-May	□	□	●	●	□	●
06-BF-TR	□	■	□	tailrace	●	21-May	□	□	●	●	□	●
06-V-04	□	□	■	upstream	●	30-Apr	●	7Q10	7Q10	●	□	●
06-V-03	□	□	■	upper imp.	●	30-Apr	●			●	□	●
06-V-02	□	□	■	mid-imp.	●	30-Apr	●			●	□	●
06-V-01	□	□	■	lower imp.	●	13-May	□		●	●	●	●
06-V-TR	□	□	■	tailrace	●	6-May	□	□	●	●	□	●
Tributary Rivers												
06-W-T02	●	□	□	Waits R.	●	25-Mar	●	□	□	□	□	●
06-W-T01	●	□	□	Ompomp. R.	●	7-Apr	●	□	□	□	□	●
06-BF-T05	□	●	□	White R.	●	7-Apr	●	□	□	□	□	●
06-BF-T04	□	●	□	Mascoma R.	●	25-Mar	●	□	□	□	□	●
06-BF-T03	□	●	□	Sugar R.	●	7-Apr	●	□	□	□	□	●
06-BF-T02	□	●	□	Black R.	●	25-Mar	●	□	□	□	□	●
06-BF-T01	□	●	□	Williams R.	●	26-Mar	●	□	□	□	□	●
06-V-T03	□	□	●	Saxton R.	●	24-Mar	●	□	□	□	□	●
06-V-T02	□	□	●	Cold R.	●	24-Mar	●	□	□	□	□	●
06-V-T01	□	□	●	West R.	●	23-Apr	●	□	□	□	□	●

(1) Three stations per transect with up to 3 loggers each (1 m below surface, mid-depth, 1 m above river bottom; less if station is shallow). At 10-day low flow conditions only.
(2) Multisonde used at these stations only during 10-day low-flow period for temperature, DO, conductivity, turbidity, and pH. At other times only temperature is recorded with a logger.
(3) Instantaneous measurement with multisonde, at 1-m increments (surface to bottom). Parameters are: temperature, DO, conductivity, turbidity, and pH.

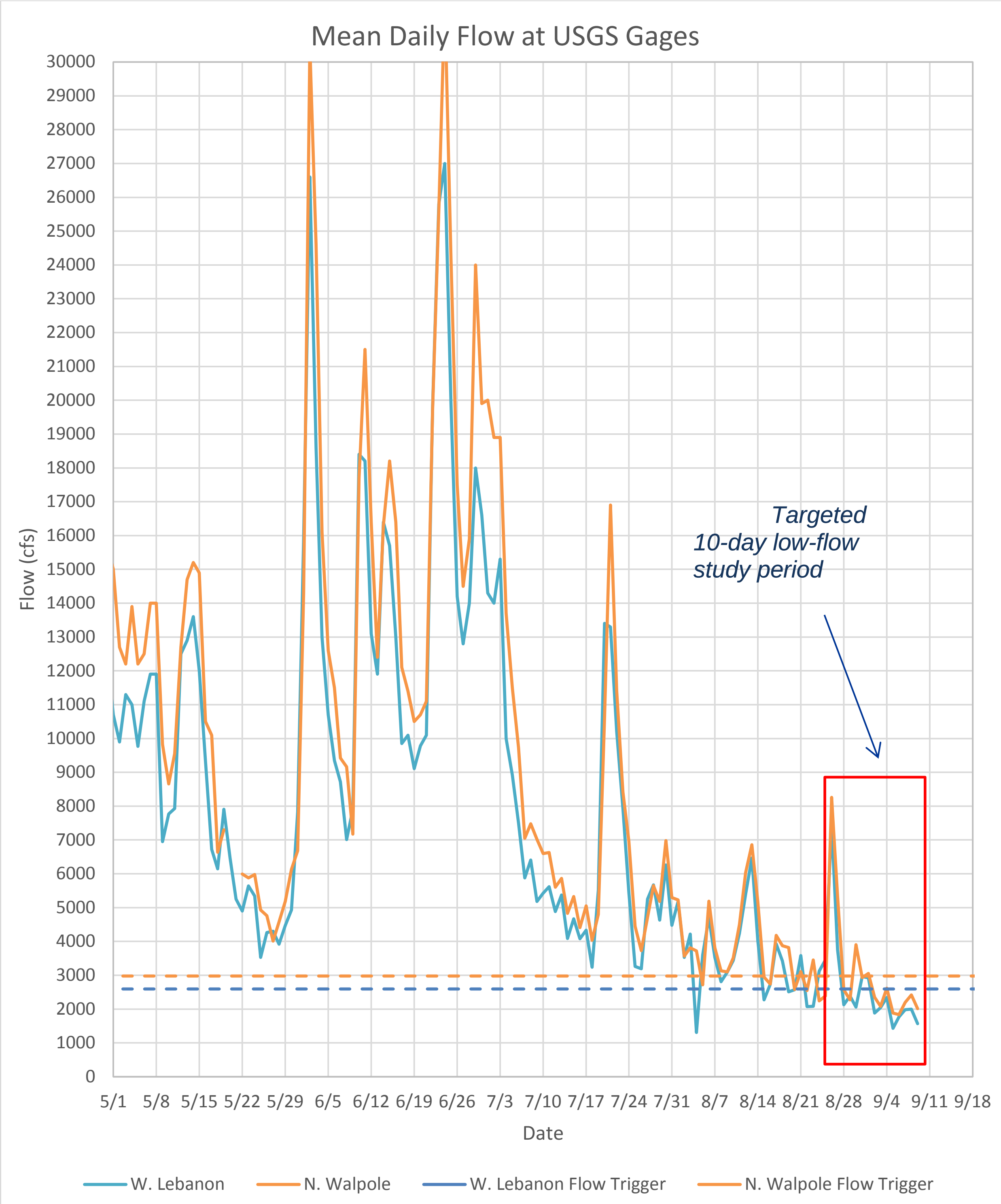

Figure 6-2. River flow at two USGS gaging stations (West Lebanon near the Wilder dam, and North Walpole near the Bellows Falls dam) and water temperatures at stations upstream of the three impoundments. The targeted period for the 10-day low-flow study component is marked.

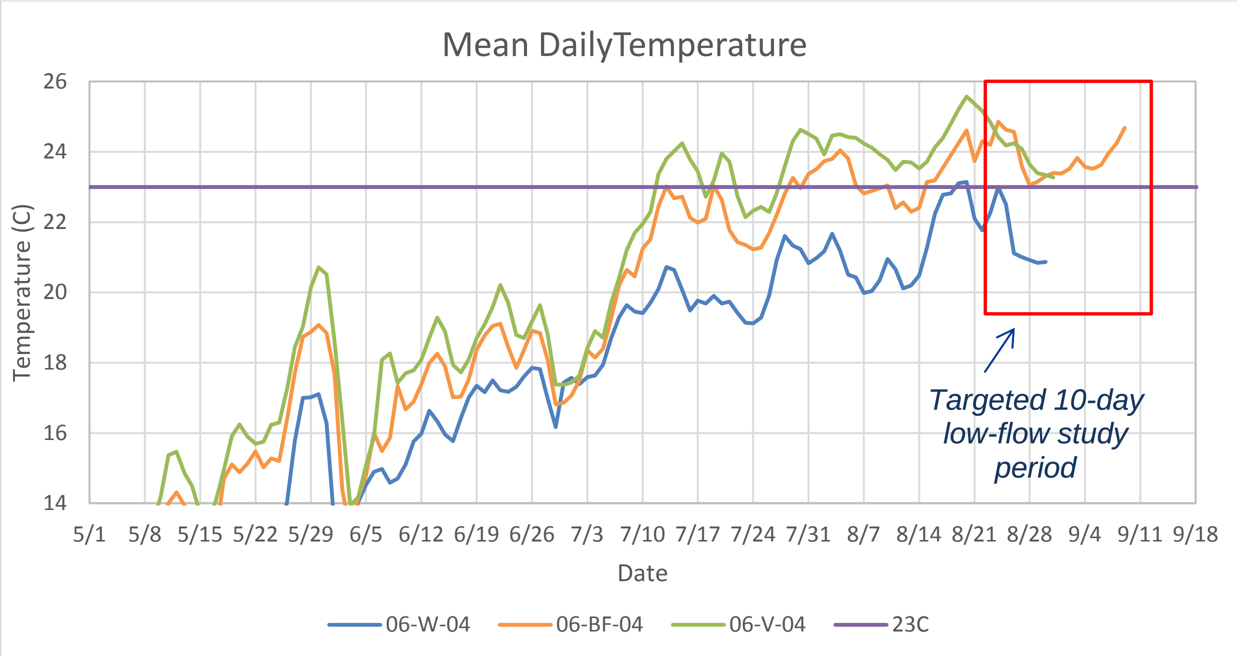

Figure 6-3. Water temperatures at stations upstream of the three impoundments. The targeted period for the 10-day low-flow study component is marked. More recent temperatures are not yet processed.

6.3 Remaining Activities

Remaining activities for this study consist of the following:

- Completion of the 10-day low-flow monitoring period (after the first week of September).
- Completion of the more intensive monitoring during the summer period (by the end of September).
- Temperature monitoring during the fall period at all stations (October through mid-November).
- Analysis of all collected data, including additional in-depth quality control review.
- Comparison of 2015 data with data and findings of the 2012 water quality study.
- Determination of potential impacts of the Wilder, Bellows Falls, and Vernon Projects on water quality and temperature as they relate to Project operations. This includes documenting whether the Connecticut River in the vicinity of the projects is in compliance with Vermont and New Hampshire surface water quality standards.
- Preparation of the final study report

6.4 Study Results to Date

The emphasis of this program to-date has been to collect high-quality data, in accordance with the Revised S&A plan. Quality control steps are undertaken during the program as also specified in the plan. A final quality control review of all data will be conducted after all data have been collected. Thus, all initial results are considered preliminary.

Initial study results consist of the following:

- Temperatures in the mainstem of the Connecticut River follow seasonal patterns. Temperatures at the three stations upstream of each impoundment are shown in Figure 6-3; temperatures at all stations were close to or exceeded 23ºC toward the end of August.
- As of September 1, the water column was not stratified in any of the three impoundments. The water column has not been stratified in any of the three impoundments. Dissolved oxygen concentrations throughout the impoundments have been high; no violations of both Vermont and New Hampshire surface water quality standards have been identified.

6.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

Variances consist of the following:

- The Revised S&A plan including moving some of the Connecticut River stations slightly to positions identical to the 2012 WQ stations. The adjustment was made prior to the deployment of any instruments at these stations, thus no data were affected. The revised S&A Plan included the following adjustments:
    - *Stations 06-W-03, 06-BF-03, 06-BF-02, 06-BF-BR, 06-V-03, 06-V-02, and 06-V-01:* These stations were moved slightly downstream to coincide with the respective 2012 WQ stations.
    - *Station 06-BF-04:* This station was moved 0.5 mile upstream to not interfere with boat traffic at the landing and to avoid the apparent sand shoal which could have complicated data collection during low-flow conditions.
    - *Station 06-BF-TR:* Minor shift of this station downstream by 50 feet.
- The number of temperature loggers on moorings during the 10-day low-flow study was reduced at stations with shallow water depths. Detailed water depth measurements during field work had shown that the upstream and some upper and mid-impoundment stations are too

shallow to reasonably require three vertical loggers. The requested modification applied to water depths of less than 4 m at the time of deployment of the temperature loggers as follows:

- One logger per mooring for water depths shallower than 3 m;
- Two loggers per mooring for water depths between 3 and 4 m; and
- Three loggers per mooring for water depths deeper than 4 m, as originally planned.

The modification was proposed to VDEC and NHDES on June 26, 2015 via email and approved by agency staff via email on June 30, 2015.

Field conditions resulted in the following loss of data:

- The pH sensor in the sonde deployed at the Bellows Falls tailrace (Station 06-BF-TR) suffered a broken bulb on June 14 at 9:45 pm. Due to high flows this was not noticed until June 28. (Loss of pH data: 14 days)
- High flows during the first week of July displaced the sonde in the Bellows Falls bypassed reach (Station 06-BF-BR) onto shore and damaged the pH sensor. This resulted in lost data from July 4 to 6. (Loss of data for pH, DO, temperature, specific conductivity, and turbidity: 3 days). The sonde was also found intentionally moved out of the water on September 9 where it was discovered on top of a boulder adjacent to the deployment location. This resulted in lost data from the evening of August 28 to the September 9 site visit when the sonde was checked and reinstalled. (Loss of data for pH, DO, temperature, specific conductivity, and turbidity: ~ 12 days).
- The Saxton River (Station 06-V-T03) temperature logger was vandalized and stolen. This was noticed during the site visit on July 21. A new logger was set up approximately 300 feet upstream. Since then, the new logger has not been disturbed and is collecting data. (Loss of temperature data: 14 days).
- The temperature logger installed upstream of the Bellows Falls impoundment (Station 06-BF-04) was found removed from the river on August 20; it had been placed onto the river bank. The logger was unharmed; it was immediately reinstalled. (Loss of temperature data: 4 days).
- Low flows upstream of the Vernon impoundment left the deployed temperature logger out the water between July 12 and 16. The logger was redeployed subsequently at a deeper station. (Loss of temperature data: 4 days).

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7. Study 7 – Aquatic Habitat Mapping Study

7.1 Introduction

TransCanada conducted this Aquatic Habitat Mapping Study (ILP Study 7) to survey, identify, and map aquatic habitat at the Wilder, Bellows Falls, and Vernon Project-affected areas to provide baseline data to be used to assess potential aquatic effects under current operations (in association with other studies). The objectives of this study were 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
- Use the data collected in conjunction with data from other studies to describe potential influences of project impoundments and project operations on the distribution of aquatic habitat within the project-affected area.

The RSP for this study was approved without modification in FERC's February 21, 2014 SPD; however, the deadline for filing of the final study report was extended to March 1, 2015 in that determination.

7.2 Study Progress

The study was completed in late 2013 with concurrence of the aquatics working group, and data consolidation occurred in early 2014. The ISR was prepared in draft form and provided for working group review on May 8, 2014. No comments were received and the initial study report was filed on September 15, 2014 in Volume II of the ISR, along with water level logger data, and GIS layers of impoundment bathymetry and habitat mapping data in the geodatabase filed separately on DVD as Volume VII of the ISR, TransCanada Initial Study Report Supporting Geodatabase. GIS data had also been provided on DVD to participants at a working group in May 2014. A final study report was completed and filed on March 2, 2015, along with overwintered water level logger data from 2013/2014 for the study.

After the March 2, 2015 filing, it was discovered that some logger data for study sites 26 and 29 was incorrectly converted resulting in elevations that were incorrect. In addition, logger data for site 70 was mis-identified as valid data (with a Use Code of "1") when in fact, it was not valid data based on additional post-processing. Revised logger data from 2013/2014 is being filed in Volume IV.A of this USR. In addition, overwintered logger data from 2014/2015 is now available and being filed as Volume IV.B of this USR.

7.3 Remaining Activities

None.

7.4 Study Results to Date

See Study 7 – Aquatic Habitat Mapping Final Study Report filed March 2, 2015, and the associated Study 7 GIS layers (filed as part of the ISR).

7.5 Variance from Study Plan and Schedule

None.

8. Study 8 – Channel Morphology and Benthic Habitat Study

8.1 Introduction

TransCanada conducted this Channel Morphology and Benthic Habitat Study (ILP Study 8) to understand how Wilder, Bellows Falls and Vernon Project operations may affect fluvial processes related to the movement of coarse sediment (e.g., gravel, cobble) in the project-affected areas and potential related effects on benthic habitat. The study goal was to understand how project operations affect bedload distribution, particle size, and composition in relationship to habitat availability for different life-history stages of anadromous and riverine fish and for invertebrates. The objectives of this study were 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.

The RSP for this study was approved without modification in FERC's February 21, 2014 SPD; however, the deadline for filing of the final study report was extended to March 1, 2015, in that determination.

8.2 Study Progress

An SSR was developed and presented to the aquatics working group in May 2014 (filed in Volume III of the ISR with study locations included as a GIS layer in the geodatabase filed separately on DVD as Volume VII of the ISR, TransCanada Initial Study Report Supporting Geodatabase).

The working group made no requests for changes to the SSR and the recommended sites were approved, with the allowance for using contingency sites as needed if variables including site access, safety considerations, site characteristics, and/or changing site conditions preclude the use of any recommended sites.

The first round of Study 8 field data collection was conducted in July and August, 2014, and the second round of data collection was conducted in October 2014. During the first round of data collection, site suitability was evaluated and confirmed, survey transects were established and documented at each study site, and pebble count and embeddedness data were collected at each study transect. During the second round of site visits, pebble count and embeddedness data collection was repeated at each of the previously established study transects.

Following completion of field data collection, material size gradation curves were developed from the pebble count data and average embeddedness was calculated from embeddedness data for both rounds of data collected at each transect. This information was used to inform an assessment of coarse-grained substrates within the study area, including apparent influences on the characteristics and distribution of coarse-grained sediment within the study area and general availability of coarse-grained benthic habitat for relevant life-stages of dependent aquatic biota. These data were included in a study report filed on March 2, 2015.

8.3 Remaining Activities

The results of this study rely on information from associated studies that will be used to inform an evaluation of the availability and stability of habitat for coarse-sediment-dependent aquatic invertebrates and anadromous and resident fish and potential project effects of project operations on these habitats.

The assessment of the potential effects of project operations will be included in the Draft License Applications (DLAs) since results from other studies will be needed to complete that assessment. Relevant studies include the erosion studies (Studies 2 and 3), Hydraulic Modeling Study (Study 4), and Operations Modeling Study (Study 5). None of these studies are complete at this time.

8.4 Study Results to Date

Study results to date are presented in the study report filed March 2, 2015.

8.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

As described in the SSR, the upstream and downstream extents of the study area were modified from those inaccurately described in the RSP.

9. Study 9 – Instream Flow Study

9.1 Introduction

TransCanada is conducting this Instream Flow Study (ILP Study 9) to assess aquatic resources and habitat in the Wilder, Bellows Falls, and Vernon Project-affected riverine 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 as listed in the RSP in riverine reaches downstream of project dams. 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.

The RSP for this study was approved without modification in FERC's February 21, 2014 SPD; however, the deadline for filing of the final study report was extended to December 31, 2015 in that determination.

9.2 Study Progress

An SSR containing a preliminary set of proposed study sites transects, and 2-dimensional modeling locations was developed in 2014 and revised in response to working group comments (Revised SSR was filed on September 15, 2014 in Volume III of the ISR). Working group representatives participated in site and transect selection field visits in all study reaches and seventy-nine transects were selected in the field with 8 of the originally selected sites being relocated or replaced based on site conditions. Maps showing transect locations for all reaches will be included in the Study 9 final report.

During site visits to the Bellows Falls bypassed reach, working group participants agreed to place transects in the riffle and run section of the upper portion of the reach. Seven transects were selected to represent this section of the bypassed reach (Figure 9-1). Based on viewing a series of flows between leakage (approximately 150 cfs) and approximately 3,000 cfs on August 11, 2014, TransCanada consultants noted that it would only be possible to acquire velocity data on all transects at the leakage flow and potentially some transects at about 1,000 cfs. Participants agreed that whatever information could be collected would be beneficial. Data collection took place on October 14, 2014 at leakage flow (300 cfs) and on May 16, 2015 at approximately 900 cfs. Final calibration of transects is pending results of Study 4 modeling of the bypassed reach.

Working group participants also recommended that a demonstration flow analysis be conducted over the range of low to middle flows at Sumner Falls. TransCanada agreed to consider this alternative pending additional discussion of this option.

VFWD representatives prepared a draft Demonstration Flow Analysis Plan on August 25, 2014 (see ISR Volume I, Appendix A). After additional discussion during the ISR meeting on September 29, 2014, it was decided that the upper portion of Sumner Falls could be evaluated by establishing a group of transects and gages to supplement a series of demonstration flows. VFWD prepared a revised plan on November 10, 2014 and TransCanada draft an updated proposal dated December 15, 2014 and provided to the working group (and summarized at a February 10, 2015 aquatics consultation conference call and at a July 14, 2014 conference call – see Appendix A) which was subsequently accepted by the participants (documents included in Appendix B of this Volume I of the USR). Working group representatives participated in selecting 5 transects (Figure 9-2) and observing demonstration flows between 1,300 cfs and 4,000 cfs on August 3-5, 2015. In addition, TransCanada acquired aerial imagery at different flow levels using a drone aircraft. Both the imagery and transect information will be used to assess changes in wetted area and depth within the Sumner Falls study area at the different flow levels observed.

During study planning, it was agreed that TransCanada could use Habitat Suitability Curves (HSCs) developed as part of FirstLight's Turners Falls Project relicensing for target species and life stages that are the same. TransCanada submitted a draft HSC report on December 15, 2014 which included the FirstLight HSCs along with some recommended modifications, and proposed HSC for smallmouth bass (the only species not on the FirstLight target species list). Working group representatives responded to the report on July 9, 2015 accepting all proposed HSC with the exception of Tessellated Darter (recommendations were made for changes to the curve) and added Longnose Dace fry and Rainbow Trout adult (documents included in Appendix B of this Volume I of the USR). TransCanada agreed to the recommendations and will also develop suitability criteria for some mussel species found within the projects through Study 24 - Dwarf Wedgemussel and Co-occurring Mussel Study (see Section 24).

Field data collection commenced in July 2014 and continued through October 2014. Low water levels did not allow for high flow releases in the fall of 2014. As a result, high flow data collection and velocity acquisition on 1D transects was not completed until May 2105. Bathymetry for 2D study sites was collected in October 2014. Calibration of both 1D and 2D models has been initiated and should be completed during the fall of 2015.

9.3 Remaining Activities

Once model calibration is completed in the fall of 2015 a habitat index versus flow relationship will be computed over a range of flows for key aquatic species in each project reach. Results will be presented in tabular and graphic form for individual transects and mesohabitat types in addition to combined mesohabitat types by reach.

Potential effects of project operations on aquatic resources are dependent on results of the Operations Modeling Study (Study 5). Hydrology from this study will be used to complete a time series analysis of various project flow scenarios for each reach. The dual flow analysis, which will examine the influence of peaking, will need stakeholder input to select representative life stages and flow combinations to model.

A study report will be completed by December 31, 2015, in accordance with the SPD final study report deadline, pending completion of Study 5.

9.4 Study Results to Date

Measured flows for 1D transects were generally close to specified target flows (Tables 9-1 and 9-2). Target flows for the Wilder reaches were based on releases from the dam, anticipating normal accretion levels downstream in Wilder reach 1 and 2. Due to unexpected accretion levels from rain events, high flow measurements in Wilder reach 3 were higher than expected. However this does not diminish the data and, in fact, results in increased accuracy of edge velocity simulation at flows at and beyond those measured.

Table 9-1. Target flows by reach for 1D transect data collection (releases from dam).

	Target Flows		
	Low (cfs)	**Middle (cfs)**	**High (cfs)**
Wilder Reach 1	700-2,000	5,000	10,000-12,000
Wilder Reach 2	700-2,000	5,000	10,000-12,000
Wilder Reach 3	700-2,000	5,000	10,000-12,000
Bellows Falls	1,300-2,000	4,500-7,500	9,000-11,000
Vernon	1,600-2,500	5,000-7,500	10,000-12,000

Table 9-2. Measured flows by reach for 1D transect data collection. Higher flows in Wilder reach 1 and 2 due to expected accretion. Ranges indicate measurements over multiple days or conducted under varying flow levels.

	Measured Flows		
	Low (cfs)	**Middle (cfs)**	**High (cfs)**
Wilder Reach 1	793	5,650	12,057
Wilder Reach 2	1,392	6,598 - 7,340	12,899 - 13,788
Wilder Reach 3[a]	1,661 - 1,737	6,550 - 6,969	15,419 - 16,926
Bellows Falls	1,824 – 1,880	5,400 – 5,575	11,439 – 12,298
Vernon	2,035	4,100 and 8,600	12,550

a. Measured high flows in Wilder reach 3 were greater than anticipated due to elevated accretion from rain events.

Figure 9-1. Transect locations in the Bellows Falls bypassed reach.

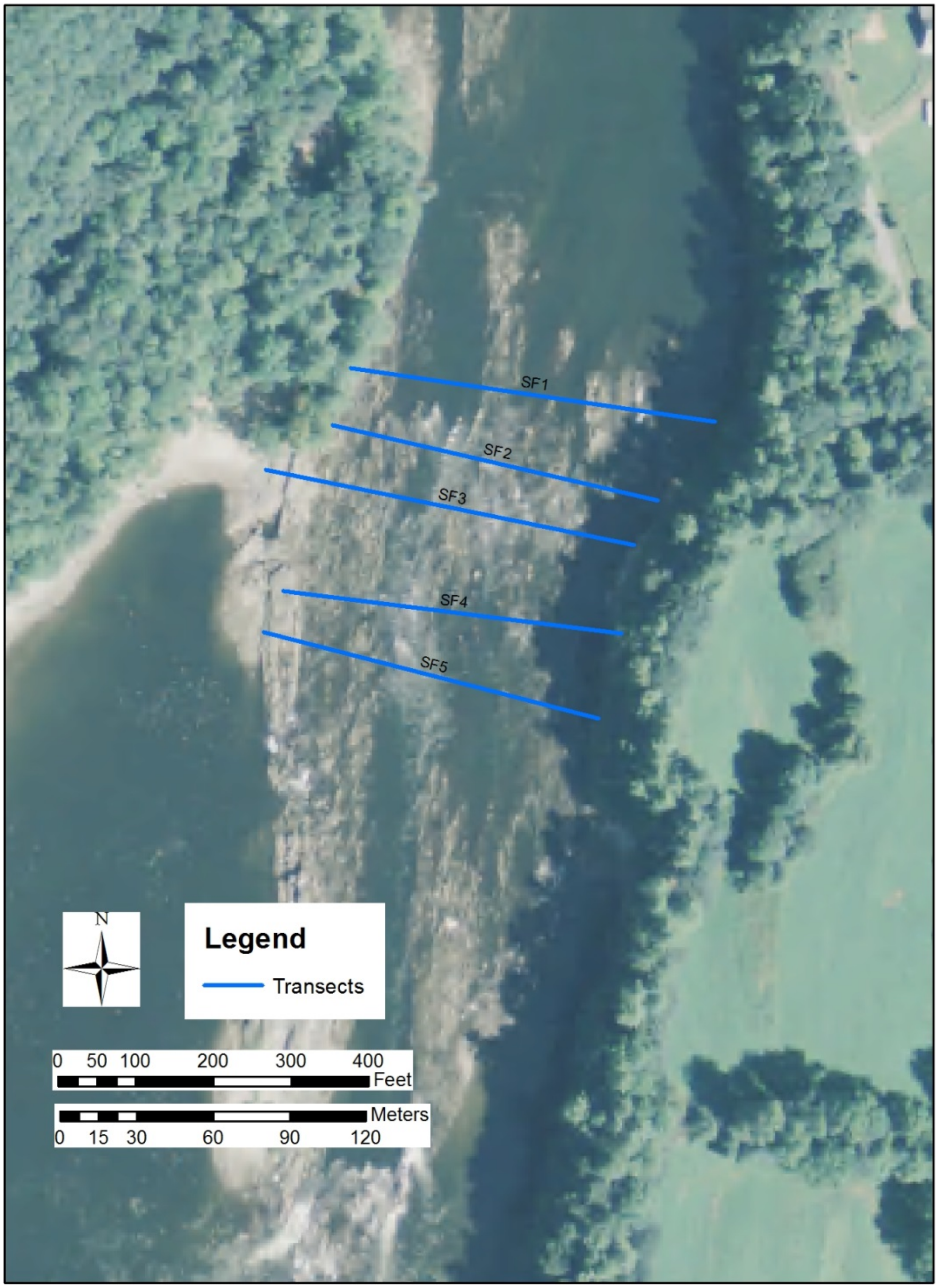

Figure 9-2. Transect locations for the Sumner Falls demonstration flow.

9.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

Field work in 2014 was extended into the fall due to sustained high flows in July 2014 which delayed the working group field visits and some data collection. However, later in the summer and fall of 2014, there were not sufficient sustained high flows needed to collect the high flow data which was delayed until May 2015.

10. Study 10 – Fish Assemblage Study

10.1 Introduction

TransCanada is conducting this Fish Assemblage Study (ILP Study 10) in 2015 to characterize the occurrence, distribution, and relative abundance of fish species present in the project-affected areas. The specific objectives of this study are to:

- Document fish species occurrence, distribution, and relative abundance within the project impoundments, tailwaters, and downstream riverine sections;
- Compare historical records of fish species occurrence in the project-affected areas to the results of this study; and
- Describe 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 at Vermont Yankee in the Vernon impoundment).

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

10.2 Study Progress

Prior to the initialization of field sampling, an SSR was prepared and submitted for review to the aquatics work group. The SSR was subsequently revised based on comments received at a December 17, 2014 consultation meeting. The Revised SSR (included as Volume II.B of this USR with site locations included as a GIS layer identified as "TC_10_MapUnits_2015" in Volume II.I of this USR).

The Revised SSR reviewed all available aquatic habitat data and selected proposed study locations based on a stratified random sampling design. Study locations were selected on a seasonal basis; spring (May-June), summer (July, August), and fall (September, October) and were chosen proportional to available habitat types (i.e., sand-silt-clay, gravel-cobble, boulder) within each geographic reach. A total of 69 sites were selected for sampling during each seasonal period; 15 in the Wilder impoundment, 12 in the riverine section downstream of Wilder, 12 in the Bellows Falls impoundment, 3 in the Bellows Falls bypassed reach, 12 in the riverine section downstream of Bellows Falls, 12 in the Vernon impoundment and 3 in the riverine reach downstream of Vernon. Tributaries and backwater areas originally identified during 2014 in Study 13 - Tributary and Backwater Fish Access and Habitats Study located within randomly selected mainstem sampling areas were also sampled.

Sampling gear types were preselected based on anticipated site conditions and in general consisted of a 500-m boat electrofish shoreline transect and a two-hour experimental gill net set in impoundment sampling locations and a 500-m pram or backpack electrofish shoreline transect and a 100-ft (30.48-m) beach seine sample in riverine sampling locations. Selected tributaries and backwaters were sampled for fish assemblage via a pram or backpack electrofish transect placed within the project-affected portion of the water body. The final selection of sampling gears utilized at a particular location is a function of safe access and site-specific conditions at the time of sampling (i.e., water depth, velocity, etc.).

As of August, 2015, the spring (May-June) and summer (July-August) sampling has been completed. The fall sampling began on September 7 and will continue into October, 2015. Field data that was collected in spring and summer are currently being post-processed and QA/QC-ed. As a result, study results for the spring sampling period only is presented here and should be considered preliminary. Field data collected during the summer collection period is in the process of being key-punched, verified, and subjected to data QC protocols and is therefore not available for this report

10.3 Study Results to Date

Sampling effort for the spring (May-June) is presented in Table 10-1. When each of the seven geographic reaches is considered, a total of 54 boat electrofish samples, 24 pram/backpack electrofish samples, 40 gill net samples and 23 beach seine samples were conducted during the two month period. Spring fish assemblage sampling produced a total of 3,938 individuals, representing 35 fish species and two taxonomic groups (*Esox* sp., and *Lepomis* sp.) (Table 10-2). Within the impounded reaches, species richness ranged from 15 species in the Wilder impoundment to 20 species in the Bellows Falls impoundment. For riverine reaches, species richness ranged from 16 species in the Vernon riverine reach to 23 species in the Bellows Falls riverine reach. When individuals from all geographic reaches captured during the spring are considered, spottail shiner (30.6%), rock bass (9.8%), yellow perch (9.4%), tessellated darter (8.8%) and rosyface shiner (8.6%) were the five most abundant fish species (Table 10-3).

Table 10-1. Number of fish assemblage sample locations (by river reach) and number of completed samples (by gear type) for Study 10 Spring sampling (May-June, 2015).

River Reach	Number Sample Locations		# Collected Samples			
	Mainstem	Tributary / Backwater	Boat Efish	Pram / Backpack Efish	Gill Net	Seine
Wilder Impoundment	15	2	15	2	15	0
Wilder Riverine	12	2	0	14	0	9
Bellows Falls Impoundment	12	1	12	1	11	1
Bellows Falls Bypassed Reach	3	0	0	0	0	0
Bellows Falls Riverine	12	3	12	3	0	12
Vernon Impoundment	12	1	12	1	12	0
Vernon Riverine	3	3	3	3	2	1
Total	69	12	54	24	40	23

*Note: Study 10 spring totals are preliminary and have yet to be subjected to QC protocols.

Table 10-2. Total catch by species and river reach (all gear types combined) for Study 10 Spring sampling (May-June, 2015).

Common Name	REACH					
	Wilder Impoundment	Wilder Riverine	Bellows Falls Impoundment	Bellows Falls Riverine	Vernon Impoundment	Vernon Riverine
American shad						3
Banded killifish		1		4	1	
Black crappie			2		2	
Blacknose dace		12		31	1	
Bluegill	1	2	1	4	20	16
Bluntnose minnow				1		
Bridle shiner	1					
Brook trout		7			5	5
Brown bullhead			2		1	
Brown trout		2				
Chain pickerel	1		1			
Channel catfish						1
Common shiner		130		3		
Creek chub	3	10	6	15		
Eastern silvery minnow	3					
Esox sp.	1					
Fallfish	109	92	48	18	67	1
Golden shiner	1	1	5	2	1	
Lake chub		1		3		
Largemouth bass			4	18	1	1
Lepomis sp.					1	
Longnose dace		3		25		
Longnose sucker		26				
Mimic shiner				4		
Northern pike	12		2	1	5	1
Pumpkinseed			5	3	17	1
Rock bass	121	141	32	35	38	18
Rosyface shiner		308	2	29		
Sea lamprey		1	7	13	16	1
Slimy sculpin		71		1		9
Smallmouth bass	69	34	32	41	29	33
Spottail shiner	49	133	498	139	384	1
Tessellated darter	112	88	21	73	52	

Common Name	REACH					
	Wilder Impoundment	Wilder Riverine	Bellows Falls Impoundment	Bellows Falls Riverine	Vernon Impoundment	Vernon Riverine
Walleye	56		1		1	1
White sucker	19	28	9	24	11	7
Yellow bullhead			1			
Yellow perch	155	3	83	6	114	10
Total Individuals	**15**	**21**	**20**	**23**	**19**	**16**
Total Number Species	**728**	**1115**	**782**	**516**	**786**	**125**

*Note: Study 10 spring totals are preliminary and have yet to be subjected to QC protocols.

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Table 10-3. Total catch and percent composition by species (all river reaches and gear types combined) for Study 10 Spring sampling (May-June, 2015).

Common Name	Total Spring Catch	% Composition
Spottail shiner	1204	30.57%
Rock bass	385	9.78%
Yellow perch	371	9.42%
Tessellated darter	346	8.79%
Rosyface shiner	339	8.61%
Fallfish	335	8.51%
Smallmouth bass	238	6.04%
Common shiner	133	3.38%
White sucker	98	2.49%
Slimy sculpin	81	2.06%
Walleye	59	1.50%
Blacknose dace	44	1.12%
Bluegill	44	1.12%
Sea lamprey	38	0.96%
Creek chub	34	0.86%
Longnose dace	28	0.71%
Longnose sucker	26	0.66%
Pumpkinseed	26	0.66%
Largemouth bass	24	0.61%
Northern pike	21	0.53%
Brook trout	17	0.43%
Golden shiner	10	0.25%
Banded killifish	6	0.15%
Black crappie	4	0.10%
Lake chub	4	0.10%
Mimic shiner	4	0.10%
American shad	3	0.08%
Brown bullhead	3	0.08%
Eastern silvery minnow	3	0.08%
Brown trout	2	0.05%
Chain pickerel	2	0.05%
Bluntnose minnow	1	0.03%
Bridle shiner	1	0.03%
Channel catfish	1	0.03%
Esox sp.	1	0.03%
Lepomis sp.	1	0.03%
Yellow bullhead	1	0.03%
Total	**3938**	**100.00%**

*Note: Study 10 spring totals are preliminary and have yet to be subjected to QC protocols.

10.4 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

In addition, stations 10-BF-001 (east bank), 10-BF-001 (west bank) and 10-BF-002 (west bank) in the Bellows Falls bypassed reach were randomly selected for fish assemblage sampling during the spring period. Due to high flow events resulting in spill conditions at the Bellows Falls dam and associated safety concerns, these stations could not be sampled during their targeted time period (latter part of June, 2015). To date, randomly selected stations 10-BF-002 (east bank) and 10-BF-002 (west bank) in the Bellows Falls bypassed reach were sampled during the July-August (summer) period.

11. Study 11 – American Eel Survey

11.1 Introduction

TransCanada is conducting this American Eel Survey (ILP Study 11) in 2015 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:

- Characterize the distribution of American Eel in the project impoundments, riverine sections, and the project-influenced portions of tributaries upstream of Wilder, Bellows Falls, and Vernon dams; and
- Characterize the relative abundance of American Eel in the project impoundments, riverine sections, and the project-influenced portions of tributaries upstream of the dams.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

11.2 Study Progress

Prior to the initialization of field sampling, an SSR was prepared and submitted for review to the aquatics work group. The SSR was subsequently revised in response to comments received at a December 17, 2014 consultation meeting. The Revised SSR is included as Volume II.C of this USR with site locations included as GIS layers identified as "TC_11_MapUnits_2015" and "TC_11_StudySites_2015" in Volume II.I of this USR.

The Revised SSR proposed sampling locations based on a stratified random design. Selected sampling areas consisted of both mainstem locations and the project-affected reaches of major tributaries. A total of 102 mainstem sampling areas were selected (37 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, 22 in the Vernon impoundment, and 1 in the riverine reach downstream of Vernon). In addition to mainstem sampling locations, the project-affected reach of 24 major tributaries (7 upstream of Wilder, 9 upstream of Bellows Falls, and 8 upstream of Vernon) were also selected for sampling.

Sampling at each of the 102 mainstem locations and the 24 major tributary locations consisted of a 500-m electrofish transect and a 24-hr baited eel trap set. As of September 10, 2015, each of the 102 mainstem sampling locations associated with Study 11 has been completed. In addition, eel trap sampling has been completed in each of the 24 major tributaries and electrofish sampling has been completed in 23 of the 24 major tributaries.

Field data collected to date are in the process of being key-punched, verified, and subjected to data QC protocols.

11.3 Study Results to Date

Sampling effort to date is presented in Table 11-1. When all six geographic reaches are considered, a total of 126 24-hour baited eel trap sets, 81 500-m boat electrofish transects and 34 500-m pram/backpack electrofish transects have been conducted to date. As of September 10, 2015, a total of two American Eels have been captured. Both individuals were collected during boat electrofish sampling effort in map-unit 11-BF-051 in the Bellows Falls impoundment.

Table 11-1. Number of Study 11 American Eel sample locations (by river reach) and number of completed samples (by gear type) (August, 2015).

River Reach	Number Sample Locations		# Collected Samples		
	Mainstem	Major Tributaries	Boat Efish	Pram / Backpack Efish	Eel Trap
Wilder Impoundment	37	7	38	6	44
Wilder Riverine	15	4	0	19	19
Bellows Falls Impoundment	22	5	24	3	27
Bellows Falls Riverine	5	3	0	8	8
Vernon Impoundment	22	5	22	4	27
Vernon Riverine	1	0	1	0	1
Total	**102**	**24**	**85**	**40**	**126**

11.4 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

12. Study 12 – Tessellated Darter Survey

12.1 Introduction

TransCanada is conducting this Tessellated Darter Survey (ILP Study 12) in 2015 to assess the effects of project operations on populations of tessellated darter (*Etheostoma oldstedi*), a New Hampshire Species of Greatest Conservation Need (SGCN) and known host species for the federally listed as endangered dwarf wedgemussel (*Alasmidonta heterodon*). The specific objective of this study is to characterize the distribution and relative abundance of tessellated darter within the project-affected areas. This information will help to determine whether the dwarf wedgemussel population may be constrained due to the distribution and abundance of tessellated darters.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

12.2 Study Progress

Prior to the initialization of field sampling, an SSR was prepared and submitted for review to the aquatics work group. The SSR was subsequently revised in response to comments received at a December 17, 2014 consultation meeting. The Revised SSR is included as Volume II.D of this USR with site locations included as GIS layers identified as "TC_12_MapUnits_2015" and "TC_12_SelectedTransects_2015" in Volume II.I of this USR.

The Revised SSR reviewed all available aquatic habitat data and selected proposed study locations based on a stratified random sampling design. Selected sampling areas consist of mainstem locations and were chosen proportional to available habitat types (i.e., sand-silt-clay, gravel-cobble, boulder) within each geographic reach. A total of 45 sites were selected for sampling during each seasonal period; 14 in the Wilder impoundment, 8 in the riverine section downstream of Wilder, 8 in the Bellows Falls impoundment, 4 in the riverine section downstream of Bellows Falls, 8 in the Vernon impoundment and 3 in the riverine reach downstream of Vernon. Within each 500-m site, three cross-river transects were randomly placed.

Each cross-river transect contained 5 fixed-radius count locations spaced evenly across the channel (i.e., west bank, ~1/3rd channel width, ~channel midpoint, ~2/3rd channel width, east bank). Once center points were established at a particular count location, a diver or snorkeler (to be determined in field and dependent upon site conditions) descended down the line and recorded pertinent field data.

12.3 Study Results to Date

None at this time. Field sampling began the first week of September 2015.

12.4 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

13. Study 13 – Tributary and Backwater Fish Access and Habitats Study

13.1 Introduction

TransCanada conducted this Tributary and Backwater Fish Access and Habitats Study (ILP Study 13) in 2014 to assess whether water-level fluctuations from Wilder, Bellows Falls, and Vernon Project operations impede fish movement into and out of tributaries and backwater areas within the project-affected areas and whether project operations affect available fish habitat and water quality in those areas. The objectives for this study were to conduct a field study of a subset of tributaries and backwaters in the project-affected areas to:

- Assess potential effects of water-level fluctuations on fish access to these areas; and
- Assess potential effects of water-level fluctuations on available habitat and water quality.

The RSP for this study was modified by TransCanada in its December 31, 2013, filing, based on stakeholder agreement from the VY technical meeting, with the following specific change.

- Monitor water quality parameters in 2015 at any selected sites within areas previously affected by the VY thermal discharge. [Note: The sites randomly selected within the Vernon impoundment are all upstream of the VY outfall. The closest (site CT-V- 5.50) is located just upstream. There are two sites in the riverine section downstream of Vernon dam (CT-VR 6.01 and CT-VR-6.05) that will no longer be affected by VY once it is closed, and these sites will be monitored for water quality in 2015].

The RSP was approved without material modification in FERC's February 21, 2014 SPD; however, the deadline for filing of the final study report was extended to March 1, 2015.

13.2 Study Progress

A preliminary set of randomly selected proposed study sites was developed in an SSR and presented to the aquatics working group on May 23, 2014. Meeting attendees requested that tributaries be re-evaluated more closely with the originally requested 1-foot or less water depth during low impoundment water-level criteria; and that the water-level data for all tributaries and backwaters be provided to the working group. Depth sounding data collected in the tributary/backwater-impoundment confluence areas during Study 7 sampling conducted in 2013 were assembled and provided to the working group as part of the Revised SSR (included in Volume III of the ISR with locations included as a GIS layer in the geodatabase filed separately on DVD as Volume VII of the ISR, TransCanada Initial Study Report

Supporting Geodatabase). Site locations were subsequently finalized in the field and the GIS layer revised (Section 13.4).

All of the 37 study locations were visited at least three times and most were visited four times between late July and early November 2014. Two Onset HOBO data loggers were installed at each site and were programmed to collect temperature and water surface elevation data. One logger was installed within the project-affected portion of the confluence area and the second was installed in the mainstem Connecticut River, adjacent to the study site. At each site visit, water depths were measured manually and water quality information was recorded and included temperature, DO (percent saturation and mg/L), conductivity, pH, and turbidity. A series of time-stamped photographs was taken to document site conditions at the time of the initial visit and thalweg elevation profiles were also measured.

13.3 Remaining Activities

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). Study 4 will develop rating curves, associating station flows and spill and/or project operations with WSEs at specific cross-sections. Cross-sections have been identified in the hydraulic model with the backwater and tributary study locations and modeled WSEs will be determined for a variety of operational and spill flow levels. The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical WSEs noted in the Study 13 report, with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

13.4 Study Results to Date

Study results to date are presented in the study report filed as Volume III.A of this USR. Water level logger data in three Excel files is included in Volume IV.C – IV.E of this USR, and a GIS layer of final study site locations (showing exact locations of water level loggers) identified as "TC_13_Supporting Geodata" is included in Volume III.C of this USR.

13.5 Variance from Study Plan and Schedule

The methods and schedule for field work were at variance with the RSP, which assumed that some related studies (Study 10 – Fish Assemblage, Study 14 – Resident Fish Spawning in Impoundments, and Study 15 – Resident Fish Spawning in Riverine Sections) would be conducted concurrently with this study. Those studies were delayed until 2015 in FERC's February 21, 2014 SPD.

Delays due to persistent high water early in the 2014 season, and longer than expected time needed at each site for the initial site visits, delayed the initial field work for the study; however, these delays did not materially affected the study's data collection efforts.

The study report was not filed on March 1, 2015 as required in FERC's SPD due to the extensive analysis of water level logger data in relation to TransCanada operations data that was incomplete at that time. FERC staff verbally approved the delay in filing the study report in order to complete the data analysis.

14. Study 14 – Resident Fish Spawning in Impoundments Study

14.1 Introduction

TransCanada is conducting this Resident Fish Spawning in Impoundments Study (ILP Study 14) in 2015 to assess whether project-related, water-level fluctuations in the impoundments affect resident fish spawning. The target species of interest for this study were smallmouth bass, largemouth bass, yellow perch, black crappie, pumpkinseed, bluegill, chain pickerel, northern pike, golden shiner, white sucker, spottail shiner, walleye, and fallfish. The objectives of this study were 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 1 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.

The RSP was approved in FERC's February 21, 2014 SPD with the following specific change.

- Record species data (e.g., spawning habitat presence and depth of spawning habitat) of eastern silvery minnow (*Hybognathus regius*) if the species is found during other target species surveys, and evaluate project effects on eastern silvery minnow.

The determination also delayed the study until 2015 and the final report to March 1, 2016.

14.2 Study Progress

Preliminary work on the study began in November 2014 and included literature review of species spawning periodicities and habitat characteristics; and development of an SSR based on the above literature review and required sampling design elements (i.e., purposive selection where local information was available, random selection in absence of local information) and presentation of proposed sampling locations to the working group and discussion/adoption of proposed modifications (e.g., addition of smaller tributaries to tributary site selection). The SSR was subsequently revised in response to comments received at a December 17, 2014 consultation meeting.

The Revised SSR (included as Volume II.E of this USR with site locations included as GIS layers identified as "TC_14_BackwaterStudySites_2015" and "TC_14_ConfluenceStudySites_2015" in Volume II.I of this USR) included 12 backwater sites and 17 tributary sites.

Field surveys began on April 21, 2015 with egg-block sampling and concluded on July 2, 2015 with backwater sampling. Sampling periodicities for each species/habitat type were:

- Tributary Egg-Block Sampling (walleye & sucker): April 21 to May 27, 2015
- Backwater Sampling (multiple species): April 28 to July 2, 2015
- Tributary Nest Sampling (smallmouth bass & fallfish): May 22 to July 2, 2015

At this time, data entry has been completed for the tributary egg-block sampling and for the backwater sampling, but is ongoing for the tributary nest sampling. Data has also been downloaded from all field-deployed water level loggers, and calibrated using the three barometric data loggers. These data are currently being verified and exploratory plots showing the relationships between the measured elevations of observed eggs or nests and water surface elevations are currently being developed for egg block and early-spring spawners (yellow perch). However, data analysis has not yet progressed to the point of assessing the effects of localized water level fluctuations on probable egg or nest success, nor of the influence of project operations on spawning success.

14.3 Remaining Activities

Remaining tasks include completion of data entry for the tributary nest spawning data, QA/QC of the backwater and tributary nest data files, and analysis of the relationship between egg and nest elevations and localized changes in water surface elevations (WSEs).

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). Study 4 will develop rating curves, associating station flows and spill and/or project operations with WSEs at specific cross-sections. Cross-sections will be identified in the hydraulic model with the nest locations and modeled WSEs will be determined for a variety of operational and spill flow levels. The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical spawning site WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

14.4 Study Results to Date

Tributary Egg-Block Sampling

A total of 162 egg blocks were deployed within 16 tributary sites during this study. Sixty-six egg-blocks were deployed in 7 tributaries to the Wilder impoundment; 41 egg-blocks deployed in 5 tributaries to the Bellows Falls impoundment; and 55 egg-blocks deployed in 4 tributaries to the Vernon impoundment. Egg-blocks were typically inspected 3 times/week (Mondays, Wednesdays, and Fridays), and were fished for a total of 2,340 block-days.

Despite the intense level of effort, eggs of target species were only captured at two sites in the Wilder impoundment. White sucker eggs were collected from 5 egg-blocks over 3 sampling dates (on May 6, 8, and 11) in lower Olivarian Brook, and from 3 blocks over 2 sampling dates (May 8 and 11) in lower Hewes Brook (Figure 14-1). Olivarian Brook was one of only two tributaries where a school of suckers was observed staging at the tributary mouth - the other was Cold Creek in the riverine reach downstream of Bellows Falls (both schools were observed in early May). Most blocks had <5 eggs (maximum 24 eggs), suggesting that spawning did not occur in the immediate proximity of the egg-block locations (i.e., spawning likely occurred some distance upstream). In contrast, egg-blocks placed in close proximity to intense sucker spawning activities in a non-related hydroelectric project (Grasse River, New York work conducted by Normandeau) produced blocks with hundreds of attached eggs. Water temperatures at Olivarian and Hewes brooks ranged from approximately 10-18^{o}C when eggs were collected, with daily means of 13-16^{o}C.

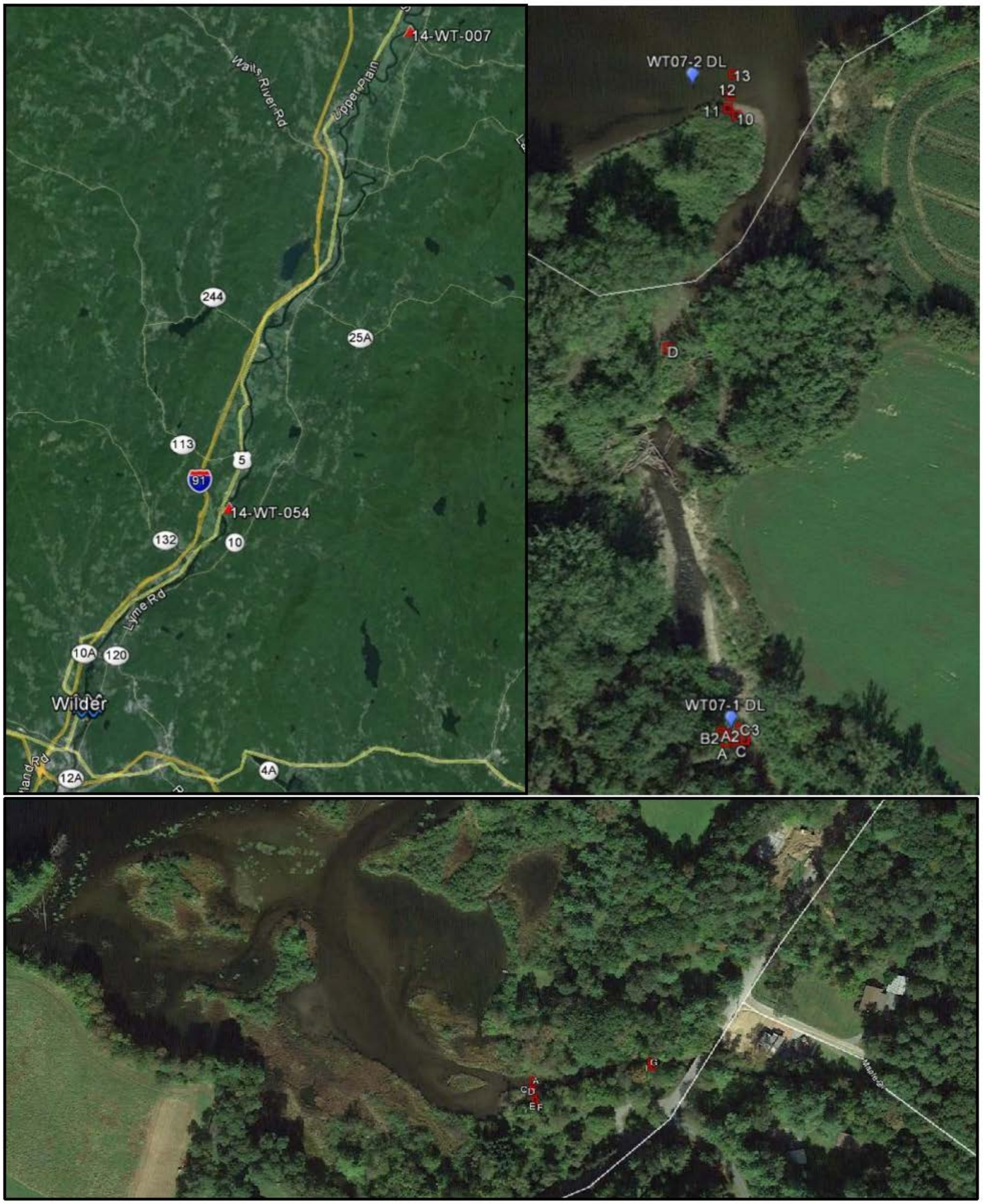

Figure 14-1. Map of the Wilder Impoundment with locations of the 2 tributaries where sucker eggs were found (upper left): Olivarian Brook, WT-007 (upper right) and Hewes Brook, WT-054 (lower) showing egg block locations (red squares). Sucker eggs were found at the upper set of egg-blocks at both tributaries.

Backwater Sampling

Twelve backwaters were sampled in the study area, 6 in the Wilder impoundment and 3 each in the Bellows Falls and Vernon impoundments. Backwaters were generally sampled twice per week (Tuesdays and Thursdays). Most surveys involved slowly traversing the shallow spawning flats by boat (motoring or poling) or by wading through flooded vegetation (Figure 14-2). Additional attempts to verify the presence of proximal spawning involved angling to determine adult ripeness (by expressed eggs or milt), view tube and net sweeps near adult observations to look for attached eggs or nests, and deployment of baited minnow traps and conducting larval trawls to detect newly hatched larvae. Only the visual survey methods were capable of documenting the specific locations of spawning activities (i.e., nest or egg depths and elevations), but such surveys were highly influenced by existing water clarity. Most backwater surveys conducted throughout May allowed confident visual identification of eggs or nests down to 3 ft (0.91m), with some days of 4 ft (1.22 m) visibility. Water clarity was generally reduced throughout June due to high water conditions and many days provided visibility conditions <2 ft, which were judged insufficient to adequately identify new spawning activities or to re-locate existing nests or eggs. Because of the above limitations, it should be noted that all visually-based spawning observations are likely biased towards shallow spawning, as deeper nests or eggs were less likely to be detected.

Yellow perch egg masses were observed in the Bellows Falls backwaters when surveys first began on April 28, and were first observed a few days later in the Vernon and Wilder backwaters, but were no longer present at most sites by the second week of May. Initial observations included many egg masses hanging from tree branches, some elevated out-of-water, likely due to spill conditions and higher water levels that occurred during the prior two weeks. Although data is still under analysis, mean daily temperatures at several backwaters generally ranged from 9-12^{o}C when most perch egg masses were observed.

Northern pike and chain pickerel were observed in most backwaters throughout the sampling period; however neither species were observed in a spawning aggregation or otherwise exhibiting spawning behavior, and no esocid eggs were collected despite repeated net sweeps and trawls through shallow, vegetated habitats. Numerous pike and pickerel were captured via angling, but no individuals exhibited signs of ripeness. Also, larval fish trawls were conducted in most backwaters throughout May, yielding a total of 1,161 larvae of target species (including unidentified cyprinids). Of these larvae, only a single esocid larvae, a chain pickerel was captured (in a Wilder backwater on May 19).

Nest-related activities of largemouth bass, bluegill, and pumpkinseed appeared to begin in the Vernon and Bellows Falls impoundments the last two weeks of May at mean daily temperatures of 19-21^{o}C. Pumpkinseed eggs were first observed on May 28, and were observed in association with nests (with or without eggs or fry) throughout June. Hatched largemouth bass fry were first observed the first week of June. Sunfish spawning activities in Wilder backwaters appeared delayed, likely due to lower water temperatures (approximately 3°C lower than comparable temperatures in Vernon and Bellows Falls).

Although black crappie were occasionally caught by angling in backwaters, no captured individuals exhibited spawning conditions and no crappie nests were observed during backwater surveys. Ripe golden shiner or spottail shiner were occasionally captured in minnow traps or small nets, but no aggregations of fish appearing to exhibit spawning behavior was observed for these species. No documented observations of eastern silvery minnow were made during spawning surveys.

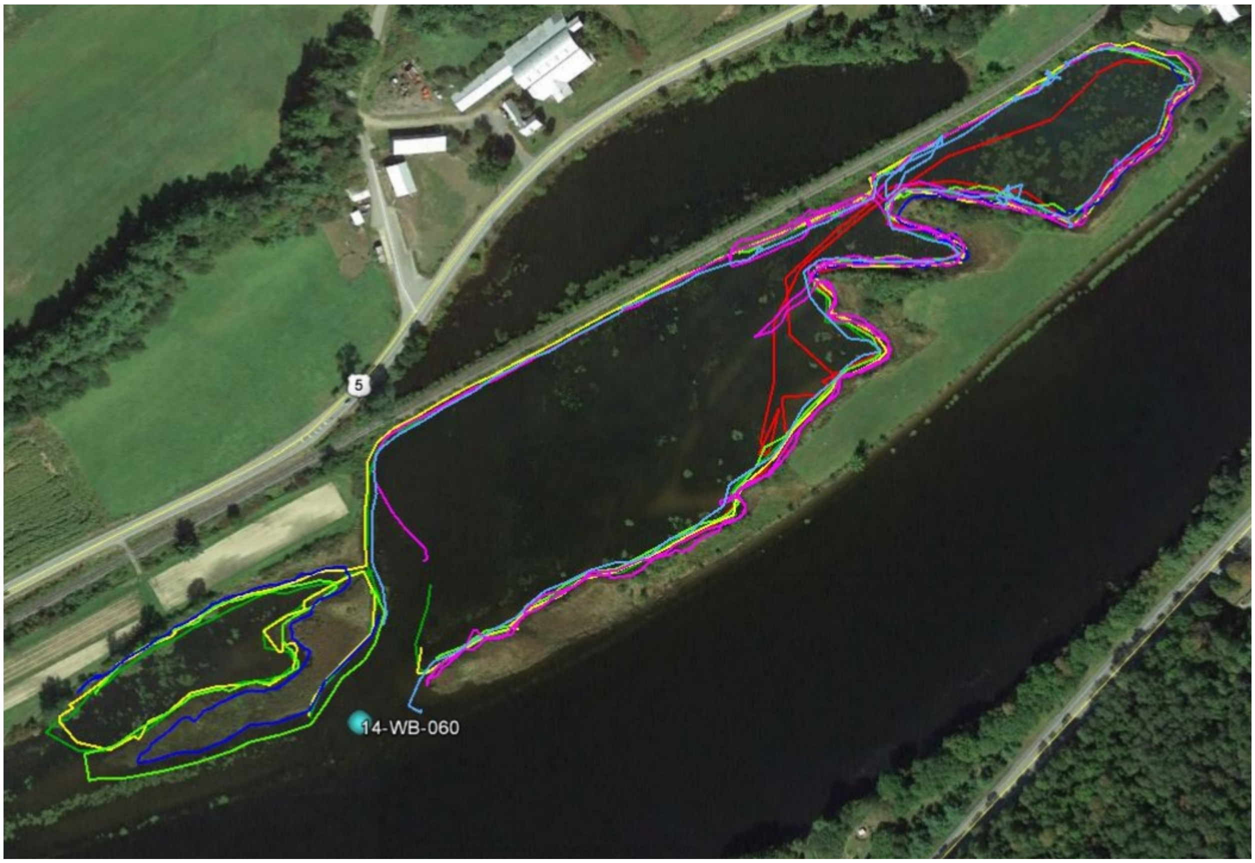

Figure 14-2. Boat-recorded GPS tracklogs recorded during 7 backwater surveys in Wilder station WB-060. Individual tracks ranged in length from 1,122 m to 3,042 m.

Tributary Nest Sampling

Spawning by smallmouth bass and fallfish was assessed by surveying the deltas of smaller tributaries or the lower reaches of larger tributaries entering each impoundment. Seven tributary study sites were sampled in the Wilder impoundment, 6 in the Bellows Falls impoundment, and 4 in the Vernon impoundment. Most tributary sites surveyed for smallmouth and fallfish spawning were the same sites used for walleye and sucker egg block sampling, but specific survey areas were frequently different due to the differences in spawning habitat requirements of these species groups. Tributary nest sampling began immediately following removal of the egg-blocks from those sites, and generally followed the Monday/Wednesday/Friday schedule as for egg blocks. Most tributary sites were visited on 6-8 occasions with adequate water clarity (i.e., 2 ft [0.61 m] or better).

Fully completed fallfish nests were observed at the initiation of the tributary nest surveys, suggesting that spawning activities had initiated (and perhaps concluded) by the end of May at mean daily temperatures of 15-18^{o}C. Adult fallfish were not observed at any nests, nor were partially constructed nests observed. Old nests, presumably from the previous year(s), were occasionally observed, but were generally recognizable by the darker pebbles containing algal growth, versus the new nests which were clearly built with recently moved particles. Larval fallfish were captured in several trawls in both the Vernon and Wilder impoundments on June 9-10. Larval fallfish were also captured in a Vernon impoundment shad trawl (Study 21) on June 9.

Smallmouth bass appeared to be initiating spawning when the tributary nest surveys began on May 22. Active bass nests containing eggs were first observed on May 25 in the Vernon and Wilder impoundments, and on May 26 in the Bellows Falls impoundment at mean daily temperatures of 14-18^{o}C. Nests containing eggs continued at least into mid-June (June 19), and bass fry were observed on active nests from May 29 through June 26. Although some “inactive” nests (apparently new nests without attending adult bass, eggs, or fry) were seen in shallow locations that may have been subject to dewatering (analysis is ongoing), the only “active” bass nest that was observed to be nearly dewatered (depth of 2 inches at the time of observation) occurred in a Wilder tributary site (14-WT-074, Mink Creek) on June 24. Field crews did not observe any stranded eggs or larvae at that nest site.

14.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC’s February 21, 2014 SPD.

An additional variance from the RSP and Revised SSR was associated with the replacement of two tributary study sites used for egg-block and nest spawning surveys. Beaver Brook (14-BT-016) in the Bellows Falls impoundment and Partridge Brook (14-VT-018) in the Vernon impoundment were both judged by field crews to be lacking in the gravel and cobble substrates preferred for spawning by suckers and walleyes. Based on field conditions Beaver Brook was replaced with the Sugar River (14-BT-002) and Partridge Brook was replaced with Mill Brook (14-VT-016). Both of these alternative sites appeared to contain suitable spawning habitat for the early spring spawners. These two sites were subsequently retained for the late-spring tributary nesting species.

15. Study 15 – Resident Fish Spawning in Riverine Sections Study

15.1 Introduction

TransCanada is conducting this Resident Fish Spawning in Riverine Sections Study (ILP Study 15) in 2015 to assess whether project-related, water-level fluctuations in the affected areas downstream of Wilder, Bellows Falls, and Vernon dams negatively affect resident fish spawning. The target species included in this study were 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, Bellows Falls, and Vernon dams to locate and map nesting locations and spawning sites; and
- Conduct field studies in the project-affected areas below Wilder, 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.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

15.2 Study Progress

Preliminary work on the study began in November 2014 and included literature review of species spawning periodicities and habitat characteristics; and development of an SSR based on the above literature review and required sampling design elements (i.e., purposive selection where local information was available, random selection in absence of local information). The SSR was subsequently revised in response to comments received at a December 17, 2014 consultation meeting.

The Revised SSR (included as Volume II.F of this USR with site locations included as GIS layers identified as "TC_15_IslandBarStudySites_2015" and "TC_15_RiffleBarStudySites_2015" in Volume II.I of this USR) included 12 riffle sites and 12 island/bar sites.

Field surveys began on April 16, 2015 with egg-block sampling and concluded on July 2, 2015 with island/bar sampling. Sampling periodicities for each species/habitat type were:

- Riffle Egg-Block Sampling (walleyes & suckers): April 16 to June 5, 2015
- Island/Bar Nest Sampling (smallmouth bass & fallfish): May 20 to June 26, 2015 (note: island/bar sampling continued into July but water conditions prevented collection of additional spawning data).

Data entry has been completed for the riffle egg-block sampling but is ongoing for the island/bar nest sampling.

Data has also been downloaded from all field-deployed water level loggers, and has been calibrated using the three barometric data loggers. This data is currently being verified and exploratory plots showing the relationships between the measured elevations of observed eggs or nests and project water surface elevations are currently being developed for egg block and late-spring spawners (smallmouth bass). However, data analysis has not yet progressed to the point of assessing the effects of localized water level fluctuations on probable egg or nest success, nor of the influence of project operations on spawning success.

15.3 Remaining Activities

Remaining tasks include completion of data entry for the island/bar nest spawning data, QA/QC of all spawning data files, and analysis of the relationship between egg and nest elevations and localized changes in water surface elevations (WSEs).

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). Study 4 – Hydraulic Modeling Study will develop rating curves, associating station flows and spill and/or project operations with WSEs at specific cross-sections. Cross-sections will be identified in the hydraulic model with the nest locations and modeled WSEs will be determined for a variety of operational and spill flow levels. The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical spawning site WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

15.4 Study Results to Date

Riffle Egg-Block Sampling

One hundred egg-blocks were deployed within 12 riffle habitats during this study and were fished for a total of 2,080 block-days. Fifty blocks were deployed in 7 Wilder riverine riffle habitats; 37 blocks were deployed in 3 riffles in the Bellows Falls riverine reach; and 13 blocks were deployed in 2 riffles below Vernon Dam. Egg-blocks were typically inspected 3 times per week (Mondays, Wednesdays, and

Fridays). Despite the intense level of effort, no white sucker eggs were captured at any egg blocks, and only a single walleye egg was collected on an egg-block in the Bellows Falls riverine reach in the lower reach of the Cold River (Figure 15-1). The egg was captured on May 4 at a morning water temperature of 8°C. Mean daily temperature the following day (after placement of a temperature logger) was approximately 14°C. The capture of only a single egg suggests that walleye spawning occurred well upstream of the block sites.

Island/Bar Nest Sampling

Spawning surveys for nesting smallmouth bass and fallfish were conducted at 7 island/bar habitats in the Wilder riverine reach; 3 island/bars in the Bellows Falls riverine reach; and 2 island/bars in the Vernon riverine reach. Active smallmouth bass nests (those with an attending adult, eggs, or fry) were observed at 4 of the 7 Wilder study sites; all 3 of the Bellows Falls study sites; and at 1 of the 2 Vernon study sites (Stebbins Island). Eggs were first observed in smallmouth bass nests on May 25 in the Vernon and Wilder riverine reaches, and on May 27 in the Bellows Falls riverine reach. Water temperature data has not yet been assessed for island/bar habitats, but spot measurements at nest sites containing eggs ranged from 15-17°C. Newly-hatched bass fry were first noted in nests on May 29 and observations of active bass nests (with fry) continued until June 26 in the Wilder riverine reach. High water and poor visibility severely restricted the monitoring of existing bass (and fallfish) nests or the identification of new nests throughout most of June and early July.

Figure 15-1. Map of riffle egg-block study site in Bellows Falls riverine reach (Cold River, BR-007), showing egg-block locations (red squares). Walleye egg was found on block A.

Fallfish nests were observed at 4 of the 7 Wilder island/bar study sites; at 2 of the 3 Bellows Falls study sites; and at the Stebbins Island study site below Vernon

Dam. Fallfish nests were generally observed during the first island/bar surveys in each reach. No adult fallfish were observed at nest sites, and no partially constructed nests were identified; consequently it is possible that most fallfish nesting activities had concluded by May 20 when island/bar surveys began. At least one fallfish nest from Stebbins Island was dewatered on May 27, but additional analysis is required to assess the occurrence of dewatering on this and other bass and fallfish nests.

Gravid spottail shiners were captured in the Wilder riverine reach during fish assessment surveys on June 22, however aggregations of spottail shiners exhibiting spawning behaviors were never observed at any island/bar study sites. A school of related shiners which were field- and laboratory-identified as rosyface shiners (*Notropis rubellus*) was observed to exhibit spawning-related behaviors over an existing fallfish nest on June 8 at an afternoon water temperature of 16^{o}C (Figure 15-2).

Figure 15-21.Underwater image of rosyface shiner spawning aggregation over a fallfish nest in the Wilder riverine reach.

15.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

In addition, one minor shift in egg-block locations occurred in the Wilder riverine reach. High flows present during initial deployment of egg-blocks in Wilder riffles made identification of optimal locations difficult, and riffle site WR-094 did not appear to contain suitable habitat for egg-block deployment. Consequently egg-blocks were moved from WR-094 to a more suitable location 0.8 mi downstream, which was re-labeled as WR-100.

16. Study 16 – Sea Lamprey Spawning Study

16.1 Introduction

TransCanada is conducting this Sea Lamprey Spawning Study (ILP Study 16) in 2015 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. 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
- Assess whether operations at the Wilder, Bellows Falls, or Vernon Projects adversely affect these spawning areas, specifically if flow alterations cause dewatering and/or scouring of sea lamprey redds.

The RSP was approved in FERC's February 21, 2014 SPD with the following specific change.

- Conduct habitat-based surveys to identify suitable spawning habitat and redds, using data from Study 7 – Aquatic Habitat Mapping to focus survey efforts on potential spawning habitat including shallow, fast-moving water with gravel/cobble substrate.

The determination also delayed the study until 2015 and the final report to March 1, 2016.

16.2 Study Progress

Preliminary work on the study began in the fall and winter of 2014/2015 and included literature reviews; review of aquatic habitat mapping and select proposed study locations using stratified random sampling; and of an SSR based on the above literature review and required sampling design elements. The SSR was subsequently revised in response to comments received at a December 17, 2014 consultation meeting.

The Revised SSR (included as Volume II.F of this USR with site locations included as GIS layers identified as “TC_16_ImpoundmentStudySites_2015” and “TC_16_RiverineStudySites_2015” in Volume II.I of this USR) included 23 study sites.

Field-work commenced in May 2015 and continued through August 2015, and included:

- Tagging immigrating pre-spawn adult sea lamprey with radio transmitters.
- Tracking tagged lamprey to characterize disbursement throughout the study area and identify specific spawning habitats.
- Assessing pre-selected sites with suitable habitat as modified by tracking of radio-tagged fish and visual observation to confirm habitat suitability and characterize observed redds (nests).
- Deploying and monitoring redd caps on selected nests in an attempt to confirm spawning success.
- Compiling project operational and total discharge data for the assessment of potential project effects on spawning habitat.

16.3 Remaining Activities

Final compilation of radio-telemetry and spawning habitat assessment data will be completed in the fall of 2015. Habitat assessment data includes post-spawning season identification of remnant nests and associated elevation data collected in August 2015. A study report will be prepared once all data has been compiled and data on sea lamprey from other fisheries studies has been processed.

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). Study 4 – Hydraulic Modeling Study will develop rating curves, associating station flows and spill and/or project operations with WSEs at specific cross-sections. Cross-sections will be identified in the hydraulic model with the nest locations and modeled WSEs will be determined for a variety of operational and spill flow levels. The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical spawning site WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

16.4 Study Results to Date

Study results presented below are to be considered preliminary at this time since radio-telemetry and habitat assessment data compilation, QA/QC, and analysis is ongoing.

- A total of 40 migrating sea lamprey were collected from the Vernon Fish Ladder, surgically tagged with a uniquely coded radio transmitter and released approximately one mile upstream of the Vernon and Bellows Falls Projects (N = 20 each). Length, weight, and sex data for tagged individuals are provided in Table 16-1. The recorded sex ratio was 18 females, 8 males, and 14 unknown. Those counts may be misleading because eggs were obvious during tag implantation surgery while testes were less apparent. It is probable that specimens recorded as sex unknown were males, but verification would have required a more lengthy surgical procedure and/or more invasive techniques that were beyond the scope of the study.

- Tagged lamprey were re-located in discrete tracking events throughout the study area using boat and aircraft. The tracking area included Stebbins Island (1.5 mi. downstream of Vernon Project) to Wilder Dam, and major tributaries, generally to the first obstruction. In addition to the tagged lamprey released for Study 16, at least one position fix was made for each of 18-tagged lamprey released further downstream for FirstLight relicensing studies (Turners Falls Project). Positions of tracked lamprey were considered in revising the pre-selected sites for assessment of spawning habitat (Table 16-2).

- High total river discharge, frequently above station operational capacity (spilling), persisted through much of the spawning season (nominally late May – late June) resulting in elevated velocities, water surface elevations, and turbidity. As a result, while in many cases radio-tagged fish were tracked to the vicinity of selected stations, suitable habitat was in water depths exceeding 5 - 8 ft. and observations of potential spawning behavior and subsequent characterization of habitat was hindered or not possible. In response, those sites were revisited during the late summer in low flow conditions with lower water surface elevations and velocities. Remnant nests were searched for and nest elevations recorded for later assessment with modeled water surface elevations representing project operations over a representative range.

- Redd capping was attempted on four nests within 3 station / sites where nest building was actively observed. Caps were not placed until after adult lamprey had left the site and were then tended for up to 1.5 months. No ammocoetes were collected from redd caps. It became apparent that nest micro-habitat was being altered within the redd caps. Generally, slower velocities inside redd caps than outside were apparent. In two cases, it appeared that redd caps may have prevented beneficial sand deposition in nests, while in one case, fine-grain sand penetrated the redd cap mesh but settled inside resulting in deeper sand deposits than observed in surrounding un-capped nests. Termination of redd capping followed an agency consultation conference call on August 27, 2015.

- Post-emergent ammocoetes were successfully collected in ichthyoplankton sampling conducted for Study 21 - American Shad Telemetry Study. One or more additional ammocoeates were collected in Study 10 – Fish Assemblage Study sampling although that information is preliminary at this time, pending analysis. Sea lamprey spawning data from other studies will be included in the sea lamprey study report.

Table 16-1. Tagging data for sea lamprey tagged with radio transmitters and released upstream of the Vernon and Bellows Falls Projects. All radio transmitters were frequency 150.320 mHz.

Code	Length (mm)	Weight (g)	Girth (mm)	Sex[a]	Release Date-Time	Release Latitude	Release Longitude
161	680	700	145	M	5/26/15	42.78747222	72.51655556
162	752	750	135	F	5/26/15	42.78747222	72.51655556
163	708	720	146	F	5/26/15	42.78747222	72.51655556
164	710	680	145	.	5/26/15	42.78747222	72.51655556
165	732	710	152	.	5/26/15	42.78747222	72.51655556
166	716	850	162	.	5/26/15	42.78747222	72.51655556
167	720	850	166	.	5/26/15	42.78747222	72.51655556
168	681	500	127	.	5/29/15	42.78747222	72.51655556
169	715	650	142	.	5/29/15	42.78747222	72.51655556
170	731	700	166	.	5/29/15	42.78747222	72.51655556
171	719	650	161	.	5/29/15	42.78747222	72.51655556
172	697	500	152	F	5/29/15	42.78747222	72.51655556
173	725	700	162	.	5/29/15	42.78747222	72.51655556
174	636	400	157	.	5/29/15	42.78747222	72.51655556
175	771	1050	155	F	5/30/15	43.15073333	72.4532
176	700	690	147	.	5/30/15	43.15073333	72.4532
177	695	800	152	.	5/30/15	43.15073333	72.4532
178	672	700	137	F	5/30/15	43.15073333	72.4532
179	645	650	138	F	5/30/15	43.15073333	72.4532
180	680	700	146	.	5/30/15	43.15073333	72.4532
181	683	700	145	.	5/30/15	43.15073333	72.4532
182	671	600	137	M	6/3/15	43.15305	72.45091667
183	631	500	135	M	6/3/15	43.15305	72.45091667
184	718	725	147	F	6/3/15	43.15305	72.45091667
185	766	1000	165	F	6/3/15	43.15305	72.45091667
186	682	725	151	M	6/3/15	43.15305	72.45091667
187	732	850	146	F	6/3/15	43.15305	72.45091667

Code	Length (mm)	Weight (g)	Girth (mm)	Sex[a]	Release Date-Time	Release Latitude	Release Longitude
188	733	850	144	F	6/3/15	43.15305	72.45091667
189	727	825	161	F	6/8/15	42.78747222	72.51655556
190	744	950	175	M	6/8/15	42.78747222	72.51655556
191	694	625	134	F	6/8/15	42.84885556	72.54918056
192	775	975	165	F	6/8/15	42.84885556	72.54918056
193	731	750	171	M	6/8/15	42.84885556	72.54918056
194	696	700	143	F	6/8/15	42.84885556	72.54918056
195	707	675	136	F	6/9/15	43.15231667	72.45260278
196	655	625	127	F	6/9/15	43.15231667	72.45260278
197	706	700	159	M	6/9/15	43.15231667	72.45260278
198	733	725	164	M	6/9/15	43.15231667	72.45260278
199	728	775	147	F	6/9/15	43.15231667	72.45260278
200	745	825	153	F	6/9/15	43.15231667	72.45260278

a. Sex was determined where gonads were evident at the time of tag implantation. The sex of specimens denoted as missing were likely males but that could not be visually confirmed without expending additional time in the surgical process and / or more invasive techniques.

Table 16-2. Habitat areas selected in the Wilder riverine (WL), Bellows Falls impoundment (BT), Bellows Falls riverine (BL), Vernon impoundment (VT), and Vernon riverine (VL) reaches for sea lamprey spawning habitat characterization[a].

Site ID	Name	Location (DD NAD83 UTM Z18N)	
		X	Y
16-WL-001	First Island below Wilder Dam	-72.308651	43.661409
16-WL-002	n/a	-72.312517	43.655811
~~16-WL-003~~	~~Johnston Island~~	~~-72.329968~~	~~43.624874~~
16-WL-003	Mascoma River	- 72.322653	43.635861
16-WL-004	Burnap's Island	-72.340817	43.591786
16-WL-005	Hart Island	-72.394997	43.523613
16-WL-006	Bar below Cornish Bridge	-72.386233	43.471477
16-WL-007	Chase Island	-72.390409	43.463315
16-BT-003	Sugar River	-72.397636	43.401580
~~16-BT-004~~	~~Mill~~	~~-72.401287~~	~~43.401497~~
16-BT-004	Shoal near Balloch, NH	-72.394678	43.438097
~~16-BT-006~~	~~Blood~~	~~-72.414300~~	~~43.364467~~
16-BT-006	Jarvis	-72.401622	43.358747
16-BT-013	Little Sugar River	-72.397392	43.307053
~~16-BT-016~~	~~Beaver Brook~~	~~-72.414354~~	~~43.268448~~
16-BT-018	Black River	-72.430748	43.260172
16-BT-031	Williams River	-72.457251	43.180537
16-BL-001	2014 nest site	-72.441668	43.098007
16-BL-002	Bar below Westminster Bridge	-72.434533	43.081773
16-BL-003	Dunshee Island	-72.449738	43.066225
16-VT-014	Aldrick Brook	-72.449570	43.015160
16-VT-016	Mill Brook	-72.454503	42.999753
16-VT-018	Partridge Brook	-72.466343	42.976344
~~16-VT-024~~	~~Sacketts Brook~~	~~-72.514282~~	~~42.963634~~
16-VT-040	West River	-72.568874	42.871940
16-VT-046	Broad Brook	-72.544267	42.820087
16-VL-001	Island just below Vernon Dam	-72.514745	42.766711
16-VL-002	Stebbins Island	-72.502771	42.769141

a. Four pre-selected stations (strikethrough text) were replaced with stations in the same reach (highlight text) where spawning behavior was indicated by radio telemetry and/or visual observations.

16.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

17. Study 17 – Upstream Passage of Riverine Fish Species Assessment

17.1 Introduction

TransCanada is conducting this Upstream Passage of Riverine Fish Species Assessment (ILP Study 17) in 2015 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 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.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

17.2 Study Progress

Preliminary work on the study began in the fall and winter of 2014/2015, including purchase and installation of recording equipment at fishways; coordination with VDFW on installation and operation of Salmonsoft software; and inspection of fishways prior to operation in the spring of 2015.

Fishways began operation in 2015 on April 15 at Wilder, May 15 at Bellows Falls, and May 5 at Vernon and video equipment began operating on April 16 at Wilder, April 15 at Bellows Falls, and May 5 at Vernon. In accordance with the study plan, video monitoring will continue through fall 2015 until icing in the fishways prohibits further work. Video data has been continually processed, reviewed and summarized on a weekly basis throughout the study season. Weekly fish count updates are sent via email to VDFW at their request. To date, motion capture video for all three dams has been reviewed through August 22, 2015.

17.3 Remaining Activities

In accordance with the RSP, video monitoring and data processing will continue through the fall of 2015 until icing in the fishways prohibits further work. Once all data has been processed and analyzed, a study report will be prepared as described in the RSP.

Upstream passage counts have been produced for the four migratory species found in the study waters, but analysis of resident activity has not yet been conducted. Once all of the motion capture video has been reviewed, analysis of usage by resident fish species will be produced to show time of year and time of day usage throughout the season. In addition, quality control video, (not motion activated) will continue being filmed once a week at each dam until icing occurs and will be reviewed to compare with motion activated video. This will provide a measure of accuracy of the Salmonsoft system for each species that uses the ladders.

17.4 Study Results to Date

Table 17-1 provides the most recent counts as of August 22, 2015 of each species (net upstream counts) as produced from the motion activated video provided by the Salmonsoft system.

Species	Wilder	Bellows Falls	Vernon
Migratory Species			
Atlantic Salmon	0	0	6
American Shad	0	44	39775
Sea Lamprey	2	971	2519
American Eel	38	30	1417
Resident Species			
Bass (*Micropterus spp.*)	44	-75	761
White Sucker	1	6	352
Walleye	18	-7	55
Trout	74	11	26
Sunfish (*Lepomis spp.*)	-1	2	507
Bullhead	0	0	2
Crappie (*Pomoxis spp.*)	0	0	0
Pike (*Esox spp.*)	0	0	-1
Yellow Perch	0	0	27
Carp	0	0	31

Note: Negative values indicate net cumulative downstream movement

17.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC’s February 21, 2014 SPD.

18. Study 18 – American Eel Upstream Passage Assessment

18.1 Introduction

TransCanada is conducting this American Eel Upstream Passage Assessment (ILP Study 18) in 2015 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; 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.

The RSP for this study was modified by TransCanada in its December 31, 2013, filing, based on stakeholder agreement from the VY technical meeting, with the following specific changes.

- Consolidate the systematic surveys and temporary eel trap passes into a single study year;
- Install temporary eel trap passes within 24 hours to the extent possible if adequate concentrations of eels are identified in the systematic surveys; and
- Develop a communication and consultation protocol with agencies and the aquatics working group that enables periodic, updated information on the surveys, observations, and data from eel trap passes to be shared.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

18.2 Study Progress

Preliminary work on the study was conducted in the fall and winter of 2014/2015, and included design and construction of 8 eel trap passes; and development of a communications and consultation protocol for notifying the working group prior to installation of eel trap passes.

Field work for the study began in April 2015 and will continue through October 2015. Collection of eels using baited eel pots began in April 2015, and ended on August 27, 2015 as a result of a working group consultation conference call on that date at which the group decided that using baited eel pots would cease due to their limited success even with a variety of bait used. The deployment of temporary ramp traps was also discussed on the call. To date, no temporary ramp traps have been deployed because the only aggregation point identified thus far is the Vernon fishway and it may be infeasible to deploy the ladders during the continued upstream fish passage operational flows required by Study 17 – Upstream Passage of Riverine Fish Species Assessment. Systematic surveys of eel presence/abundance at tailrace and spillway locations at all three dams began in April 2015 and will continue through October 2015.

18.3 Study Results to Date

As of September 10, 2015, eels have been observed and/or trapped at Vernon and Bellows Falls dams. None have been observed or trapped at Wilder; however, eel activity has been detected at Wilder dam during Study 17 – Upstream Passage of Riverine Species Assessment. Figures 18-1 – 18-4 illustrate the results to date for all three dams. Tables 18-1 and 18-2 enumerate the Bellows Falls and Vernon data, respectively.

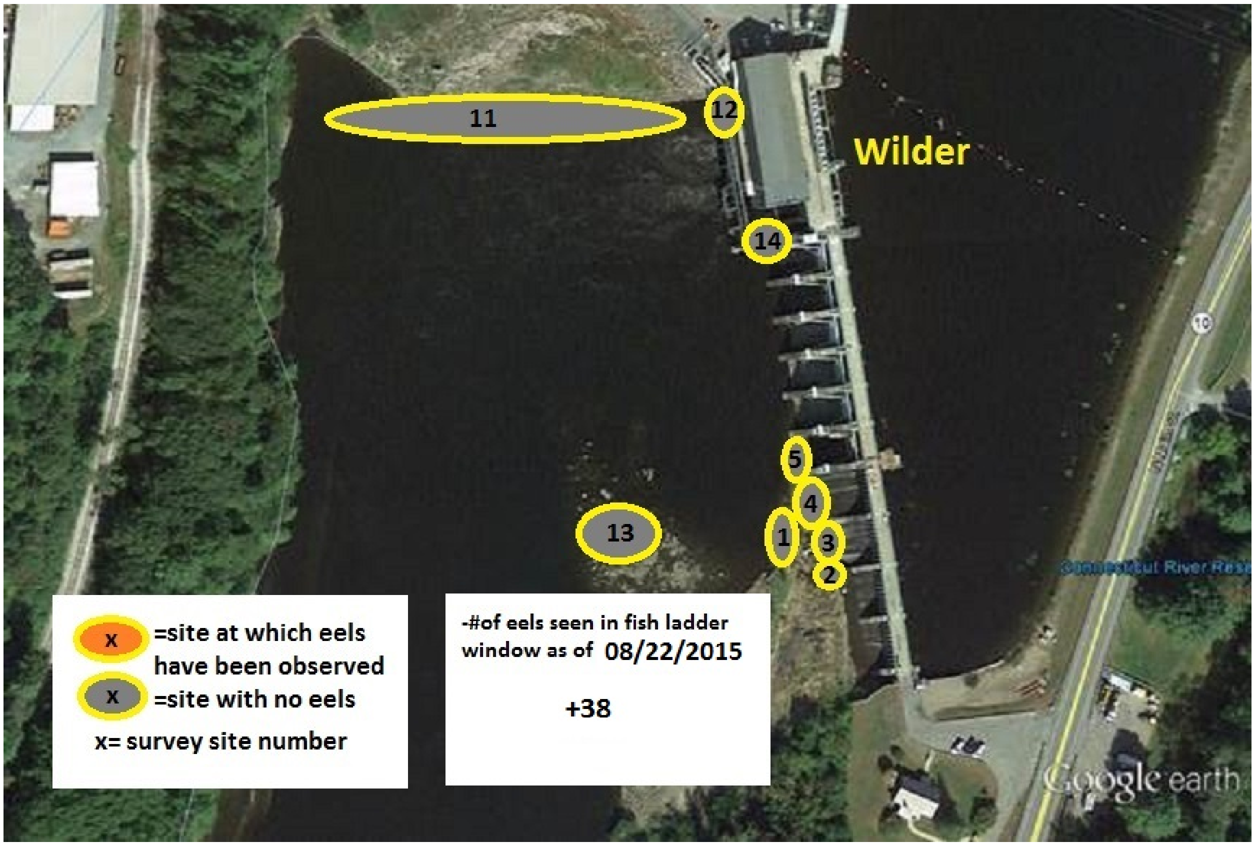

Figure 18-1. Wilder dam eel observations.

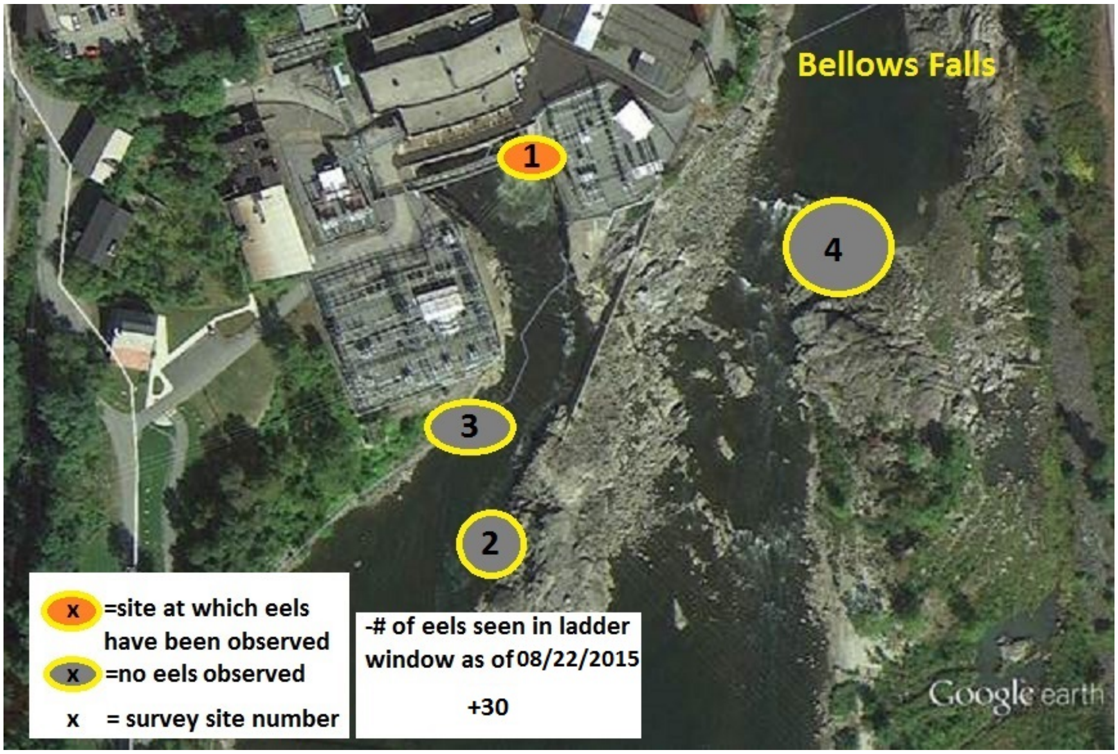

Figure 18-2. Bellows Falls tailrace and lower bypass eel observations.

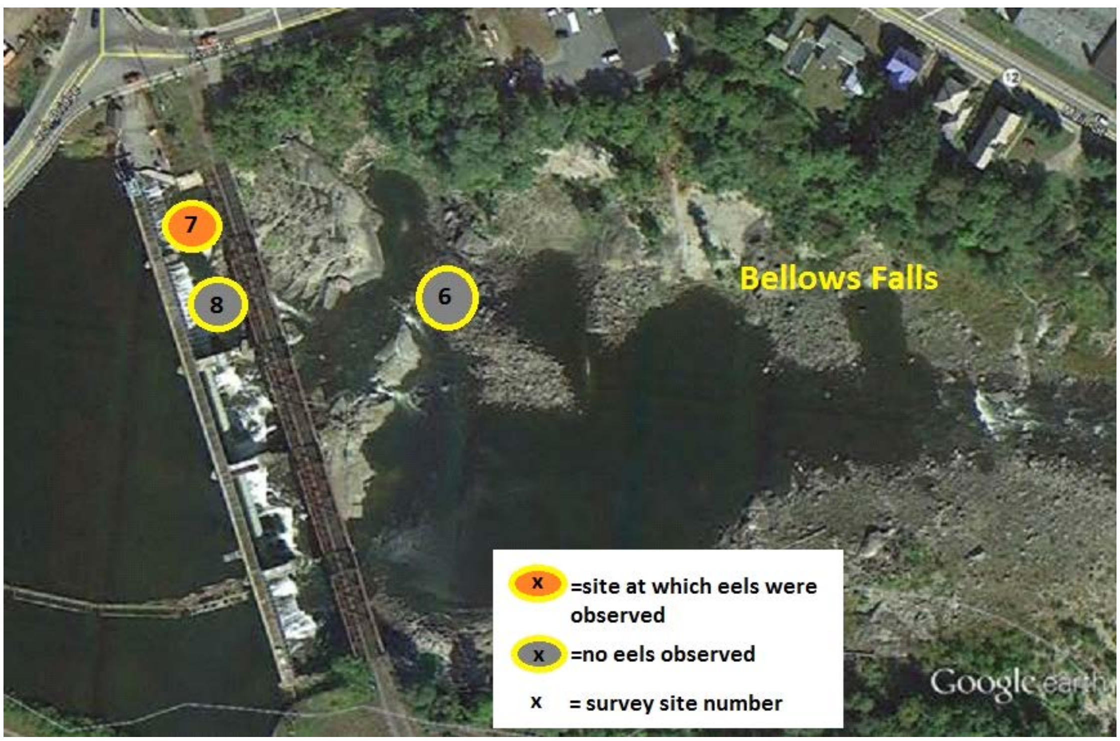

Figure 18-3. Bellows Falls bypass eel data.

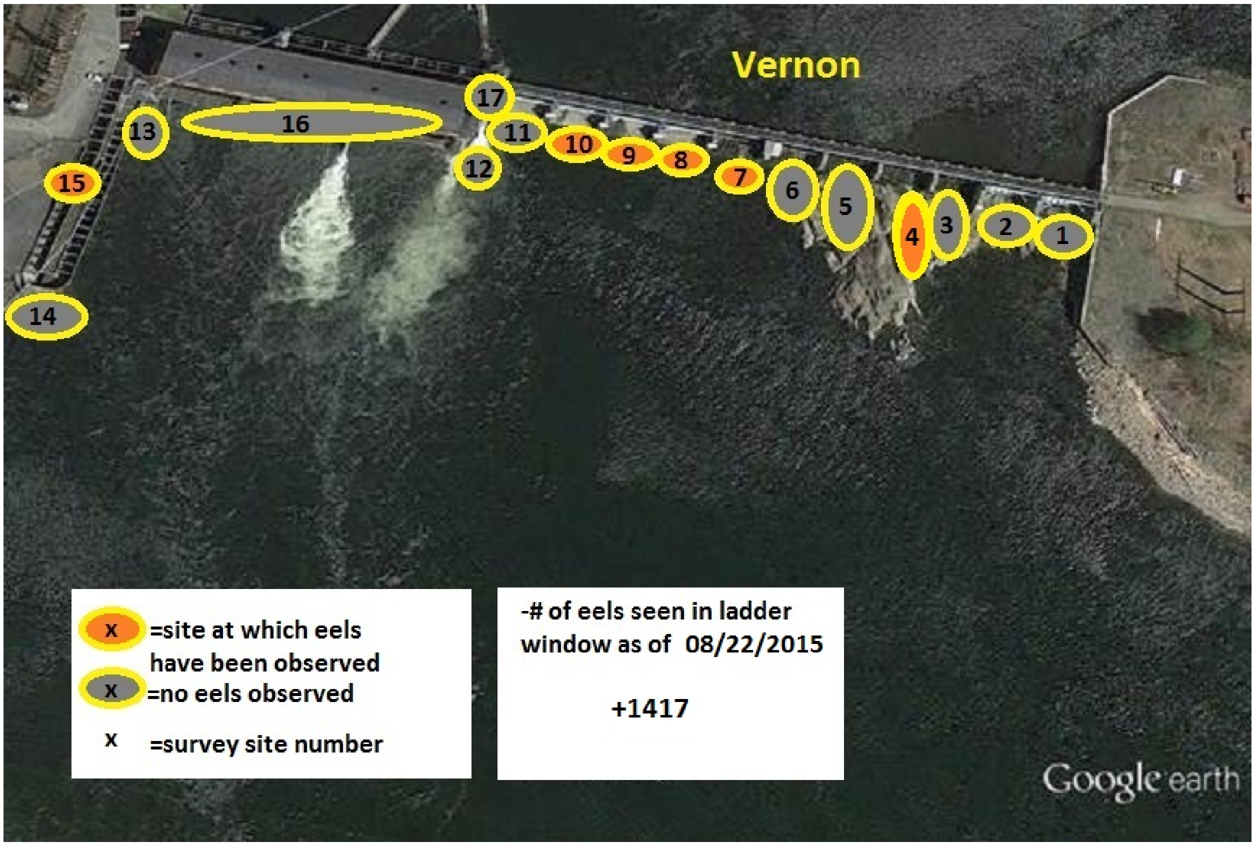

Figure 18-4. Vernon dam eel observations.

Table 18-1. Numerical data for Bellows Falls eel observations[a].

Date	Site 1[a]	Site 7
7/8/2015	0	1 eel
7/21/2015	1 eel	0
8/25/2015	1 eel	0

a. Survey site numbers can be referenced to site numbers in Figures 18-2 and 18-3.

Table 18-2: Numerical data for Vernon eel observations[b].

Date	Site 4	Site 7	Site 8	Site 9	Site 10	Site 15
7/8/2015	0	0	2 eels	0	0	0
7/15/2015	0	2 eels	3 eels	4 eels	4 eels	1 eel
7/22/2015	0	0	0	0	0	2 eels
7/29/2015	0	0	2 eels	0	0	1 eel
8/5/2015	0	0	0	0	1 eel	0 eel
8/12/2015	0	0	0	0	0	1 eel
8/19/2015	0	1 eel	2 eels	1 eel	0	2 eels
8/26/2015	0	0	0	0	0	2 eels
9/2/2015	0	0	4 eels	0	0	6 eels
9/9/2015	2 eels	1 eel	4 eels	0	0	3 eels

b. Survey site numbers can be referenced to site numbers in Figure 18-4.

18.4 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

Spill conditions in the spring precluded installing baited eel pots in all locations due to safety hazards of entering those areas. Some eel pots that were installed were damaged as a result of spill which also restricted the number of stations that could be observed during nighttime systematic surveys during the spring.

Due to the unacceptable threat to worker safety during spill, no sites in the Bellows Falls bypassed reach were visited on some occasions during the spring (of the 11 weeks from May 11 through June 26 the bypassed reach was inaccessible during 7 of those weeks). Depending on the specific gates being used for spill, and elevation of the water created by spill conditions, it was unsafe to visit some survey sites at the other two dams during that period as well.

On August 27, 2015, eel trapping was suspended due to limited success of the baited traps.

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19. Study 19 – American Eel Downstream Passage Assessment

19.1 Introduction

TransCanada is conducting this American Eel Downstream Passage Assessment (ILP Study 19) in the fall of 2015 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 objectives of this study are to:

- Quantify the movement rates, 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 each turbine type.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

19.2 Study Progress

On February 5, 2015, Normandeau staff on behalf of TransCanada notified NHFGD and VFWD via email of concerns over collection of enough in-basin eels as specified in the RSP. The only reliable source to collect numbers of silver-phase American eels in the Connecticut River Basin is the Holyoke Canal Bypass Sampler. However, due to the large number of silver-phase American eels needed to fulfill the requirements of relicensing studies for the TransCanada Projects as well as FirstLight (Turners Falls, Northfield Mountain), and Conte Lab research, it was determined that no in-basin source will be sufficient. As a result, TransCanada and FirstLight proposed to import eels from out-of-basin sources and submit a sample for fish disease assessment prior to release into the Connecticut River. This issue was discussed in more detail at a working group consultation conference call on February 10, 2015 (Appendix A) and comments and recommendations were provided by VFWD and NHFGD on March 25, 2015 and April 9, 2015, respectively.

TransCanada and FirstLight consultants jointly prepared and submitted to NHFGD, VFWD, and MDFW, a "Plan for Implementation of Adult American Eels to the Connecticut River Basin in 2015" (Normandeau and Kleinschmidt, 2015) which proposed to procure eels from a source in Newfoundland likely to collect sufficient numbers, and proposed a series of pathogens tests and testing protocols. NHFGD and VFWD provided comments on the plan and additional recommendations on June 4, 2015 and Normandeau provided additional information in response on July 16, 2015 (to NHFGD) and July 17, 2015 (to VFWD). Kleinschmidt had similar interaction and communications with MDFW. All related documents and communications are included in Appendix C of this USR.

VFWD issued a fish import permit on August 3, 2015, and NHFGD is expected to issue a letter permit approval; both permits are contingent upon the results of pathology testing.

It is expected that the earliest shipment off eels will occur in early to mid-October. Radio telemetry and survival equipment setup began in early September.

19.3 Remaining Activities

Study implementation will commence when test eels have successfully passed pathology tests and are imported from Canada. Eels will be transported immediately upon delivery to the U.S. (Logan Airport), to the project dams.

TransCanada will propose turbine operation settings for the turbine survival tests, based upon high probability of the settings, and efficiency set point.

Once field work is completed in the fall of 2015, a report will be prepared that presents the results of the study.

19.4 Study Results to Date

None at this time.

19.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

In addition, due to the eel fishing season in Newfoundland, eels are not expected to be delivered (assuming acceptable pathology test results) until early to mid-October, thus delaying the start of the route selection radio-telemetry from the RSP schedule which assumed collection of eels from Holyoke from late August to mid-October.

19.6 Literature Cited

Normandeau (Normandeau Associates, Inc.) and Kleinschmidt. 2015. Plan for Implementation of Adult American Eels to the Connecticut River Basin in 2015. Prepared for TransCanada Hydro Northeast Inc. and FirstLight Power Resources, May 2015.

20. Study 20 – American Eel Downstream Migration Timing Assessment

20.1 Introduction

TransCanada will conduct this American Eel Downstream Migration Timing Assessment (ILP Study 20) in the fall/winter of 2015 to assess the timing of American eels migrating from the Connecticut River to their spawning grounds. The objective of this desktop study is to characterize the general migratory timing and presence of silver phase American eels in the Connecticut River relative to environmental factors, including air and water temperature, turbidity, rainfall, river flow, lunar phase, and flow-related operations of mainstem river hydroelectric projects. A thorough desktop review of existing eel downstream migration literature will be conducted and is intended to augment any field data collected at Cabot Station by FirstLight in its ILP Study 3.3.5 (Evaluate Downstream Passage of American Eel).

The RSP was approved in FERC's February 21, 2014 SPD with the following specific change.

- Study analysis should incorporate results from the "Vernon Hydroacoustic Study" to help quantify and characterize silver phase eel outmigration within the Connecticut River basin upstream of Vernon dam to provide information on the timing and magnitude of downstream eel migration.

However, on May 14, 2015 FERC issued an order granting TransCanada's request for rehearing (filed March 24, 2014) that removed the requirement to conduct the "Vernon Hydroacoustic Study".

The February 21, 2014 SPD also delayed this study until 2015 and the final report to March 1, 2016.

20.2 Study Progress

Preliminary work on the study of conducting literature reviews has begun but is not yet complete.

20.3 Remaining Activities

Literature reviews will be completed in the fall of 2015. Completion of this study depends in part upon the results of the other American eel studies (Studies 11, 18 and 19) which are in progress or not yet started.

20.4 Study Results to Date

None at this time.

20.5 Variance from Study Plan and Schedule

The study is being conducted in 2015 in order to evaluate post-VY closure baseline river conditions (in studies associated to this study) per the February 21, 2014 SPD.

21. Study 21 – American Shad Telemetry Study

21.1 Introduction

TransCanada conducted this American Shad Telemetry Study (ILP Study 21) in 2015 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 to characterize whether project operations affect American shad spawning site use and availability, spawning habitat quantity and quality, and spawning activity in the river reaches from downstream of Vernon dam to the Bellows Falls Project. The objectives of the study were 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 VY's discharge located on the west bank of the river 0.45 mile upstream of the Vernon fish ladder exit;
- Assess upstream migration beyond Vernon dam up to the Bellows Falls Project;
- Characterize project operational effects on post-spawn downstream migration route selection, passage efficiency, downstream passage timing/residence, and survival related to the Vernon Project;
- 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.

The RSP for this study was modified by TransCanada in its December 31, 2013, filing, based on stakeholder agreement from the VY technical meeting, with the following specific changes.

- Conduct a limited review of the 2012 shad data from a study conducted by USGS (rather than a full analysis of that data) to see whether those data may contribute to existing information on optimal placement of receivers and/or selection of radio frequencies for this study; and
- Eliminate temperature tags from the fish tagging protocol.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

21.2 Study Progress

The study began in the winter of 2014/2015, including non-field tasks such as preliminary review of the USGS 2012 data. No critical study modifications based on those data appear to be warranted (FirstLight has also conducted a review of these data for their similar study). The study was discussed at the February 10, 2015 working group consultation conference call (Appendix A) and a revised Figure 21-3 from the RSP was prepared that moved one radio-telemetry receiver closer to the Vernon forebay in response to comments (Figure 21-1). The study field effort was conducted from May to early July 2015.

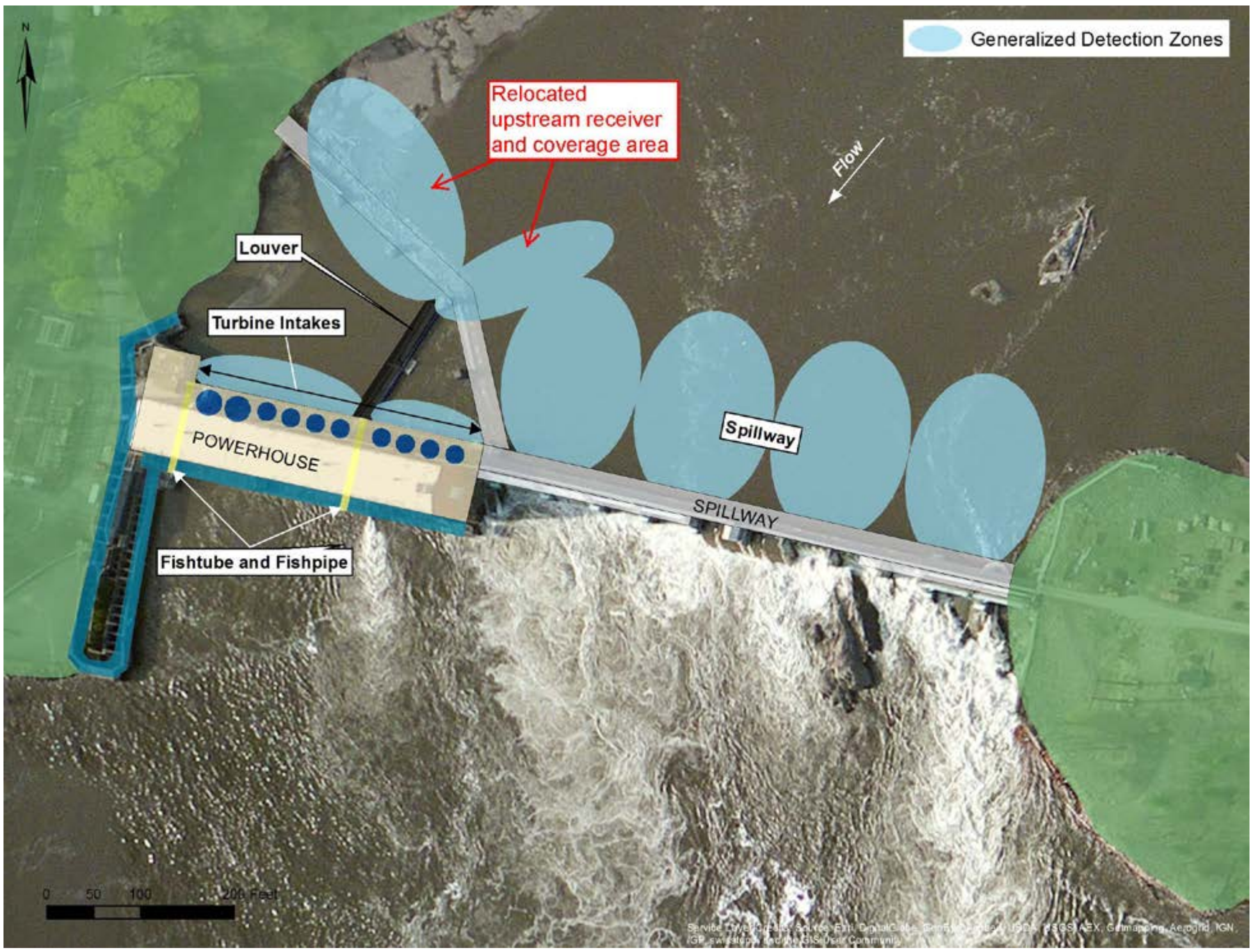

Figure 21-1. Revised Figure 21-3 from the RSP, showing relocated receiver and coverage area.

21.3 Remaining Activities

At this time, data are being reviewed and analyzed and the study report is being drafted.

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). Study 4 will develop rating curves, associating station flows and spill and/or project operations with WSEs at specific cross-sections. Cross-sections will be identified in the hydraulic model with the nest locations and modeled WSEs will be determined for a variety of operational and spill flow levels.

The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical spawning site WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

21.4 Study Results to Date

Tagging and Release

A total of 100 adult American shad were collected from the Holyoke fishlift, and tagged and released at Northfield, MA downstream of Vernon on three occasions; May 10, 14, and 28, 2015. Of these, 52 were tagged with both a radio tag and PIT tag and the remaining 48 were only PIT tagged. Water temperatures at the time of release ranged from 13.4-16.1^{o}C and Vernon discharge ranged from 8,549 -13,312 cfs (Table 21-1).

To supplement the population of shad passing upstream of Vernon and to address the study objectives, 54 additional shad were collected at the Vernon fish ladder, radio-tagged, and released into the Vernon impoundment from the Old Ferry Boat Launch on three occasions - May 17, 24, and 30. Water temperatures at the time of release ranged from 13.4-16.1^{o}C and Vernon discharge ranged from 7,611 - 12,543 cfs (Table 21-2).

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Table 21-1. Summary of adult American shad tagged and released downstream of Vernon Dam, spring 2015.

Release Group	Shad Run Segment	Release Dates	Number Released	Tag Type	Number	Sex of Tagged Shad		Water Temp. °C	Plant Discharge (cfs)
1	Early	10-May	40	PIT	20	M	21	16.1	13,312
				Radio & PIT	20	F	19		
2	Mid	14-May	40	PIT	20	M	26	13.4	11,789
				Radio & PIT	20	F	14		
3	Late	28-May	20	PIT	8	M	3	14.2	8,549
				Radio & PIT	12	F	17		
TOTAL			**100**	**Pit**	**48**	**M**	**50**		
				Radio & Pit	**52**	**F**	**50**		

Table 21-2. Summary of adult American shad radio-tagged and released upstream of Vernon Dam, spring, 2015.

Release Group	Shad Run Segment	Release Dates	Number Released	Sex		Water Temp. °C	Plant Discharge (cfs)
1	Early	17-May	20	M	16	16.1	8,016
				F	4		
2	Mid	24-May	23	M	16	13.4	7,611
				F	7		
3	Late	30-May	11	M	5	14.2	12,543
				F	6		
TOTAL			**54**	**M**	**37**		
				F	**17**		

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Spawning Surveys

A total 120 individual ichthyoplankton net samples were collected on 30 nights between 26 May and 2 July, 2015. For each effort at a given site two nets were fished simultaneously. Sample effort at each site was 30 minutes. The number of samples collected per night ranged from two to six with four being the most common. Four samples per night were collected on 26 of the 30 (87%) nights of effort.

A total 792 American shad eggs and larvae were collected from May 29 through July 2, 2015 below and above Vernon Dam. Of these, 774 (98%) were eggs, 9 (1%) were yolk sack larvae (YSL), and 9 (1%) were post yolk sack larvae (PYSL) (Table 21-3). The sampling locations will be provided on maps with the study report.

Table 21-3. Summary of American shad eggs and larvae collections in the vicinity of Vernon Dam, 2015

Date	Sample Location	Life Stage	Number Collected
5/29/2015	21-013	egg	2
5/29/2015	21-013	YSL	2
5/31/2015	21-017	egg	39
5/31/2015	21-018	egg	20
5/31/2015	21-017	YSL	1
6/1/2015	21-019	egg	65
6/1/2015	21-020	egg	39
6/1/2015	21-019	PYSL	1
6/1/2015	21-020	PYSL	3
6/1/2015	21-019	YSL	1
6/1/2015	21-020	YSL	3
6/3/2015	21-025	egg	3
6/3/2015	21-026	egg	1
6/3/2015	21-027	egg	1
6/5/2015	21-033	egg	20
6/5/2015	21-034	egg	3
6/5/2015	21-035	egg	19
6/5/2015	21-036	egg	25
6/9/2015	21-043	egg	2
6/10/2015	21-045	egg	2
6/10/2015	21-046	egg	1
6/10/2015	21-047	egg	3
6/11/2015	21-049	egg	1

Date	Sample Location	Life Stage	Number Collected
6/11/2015	21-051	egg	25
6/11/2015	21-052	egg	20
6/11/2015	21-052	YSL	1
6/13/2015	21-054	egg	109
6/14/2015	21-059	egg	2
6/15/2015	21-062	egg	1
6/15/2015	21-063	egg	15
6/15/2015	21-064	egg	19
6/17/2015	21-070	egg	1
6/17/2015	21-071	egg	2
6/17/2015	21-072	egg	4
6/19/2015	21-074	egg	1
6/19/2015	21-075	egg	39
6/19/2015	21-076	egg	2
6/20/2015	21-078	egg	1
6/20/2015	21-080	egg	1
6/22/2015	21-084	egg	3
6/23/2015	21-086	PYSL	2
6/23/2015	21-087	PYSL	2
6/23/2015	21-088	YSL	1
6/24/2015	21-090	PYSL	1
6/26/2015	21-097	egg	119
6/26/2015	21-098	egg	117
6/26/2015	21-099	egg	2
6/26/2015	21-100	egg	14
6/30/2015	21-110	egg	1
6/30/2015	21-111	egg	11
6/30/2015	21-112	egg	10
7/2/2015	21-117	egg	1
7/2/2015	21-118	egg	8

21.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC’s February 21, 2014 SPD.

22. Study 22 – Downstream Migration of Juvenile American Shad - Vernon

22.1 Introduction

TransCanada is conducting this Downstream Migration of Juvenile American Shad Study - Vernon (ILP Study 22) in the fall of 2015 to assess whether project operations affect the safe and timely passage of emigrating juvenile American shad. The 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;
- Characterize the proportion of juvenile shad using all possible passage routes at the Vernon Project over the period of downstream migration under normal operational conditions; and
- Conduct controlled turbine passage survival tests for juvenile shad passed through one of the older Francis units (Unit Nos. 1 to 4) and one of the new Kaplan units (Unit Nos. 5 to 8) to estimate the relative survival specific to those unit types.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD. However, the RSP was updated (filed with FERC on February 3, 2015) to incorporate proposed study plan modifications based on:

- Results of juvenile shad tagging tests conducted in 2014 to evaluate the potential use of hatchery-reared juvenile shad (Normandeau, 2014; filed with FERC on November 26, 2014);
- Stakeholder comments received on the ISR and based on the ISR meeting summary;
- Stakeholder consultation that occurred on August 26, 2014 in conjunction with the FERC-proposed Vernon Hydroacoustics Study; and
- A FERC technical meeting on November 20, 2014 (also in conjunction with proposed Study Plan 34 but related to this study as well).

The Updated RSP was approved by FERC in its May 14, 2015 Order granting rehearing and approving Revised Study 22.

22.2 Study Progress

Preliminary work on the study began in the fall and winter of 2014/2015, including coordinating with FWS and the national fish hatchery that raised juvenile shad in 2014 to conduct a transport survival evaluation and tagging experiment in October 2014 (Normandeau, 2014). Data on Vernon Project's turbine specifications, priority of operations, and unit-loading conditions have been collected and are being reviewed at this time. TransCanada will propose turbine operation settings for the turbine survival tests, based upon high probability of the settings, and efficiency set point.

FWS is rearing the needed juvenile American shad for the turbine survival tests and FWS staff have indicated that they are growing well.

The hydroacoustic transducer was installed in mid-August and data is being collected, although none has been analyzed at this time. Radio-telemetry equipment has been recalibrated, and radio tags and holding tanks are ready.

22.3 Remaining Activities

Radio-tagging is scheduled to begin in mid-September and continue through mid-November, 2015. Turbine survival tests will commence when juvenile shad of the appropriate size are received from FWS. Upon completion of all field work, data will be consolidated and analyzed and a study report prepared.

22.4 Study Results to Date

None at this time.

22.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD. As noted above, the current study plan is the Updated RSP filed February 3, 2015.

22.6 Literature Cited

Normandeau (Normandeau Associates, Inc.) 2014. Summary Report – Juvenile American Shad Radio-Tagging Assessment at Vernon Dam, 2014. Prepared for TransCanada Hydro Northeast Inc. November 2014.

23. Study 23 – Fish Impingement, Entrainment, and Survival Study

23.1 Introduction

TransCanada is conducting this Fish Impingement, Entrainment, and Survival Study (ILP Study 22) in 2015 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 desktop 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;
- Assess the potential for entrainment and estimate survival rates for target species;
- Estimate turbine passage survival rates;
- 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 Falls, and Vernon Projects.

The RSP for this study was modified by TransCanada in its December 31, 2013, filing, based on stakeholder agreement from the VY technical meeting, with the following specific changes.

- Reschedule the study for late summer and fall 2015 in accordance with delayed associated studies' schedules.

The RSP was approved without modification (except to delay the study until 2015, and the final report to March 1, 2016) in FERC's February 21, 2014 SPD.

23.2 Study Progress

Data on each project's turbine specifications, priority of operations, and unit-loading conditions have been collected and are being reviewed at this time.

23.3 Remaining Activities

Completion of this study depends in part upon the results of other studies including the Fish Assemblage Study (Study 10), the two American shad studies (Studies 21 and 22), and the two American eel downstream assessments (Studies 19 and 20) which are either in progress or not yet started. Once data is collected and consolidated from those studies, this study can be completed and a report prepared.

23.4 Study Results to Date

None at this time.

23.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC's February 21, 2014 SPD.

24. Study 24 - Dwarf Wedgemussel and Co-occurring Mussel Study

24.1 Introduction

TransCanada is conducting this Dwarf Wedgemussel and Co-occurring Mussel Study (ILP Study 24) to study of the effects of Wilder and Bellows Falls Project operations on the federally endangered dwarf wedgemussel (DWM) (*Alasmidonta heterodon*). This study includes an adaptive, two-phase plan developed in collaboration with the aquatics working group throughout the design and implementation of the study. The study goals and objectives are as follows.

Goal 1: Assess the distribution, population demographics, and habitat use of DWM 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 DWM;
- Objective 2 (Phase 1): Determine the best sites for quantitative mussel sampling in areas where DWMs 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 the DWM and co-occurring mussel species.

Goal 2: Assess the influence of flow regime (which includes water-level fluctuations) on the DWM, co-occurring mussel species, and mussel habitat. This goal has two specific objectives:

- Objective 4 (Phase 2): Observe and record behavior of the DWM and co-occurring mussel species *in situ* during varying flow conditions; and
- Objective 5 (Phase 2): Assess the potential effects of project operations on DWMs and their habitat.

The RSP for this study was approved without modification in FERC's February 21, 2014 SPD; however, the deadline for filing of the final study report was extended to March 1, 2015 in that determination.

24.2 Study Progress

Phase 1 fieldwork was completed in September 2013, and the Phase 1 Study Report was prepared (Biodrawversity et al., 2014a). The public version of the report was shared with the aquatics working group (Volume IV of the ISR filed September 15, 2014). The privileged version of the report containing specific DWM locations was provided to specific agency staff in August 2014, as requested. The privileged GIS layers from Appendix B of the report were filed as Volume V of the ISR, Privileged TransCanada Initial Study Report Supporting Geodatabase.

A Phase 2 Study Plan was developed, distributed, and discussed with the working group at a May 23, 2014, consultation meeting (Biodrawversity et al., 2014b) and following comments received via email from The Nature Conservancy (TNC) in June 2014, a working group conference call was held on July 1, 2014. The proposed Phase 2 Study Plan was subsequently revised in response to those comments (Biodrawversity et al., 2014c, included in Volume VI of the ISR filed September 15, 2014); however, it was not distributed prior to the 2014 field study because there was an indication that further comments were being prepared by FWS, and the study plan might need to be revised again.

Based upon all initial comments received previously, it was anticipated that further comments would be slight modifications on the previous discussions and draft study plan. Because the study field work time table was at risk, TransCanada initiated field work based upon its undistributed Revised Phase 2 Study Plan, presuming that any issues remaining could be addressed rather easily, and while field work was in progress. However, FWS provided substantial new comments in the form of a “counter proposal” on September 4, 2014.

Fieldwork for Phase 2 relied on the Revised Phase 2 Study Plan and consisted of establishing twenty 50x1 m monitoring transects distributed among six general locations in the Wilder impoundment, riverine reach, and upper Bellows Falls impoundment. Most were surveyed in the period from August 20-29, 2014 and one pair (Cornish Covered Bridge – North) was surveyed on October 1. Data collection followed the methods outlined in the Revised Phase 2 Study Plan. The 2014 fieldwork also included quadrat surveys in the 2,400-meter reach that included Cornish Covered Bridge and Chase Island, as described in the Revised Phase 2 Study Plan. This work was completed under low-flow conditions and warm temperatures in September. A total of 405 2.25-m^2 quadrats were sampled in this reach; 385 were distributed in a systematic random pattern across the channel (bank to bank) and 20 additional quadrats were distributed in areas where mussel densities were higher. Counts for all mussel species, and several habitat parameters, were recorded for each quadrat as described in the Revised Phase 2 Study Plan.

A consultation meeting was held on October 9, 2014 to discuss the FWS counter proposal (summary notes included as Attachment 4 of the ISR Meeting Summary filed October 14, 2014). FWS subsequently provided a revised counter proposal on November 14, 2014 along with that agency’s comments on the ISR. TNC also provided comments on the ISR on November 14, 2014. TransCanada provided a response to ISR comments filed with FERC on December 15, 2014 which included responses to the numerous comments on Study 24, and reported that the revised FWS counter proposal was under internal review, and that additional stakeholder consultation would occur once that review was completed.

The Phase 2 Study Report (public version and privileged version with supporting privileged geodata) was filed on March 2, 2015 in accordance with FERC's September 2013 SPD. The FWS revised counter proposal was included as Appendix A, and TransCanada's proposed HSI methodology was included as Appendix B of that report.

On January 22, 2015, FERC issued a Determination on Requests for Study Modifications and New Studies in which the requested study modifications in the FWS' revised counter proposal were not adopted at that time. FERC acknowledged that consultation on this study remained ongoing, and that specific methodologies for development of habitat suitability criteria (or "indices", "HSI") for DWM and/or other study methodologies would be the subject of this consultation. FERC also noted on page 3 of its determination, "[i]f agreement cannot be reached on the phase 2 study methods, we recommend that TransCanada seek a determination from the Commission and file the comments received, a response to comments, and any updates to the phase 2 study plan at least 30 days prior to commencing any additional field work."

A consultation conference call was held on March 5, 2015 (Appendix A) and the proposed HSI methodology had been provided to the working group in advance (and filed on March 2, 2015 as part of the study report). On the conference call, the working group agreed on an approach to developing HSIs for DWM and co-occurring mussel species. HSI criteria will be hybrids of Category I (qualitative) and Category II (quantitative, using empirical data), depending on the amount of data available for each parameter. HSI criteria will be developed by reviewing and synthesizing existing data, and by soliciting input from regional experts using the Delphi approach, using the following process:

- Gather, review, and synthesize available information on the distribution and habitat of DWM and co-occurring mussel species. Sources: journal articles, government and consultant reports, case studies and insight from regional experts, the mussel field data collected by TransCanada (2011 to 2014), and habitat data collected by TransCanada for other relicensing studies (Study 7 - Aquatic Habitat Mapping Study, and Study 9 - Instream Flow Study).
- Draft an HSI criteria framework for key parameters, and provide a written rationale for each criterion. Draft a questionnaire to solicit opinion of regional experts using the Delphi process.
- Identify regional experts willing to be part of the Delphi panel (i.e., to provide opinions, insight, and data on the HSI criteria). Provide experts background information and the questionnaire.
- Fine-tune, eliminate, or add HSI criteria based on responses from experts. Summarize the first round of responses, and send revised HSI criteria to experts for final review and to resolve any outstanding issues raised during the first round. Finalize the HSI criteria following the second round of comments from experts.

- All sources of information, the process used to develop the final HSI criteria, and the final HSI criteria will be summarized in a written document and submitted to the working group for final review.
- Final HSI criteria will be used to model habitat in project-affected reaches using 1D and 2D modeling, as part of Study 9, and the results will be used for interpretation and inclusion in the final study report.

24.3 Remaining Activities

Potential Delphi panelists have been identified and contacted; five have agreed to participate. Early steps of gathering and synthesizing existing information are partially complete. The remaining work is expected to be completed from September to December of 2015.

TransCanada is developing HSIs using the process described above and these are expected to be completed by December 2015. Final HSI criteria will be used to model habitat in project-affected reaches using 1D and 2D modeling, as part of Study 9 - Instream Flow Study, and the results will be provided for interpretation and inclusion in the final report for this study. The process for developing HSIs, and for using them to model and assess potential effects of water level fluctuations on dwarf wedgemussels and their habitat, was approved by stakeholders and extended the timeline for analysis and reporting to early 2016.

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical study locations noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

24.4 Study Results to Date

Study results to date were filed with FERC on September 15, 2014 for Phase 1 study work and on March 2, 2015 for Phase 2 study work.

24.5 Variance from Study Plan and Schedule

The RSP was adaptive, and though objectives and proposed methods were modified based on Phase 1 results and the subsequent re-evaluation of tasks needed to accomplish the Phase 2 objectives, there have been no deviations from the main objectives of the study plan or the schedule to this point. However, due to the ongoing consultation and HSI development via the Delphi panel, a final study report is not expected until early 2016.

24.6 Literature Cited

Biodrawversity, LBG, and Normandeau (Biodrawversity, LLC, The Louis Berger Group, and Normandeau Associates, Inc). 2014a. ILP Study 24 – Dwarf Wedgemussel and Co-occurring Mussel Study, Phase 1 Report (Public Version). Draft for Stakeholder Review. Prepared for TransCanada Hydro Northeast Inc. May, 2014.

Biodrawversity, LBG, and Normandeau. 2014b. ILP Study 24 - Dwarf Wedgemussel and Co-occurring Mussel Study, Proposed Phase 2 Study Plan. Prepared for TransCanada Hydro Northeast Inc. May, 2014.

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25. Study 25 – Dragonfly and Damselfly Inventory and Assessment

25.1 Introduction

TransCanada will conduct this Dragonfly and Damselfly (odonates) Inventory and Assessment (ILP Study 25) in 2015 to inventory the river-dependent odonate assemblages in the project-affected areas, including life history, ecology, and behavior information for each species and to assess the potential influence of project operations on river-dependent odonate larval emergence/eclosion and habitat. The four study objectives are to:

- Conduct a baseline inventory and habitat assessment that builds on prior surveys in the project areas;
- Collect field data on the emergence and eclosion behavior of river-dependent odonates in the project areas;
- Review and synthesize available information on the life history, ecology, and behavior of river-dependent odonates that occur in the project areas; and
- 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.

The RSP was approved in FERC's February 21, 2014 SPD with the following specific change.

- Increase the survey frequency from once per month to twice per month from June through August.
- Deploy water level loggers at each survey site throughout the entire study period.

The determination also delayed the study until 2015 and the final report to March 1, 2016.

25.2 Study Progress

Sites were preliminarily identified based on aerial imagery to provide a representative sample of the project areas, and field reconnaissance was performed in late May 2015 to confirm the presence of suitable emergence habitat (Figure 25-1). Eleven sites were selected which sampled the geographic extent of the project area and a variety of hydrologic conditions (see SSR included as Volume II.H of this USR and site locations included as GIS layers identified as "TC_25_StudySites_2015" in Volume II.I of this USR).

A working group consultation call on the SSR was held May 18, 2015 (Appendix A) and the SSR was accepted without revision. A Scientific Collection Permit from VFWD and a Scientific License from NHFGD were issued in late May 2015.

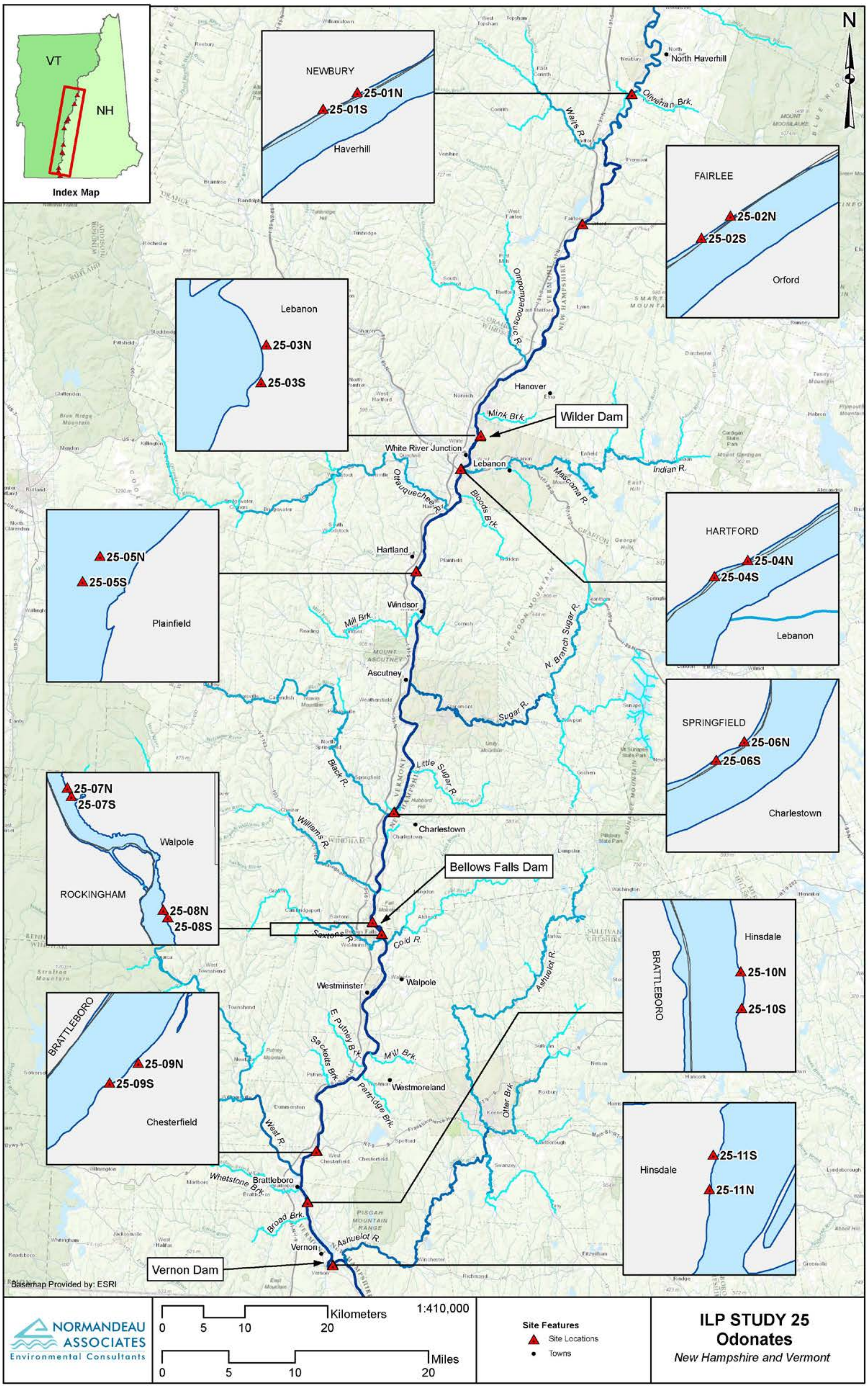

Figure 25-1. Odonate study sites.

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During June and July 2015, six visits were conducted and all eleven sites were visited. During each visit, scientists thoroughly searched five 3-meter wide transects at each site for dragonfly larvae, exuviae, and tenerals (pre-flight dragonflies). The horizontal and vertical distances from the water and the site on which they were located. If larvae were observed in the process of emerging, the time at which they were observed was noted, and the larvae were regularly observed to document the length of time and location of emergence. Additionally, near shore benthic samples were taken to sample for mature odonate larvae and prey species. A detailed habitat assessment was conducted at each site. Continuous water surface elevations for the entire sample period and representative elevation data were also collected for each site.

25.3 Remaining Activities

Habitat data is currently being analyzed to determine if there are any correlations with emergence patterns. Larval prey data is being analyzed to determine if there is any correlation between larval prey and odonate abundances. Water level logger data is currently being compared with odonate emergence elevations to determine the relationships of water level changes to emerging odonates. Upon completion of all field work, data will be consolidated and analyzed and a study report prepared.

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical study WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

25.4 Study Results to Date

Transect surveys recorded a total of 754 observations of 19 species of odonate over the 9-week sampling period (Table 25-1). Multiple larvae were observed from emergence to eclosure to flight. Six of the eight target listed odonates were observed, shown in bold in Table 25-1. Detailed accounts of study observations will be available in the study report.

Table 25-1: Count of odonate observations on transects at each of the study sites[a].

	Site											Total
	Wilder					Bellows Falls			Vernon			
	25-01	25-02	25-03	25-04	25-05	25-06	25-07	25-08	25-09	25-10	25-11	
Basiaeschna janata			3									3
Boyeria vinosa			1	2	4	1		3	1		1	13
Cordulegaster maculata					1							1
Didymops transversa	1	1	3									5
Dromogomphus spinosus	3	12	11			6	6	1	9	17	3	68
Epitheca cynosura			21									21
Epitheca princeps		1	56				4					61
Gomphus abbreviatus							2		2	5	1	10
Gomphus exilis			1									1
Gomphus quadricolor		1										1
Gomphus vastus	3	15			1	39	23	9	22	8	121	241
Hagenius brevistylus							1					1
Macromia illinoiensis	7	1				2	2					12
Neurocordulia yamaskanensis	5	2		1				3	5	3	4	23
Ophiogomphus rupinsulensis				1	2						7	10
Stylogomphus albistylus											1	1
Stylurus amnicola	2	2				21	3	2	6		3	39
Stylurus scudderi	4	1		3	L	3		1				12
Stylurus spiniceps	23	13	20	2	1	60	34	11	36	13	18	231
Total	**48**	**49**	**116**	**9**	**9**	**132**	**75**	**30**	**81**	**46**	**159**	**754**

a. An “L” indicates the species was not observed on transects, but larvae were observed at the site.

25.5 Variance from Study Plan and Schedule

The schedule for study implementation is at variance with the RSP schedule due to the closure of VY, but in accordance with FERC’s February 21, 2014 SPD.

In order to better sample focal odonate species, the number of samples was increased from three to six per FERC's SPD. However, with working group concurrence, all sampling events were conducted in June and July of 2015 based on field conditions, to better match peak emergence of focal odonate species, rather than continuing into August as the RSP and the SPD indicated.

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26. Study 26 – Cobblestone and Puritan Tiger Beetle Survey

26.1 Introduction

TransCanada conducted this Cobblestone and Puritan Tiger Beetle Survey (ILP Study 26) in 2014 to detect and gather information on known and new cobblestone tiger beetle and Puritan tiger beetle populations along the Connecticut River throughout the Wilder, Bellows Falls, and Vernon Project-affected areas. One of these species, the Puritan tiger beetle (*Cicindela puritana*) is listed as threatened federally and in Vermont. It is also listed as endangered in New Hampshire. The cobblestone tiger beetle (*Cicindela marginipennis*) is listed as threatened in both New Hampshire and Vermont. The objectives of this study were to:

- Obtain baseline distributional and abundance data and map occurrences of cobblestone and Puritan tiger beetle populations along the Connecticut River throughout the 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
- Assess whether project operations are adversely affecting the survival success of adult and larval cobblestone and Puritan tiger beetles.

The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

26.2 Study Progress

A description of likely habitats to begin screening the study area for potential sampling sites was developed, and field reconnaissance for study site selection was performed in late June 2014. Thirteen sites were selected based on the existence of previous or historical records and confirmation of suitable habitat during field reconnaissance. These sites were included as a GIS layer in the geodatabase filed separately on DVD as Volume VII of the ISR, TransCanada Initial Study Report Supporting Geodatabase.

A Scientific Collection Permit from VFWD and a Scientific License from NHFGD were issued in late June 2014. The New Hampshire license only allowed the capture and release of cobblestone tiger beetles with an aerial net. Cobblestone tiger beetles and Puritan tiger beetles could be photographed. Larval borrows could be gently probed with a grass blade to determine the angle and depth of burrows, no larvae of either species could be harmed, excavated, or collected.

The Vermont permit allowed using aerial nets, binoculars, and cameras to survey for both cobblestone and Puritan tiger beetles. It also allowed using the "fishing" technique (Brust et al., 2010) to probe one burrow to verify the presence of cobblestone tiger beetle, but larvae could not be removed. Live specimens of both species had to be released unharmed.

During July and August 2014, three visits were conducted, where 12 sites were surveyed at each visit. Two sites (Burnaps Island and Chase Island) were only visited twice due to limited access during some visits. A final visit was conducted the first week of September to conclude the study fieldwork at those two survey locations.

During each visit, scientists searched the available habitat for one person-hour and noted the presence and abundance of cobblestone tiger beetles, Puritan tiger beetles, and the common shore tiger beetle (*Cicindela repanda*) and noted any active or inactive burrows observed at the site. The common shore tiger beetle was used as a marker for general beetle activity because it is a common species and a reasonable indicator for suitable weather conditions.

When target species were observed, scientists noted habitat type, behavior and photographed the individual when possible. A detailed assessment of cobblestone tiger beetle habitat availability was performed at each site during one of the three visits.

In 2015, in conjunction with other studies' field work, data on ranges of habitat elevations at the study sites was collected via a Real Time Kinematic (RTK)-GPS. Nearby logger data from other studies are being analyzed and water level fluctuations at the Study 26 sites summarized. This information will be supplemented by the results of Studies 4 and 5 (Hydraulic Modeling and Operations Modeling).

26.3 Remaining Activities

RTK data is currently being compared to water level logger data from loggers located in the vicinity of the study sites. This information will be included in the study report as part of the assessment of project effects. Further assessment of project effects will rely in part on results from other studies will be needed to complete that assessment. Relevant studies include the Riverbank Erosion Study (Study 3), Channel Morphology and Benthic Habitat Study (Study 8), and Instream Flow Study (Study 9).

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical study WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

26.4 Study Results to Date

Preliminary results indicate that cobblestone tiger beetles were present at greater than half of study sites including several new state records (Table 26-1). No Puritan tiger beetles were observed. Common shore tiger beetles were present at all but one study site (Saxtons River), occasionally in great numbers. Detailed accounts of study observations will be available in the final report once study data has been compiled and checked for quality control.

Table 26-1: Cobblestone tiger beetle preliminary survey results.

Survey Site	Cobblestone Tiger Beetle Present?	River Section	Previous State Record?
Mascoma River	No	Wilder Riverine	No
Johnston Island	Yes	Wilder Riverine	Yes
Burnap's Island	Yes	Wilder Riverine	Yes
Sumner Falls	Yes[1]	Wilder Riverine	No
Hart Island	Yes	Wilder Riverine	Yes
Chase Island	Yes	Bellows Falls Impoundment	Yes
Claremont Island	No	Bellows Falls Impoundment	No
Ascutney Riverbank	Yes	Bellows Falls Impoundment	No
Sugar River	Yes[2]	Bellows Falls Impoundment	No
Jarvis Island	Yes[2]	Bellows Falls Impoundment	No
Saxtons River	No	Bellows Falls Riverine	No
Walpole Island	Yes	Bellows Falls Riverine	Yes
West River	Yes	Vernon Impoundment	No[3]

1 Observed outside survey period
2 Observed with low certainty
3 Previous record just upstream, outside influence of the Vernon Project

26.5 Variance from Study Plan and Schedule

The assessment of project effects has been delayed as a result of the partial delay of Study 9 – Instream Flow Study due to low flows in the summer and fall of 2014 which delayed Study 9's high flow work until the spring of 2015. That delay caused delays in Study 4 – Hydraulic Modeling Study and Study 5 – Operations Modeling Study until later in 2015.

In addition, on June 30, 2014, FWS, NHFGD, and VFWD were notified by email of minor adjustments to the study field schedule and scope, as described below (see ISR Volume I, Appendix A).

- The RSP described sampling one time per month in mid-June, mid-July, and early August. The adjustment involved retaining three sampling events but condensing them into the period from early July into mid-August. The New Hampshire and Vermont records for cobblestone tiger beetles all indicated observations between July 7 and August 28. Dr. Kristian Omland, who is a recognized expert in tiger beetles, including cobblestone tiger beetles, and involved with the study, concurred with delaying the start of the survey period until the second week in July. Mr. Omland has no record of cobblestone tiger beetles in Vermont prior to July 8. The study adjustment proposed beginning the field surveys after that date and subsequently sampling every two weeks until mid-August.

- The RSP described sampling 30 minutes for adults and 30 minutes for larval burrows. The sample approach adjustment focused on adults because the cobblestone tiger beetle larvae and their burrows have not been scientifically described and cannot be distinguished from other tiger beetles, including the common shore tiger beetle, which appears ubiquitous on the Connecticut River. The adjusted study plan included a 30-minute survey at each site for adults and a qualitative estimate of the number of burrows.
- The RSP described collecting cobblestone tiger beetle larvae if more than 10 burrows are identified. Per requests from VFWD and NHFGD, the study was adjusted to exclude collection of larvae. Because they have not been scientifically described, larval collection would not aid positive identification of cobblestone tiger beetles and would unnecessarily deplete the population.
- The RSP described sampling for federally threatened Puritan tiger beetles. The known historical sites were flooded with the construction of the Bellows Falls impoundment and no Puritan tiger beetles have been observed since 1932, despite multiple surveys since that date. FWS did not issue a collection permit for Puritan tiger beetles for this study because of the low likelihood of finding this species, although the state collection permits did allow some types of collection. The study adjustment concentrated the sampling effort more on cobblestone tiger beetle because of the higher probability of locating this species; although all species observed were noted.

26.6 Literature Cited

Brust, M.L., W.W. Hoback, and J.J. Johnson. 2010. Fishing for Tigers: A Method for Collecting Tiger Beetle Larvae Holds Useful Applications for Biology and Conservation. The Coleopterists Bulletin 64(4):313–138.

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27. Study 27 – Floodplain, Wetland, Riparian, and Littoral Habitats Study

27.1 Introduction

TransCanada is conducting this Floodplain, Wetland, Riparian, and Littoral Habitats Study (ILP Study 27) to provide baseline mapping and characterization of riparian, floodplain, wetland, and littoral vegetation and habitats within the Wilder, Bellows Falls, and Vernon Project-affected areas and to assess the potential effects of project-caused 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 vegetation habitats, and associated wildlife.

The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

27.2 Study Progress

Desktop terrestrial habitat mapping was completed, showing cover types within the 200-foot buffer zone and the floodplains within the three project areas and in the riverine habitats connecting the projects. Terrestrial cover types and 1-foot contours were merged with the aquatic habitat mapping data from Study 7 (Aquatic Habitat Mapping) to provide seamless maps of the study area. Preliminary ground-truthing was conducted, as well as data quality control check of approximately 50 percent of the terrestrial buffer mapping. New Hampshire Natural Heritage Bureau (NHNHB) and VFWD were contacted to request updated rare species lists. Both states responded that no new data beyond the 2012 survey (Normandeau, 2013) were added, so no update was necessary.

Winter bald eagle roosting habitat mapping criteria were refined based on in-house experience and discussions with Chris Martin (New Hampshire Audubon), and areas meeting those criteria were mapped in the study area.

Submerged aquatic vegetation (SAV) beds were mapped from a 2012 August orthophoto in which floating-leaved, and many submerged aquatic beds were visible.

Field verification of the terrestrial habitat mapping occurred in July and August 2014. These surveys were conducted by a combination of work from boats and on foot for locations with road access. A team of biologists visited most cover types in each impoundment to verify the mapping and to characterize the vegetation, structure, primary hydrologic inputs, and evidence of disturbance at multiple representative sites. For wetland cover types, the primary functions and values were assessed. Mapped floodplain cover types were visited and ground-verified based on evidence of duration and frequency of flooding.

Observations on invasive species included delineating stands formed by clumping species, primarily Phragmites (*Phragmites australis*) and Japanese knotweed (*Polygonum cuspidatum*). Most other species did not occur in well-defined beds, therefore, could not be mapped as easily. In those cases, their presence and relative dominance were noted in all representative cover types, and whenever encountered during the site reviews. SAV bed boundaries were reviewed in the field and modified as needed. The dominant SAV plant species, substrates, and structure of the aquatic beds were recorded.

The mapped bald eagle habitats were assessed for appropriate structure and their potential to serve as night roosts for wintering bald eagles. Other wildlife species and sign were recorded as encountered, with a focus on water-dependent species. Areas of active erosion were recorded as encountered.

The terrestrial habitat maps were revised to reflect the changes and observations resulting from the field verification effort. In 2015, representative vegetative communities within the study area were evaluated for the presence of water level loggers deployed in other studies in the vicinity. Logger data was analyzed and water level fluctuations at the representative sites were summarized. The study report is being filed as Volume III.B of this USR, four GIS layers of mapped habitat data identified as “TC_27_Supporting_Geodata” are included in Volume III.C of this USR.

27.3 Remaining Activities

An assessment of the potential effects of project operations will rely in part on results from other studies will be needed to complete that assessment. Relevant studies include the Riverbank Erosion Study (Study 3), Channel Morphology and Benthic Habitat Study (Study 8), and Instream Flow Study (Study 9).

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing critical study WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

27.4 Study Results to Date

Maps were completed of all terrestrial cover types, floodplains, aquatic vegetation beds, invasives, and bald eagle winter roosts in the study area. The associated data from the field portion of this study were tabulated and compiled in a database for future analysis.

Natural features and land uses mapped within the study area covered a total of 9,153 acres, and were comprised of upland vegetation cover (62% cover), wetlands and tributary streams (23% cover), developed lands (12% cover), and riverine features (2% cover) (Table 27-1).

Table 27-1. Acreage of cover types and land use by broad categories.

Cover type	Wilder	Wilder Riverine	Bellows Falls	Bellows Falls Riverine	Vernon	Total	% of Total
Upland Vegetated	2296.8	778.1	1139.7	92.0	1449.0	5755.7	62.8
Wetland and Stream	701.5	17.4	737.2	0.7	657.3	2114.2	23.10%
Developed	338.9	180.7	242.5	42.2	305.6	1109.9	12.1
Riverine Features	32.2	58.2	31.4	26.8	25.2	173.8	1.9
Total	3369.4	1034.5	2150.9	161.8	2437.0	9153.6	100.0

A breakdown of cover types by land use category is provided in Table 27-2. Undeveloped uplands were the most abundant cover types, comprising 63% of the total study area. Wetlands were widely distributed across the study area, comprising 23% of the study area. The dominant wetland cover types were aquatic vegetation, emergent, and deciduous forested communities. The developed lands formed 12% of the study area, and were dominated by infrastructure, consisting of dams and dam facilities, roads and railroads, and boat launches. Riverine features comprised 2% of the study area, and included steep unconsolidated slopes, eroding banks and river channel features.

Table 27-2. Acreages of cover types within the 200-foot study area.

Cover Code	Cover type	Wilder	Wilder Riverine	Bellows Falls	Bellows Falls Riverine	Vernon	Total	% of Total
Upland								
H	Hardwood	486.3	379.2	469.8	59.1	812.1	2206.4	24.10%
H/S	Hardwood/softwood	364.3	134.9	193.9	5.7	235.3	934.2	10.21%
S	Softwood	328.2	61.7	69.1	1.2	48.1	508.2	5.55%
SHR	Shrub	126.6	12.2	84.3	6.6	40.9	270.6	2.96%
H/SHR	Hardwood/shrub	3.1	5.2	0.4	0.6	6.1	15.3	0.17%
SHR/G	Shrub/Grassland						0.0	0.00%
OLD FIELD	Old field	21.2	3.5	15.3		2.9	42.9	0.47%
GRASS	Maintained Grassland	62.0	19.9	43.5	1.2	34.2	160.8	1.76%
CROP	Crop	597.3	146.2	188.9	17.6	215.9	1166.0	12.74%
PASTURE	Pasture/hayfield	307.8	15.3	74.6		53.4	451.2	4.93%
	Total	**2296.8**	**778.1**	**1139.7**	**92.0**	**1449.0**	**5755.7**	62.88%
Wetland								
PFO1	Deciduous Forested	141.3	7.7	142.2		124.1	415.3	4.54%
PFO4	Coniferous Forested	0.7				0.0	0.7	0.01%
PFO1/4	Mixed Forested	5.3		0.4		3.6	9.3	0.10%
PFO1/PSS	Deciduous Forested/shrub	1.7		26.8		7.6	36.0	0.39%
PFO1/PEM	Deciduous Forested/Emergent			1.0		0.7	1.7	0.0%
PSS	Scrub-shrub	48.3	1.8	35.3		33.9	119.3	1.30%
PSS/PEM	Scrub-shrub/Emergent	25.6	0.6	16.1		7.9	50.3	0.55%
PEM	Emergent	133.1	4.7	241.0		108.2	486.9	5.32%
PEM5	Phragmites	7.3		4.7		22.8	34.8	0.38%
PERENN	Perennial Stream	7.1	1.9	4.6	0.7	10.9	25.2	0.27%
INTERMIT	Intermittent Stream	1.2	0.4	1.9		2.1	5.6	0.06%
PUB	Pond	11.6		3.7		7.1	22.4	0.25%
PVP	Possible vernal pool	0.5	0.3	1.3		1.5	3.6	0.04%
PAB/RAB	Submerged Aquatic Vegetation	318.0	0.0	258.3	0.0	326.9	903.2	9.87%

Cover Code	Cover type	Wilder	Wilder Riverine	Bellows Falls	Bellows Falls Riverine	Vernon	Total	% of Total
	Total	**383.5**	**17.4**	**478.9**	**0.7**	**330.4**	**1211.0**	23.10%
Developed								
Comm	Commercial	47.5	47.4	31.3	24.1	73.4	223.7	2.44%
Res	Residential	135.5	36.6	108.9	1.0	81.7	363.6	3.97%
Sub	Suburban			9.3		19.2	28.5	0.31%
Mineral/dams	Dams	1.4	25.8	3.4		2.1	32.8	0.36%
Infra	Infrastructure	154.6	70.9	89.6	17.0	129.1	461.3	5.04%
	Total	**338.9**	**180.7**	**242.5**	**42.2**	**305.6**	**1109.9**	12.13%
Riverine Features								
Ledge	Bedrock ledge	0.2	4.1	0.5	20.1	2.1	26.9	0.29%
Rocky	Rocks and Boulders	0.4	3.1	0.2		1.9	5.6	0.06%
Gravel	Gravel	0.3	19.0	1.9	6.8	3.5	31.6	0.34%
Sand-mud	Sand-mud	0.9	27.3	2.7		10.3	41.1	0.45%
Riverbank	Riverbank	9.2	4.5	18.9		5.7	38.3	0.42%
Eroding bank	Eroding bank	20.9		7.2		1.4	29.5	0.32%
Riprap	Riprap	0.3	0.2			0.3	0.9	0.01%
	Total	**32.2**	**58.2**	**31.4**	**26.8**	**25.2**	**173.8**	1.90%
Grand Total		3369.4	1034.5	2150.9	161.8	2437.0	9153.6	**100.0%**
% of Total		36.81%	11.30%	23.50%	1.77%	26.62%	100.00%	

27.5 Variance from Study Plan and Schedule

The assessment of project effects has been delayed as a result of the partial delay of Study 9 – Instream Flow Study due to low flows in the summer and fall of 2014 which delayed Study 9’s high flow work until the spring of 2015. That delay caused delays in Study 4 – Hydraulic Modeling Study and Study 5 – Operations Modeling Study until later in 2015.

27.6 Literature Cited

Normandeau (Normandeau Associates, Inc). 2013. Rare, Threatened, and Endangered Plant and Exemplary Natural Community Assessment. Final Report. Prepared for TransCanada Hydro Northeast Inc. April 2013

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28. Study 28 – Fowler's Toad Survey

28.1 Introduction

TransCanada conducted this Fowler's Toad Survey (ILP Study 28) to obtain baseline distributional and abundance data on Fowler's toad (*Anaxyrus fowleri*) along the Connecticut River in the Bellows Falls and Vernon Project-affected areas.

In 2015, this species was listed as a state-endangered species as a Priority 1 "Very Rare" species. The Wilder impoundment and Wilder riverine project-affected area were not included in this study because they are unlikely to support this species because these areas lie north of the northernmost Vermont record for Fowler's toad. The objectives of this study were to:

- Develop additional information regarding the distribution and relative abundance of Fowler's toad;
- Develop additional information regarding the distribution and condition of suitable Fowler's toad habitat within the study area; and
- Assess whether project operations are likely to have an effect on suitable Fowler's toad habitat, and if those effects are likely to be positive or negative.

The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

28.2 Study Progress

Locations for field sampling were identified via the vegetation and substrate cover type maps developed as part of terrestrial habitat mapping (for Study 27). Local experts, including Jim Andrews, expert herpetologist and curator of the Vermont Reptile and Amphibian Atlas, were contacted for input on potential sampling locations.

Sixteen sites were selected as having the highest potential to support Fowler's toad. Thirteen of those sites were accessible for study, 2 additional sites were identified during field checks for a total of 15 survey sites. The locations included 11 sites associated with the Bellow Falls Project and 4 sites associated with the Vernon Project. Field work for this study (call surveys and acoustic monitoring) was completed during June and July 2014. These sites were included as a GIS layer in the geodatabase filed separately on DVD as Volume VII of the ISR, TransCanada Initial Study Report Supporting Geodatabase.

Analysis of data from the thousands of acoustic monitoring records was completed in the fall of 2014. In 2015, in conjunction with other studies' field work, data on ranges of habitat elevations at the study sites was collected via a RTK-GPS. Nearby logger data from other studies are being analyzed and water level fluctuations at the Study 28 sites summarized. This information will be supplemented by the results of Studies 4 and 5 (Hydraulic Modeling and Operations Modeling).

28.3 Remaining Activities

RTK data is currently being compared to water level logger data from loggers located in the vicinity of the study sites. This information will be included in the study report as part of the assessment of project effects. Further assessment of project effects will rely in part on the results from other studies will be needed to complete that assessment. Relevant studies include the Riverbank Erosion Study (Study 3), Channel Morphology and Benthic Habitat Study (Study 8), and Instream Flow Study (Study 9).

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical study WSEs noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

28.4 Study Results to Date

Fowler's toad was confirmed at one study location on Stebbins Island downstream of Vernon Dam. Stebbins Island and the Stebbins Road area in Vernon have the most recent Fowlers toad's records in the study area, consisting of 17 verified records from 1994 through 2007. The ISR reported that Fowler's toad may have been detected at the Hart Island site located approximately eight miles (straight line distance) downstream from well documented sightings of Fowler's toads in Hartford, Vermont. However, QA of the preliminary data presented in the ISR resulted in a determination that Fowler's toad was not present at the Hart Island site.

28.5 Variance from Study Plan and Schedule

The assessment of project effects has been delayed as a result of the partial delay of Study 9 – Instream Flow Study due to low flows in the summer and fall of 2014 which delayed Study 9's high flow work until the spring of 2015. That delay caused delays in Study 4 – Hydraulic Modeling Study and Study 5 – Operations Modeling Study until later in 2015. At this time, the modeling studies are incomplete.

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29. Study 29 – Northeastern Bulrush Survey

29.1 Introduction

TransCanada conducted this Northeastern Bulrush Survey (ILP Study 29) to assess the potential effects of Wilder, Bellows Falls, and Vernon Project operations on 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, Vermont. The objectives of this study were 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 project 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).

The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

29.2 Study Progress

Preliminary habitat analysis and cover type review to identify suitable survey locations for northeastern bulrush were conducted and nine sites within the project boundaries were identified as worthy of field visits: one at the Wilder Project, four at Bellows Falls Project, and four at the Vernon Project.

NHNHB and VFWD were contacted for their existing records for this species near the Connecticut River. NHNHB did not provide any additional data. VFWD provided confirmation of the known record in the Bellows Falls Project area.

Field visits to eight of the nine sites were conducted in late August 2014. The remaining previously known site was visited in early September 2014. Maps of the potential habitats were prepared along with summaries of the existing habitat conditions at each and a draft study report was prepared.

In 2015, in conjunction with other studies' field work, data on ranges of habitat elevations at the study sites was collected via a RTK-GPS. Nearby logger data from other studies are being analyzed and water level fluctuations at the Study 29 sites summarized. This information will be supplemented by the results of Studies 4 and 5 (Hydraulic Modeling and Operations Modeling).

29.3 Remaining Activities

RTK data is currently being compared to water level logger data from loggers located in the vicinity of the study sites having potential habitat for the species. This information will be included in the study report as part of the assessment of project effects.

An assessment of the potential effects of project operations will in part rely on the results from other studies will be needed to complete that assessment. Relevant studies include the terrestrial habitat mapping analysis (Study 27), Riverbank Erosion (Study 3), and Recreational Facility Inventory and Use & Needs Assessment (Study 30).

An assessment of the potential effects of project operations will in large part rely on the development of rating curves (flow vs water surface elevation or WSE) for impoundments and riverine sections using the Hydraulic Model (Study 4). The modeled WSE for various flows will allow for a pre-screening of project effects by comparing the critical study WSEs at potential bulrush habitat sites noted in the field with modeled flows and WSEs. If potential effects are unlikely, no further analysis is warranted since the normal project operations have little or no impact.

If the pre-screening analysis indicates potential impacts are possible further examination using the Hydraulic Model and the Operations Model (Study 5) will be undertaken to describe the frequency and periodicity of potential effects over a series of annual hydrologies, and whether potential alternative operating conditions can mitigate the potential effects. Both the pre-screening results and the need for further analysis or examination of operating alternatives will be discussed in detail with stakeholders. The project effects analysis should be completed before June 30, 2016 and will be reflected in the final study report, the 2016 USR and license applications.

29.4 Study Results to Date

No northeastern bulrush were identified during the surveys. Four of the nine sites supported habitats that could be suitable for this species, based on field observations of hydrology and plant communities and in comparison to the known site. Four other sites were deemed unlikely to support northeastern bulrush based on the presence of a direct connection to the river and local habitat conditions. No northeastern bulrush were identified at the known site.

29.5 Variance from Study Plan and Schedule

The assessment of project effects has been delayed as a result of the partial delay of Study 9 – Instream Flow Study due to low flows in the summer and fall of 2014 which delayed Study 9's high flow work until the spring of 2015. That delay caused delays in Study 4 – Hydraulic Modeling Study and Study 5 – Operations Modeling Study until later in 2015. At this time, the modeling studies are incomplete.

30. Study 30 – Recreation Facility Inventory and Use & Needs Assessment

30.1 Introduction

TransCanada conducted this Recreation Facility Inventory and Use & Needs Assessment (ILP Study 30) in 2014 and 2015 to assess recreation resource opportunities, uses, and needs within the Wilder, Bellows Falls, and Vernon Project-affected areas. In addition, the study assed public recreation access opportunities at the Connecticut River from the upstream end of the Wilder impoundment to the downstream limit of the Vernon Project. The goals of this study were 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 regional opportunities;
- Photograph views from public recreation facilities to document existing aesthetic conditions; and
- Lay the foundation for preparation of a Recreation Management Plan for the projects that will be included in the DLAs.

The RSP for this study was modified by FERC in its September 13, 2013 SPD with the following specific changes.

- Onsite survey sampling events are extended to one-half hour after sunset.
- Question 36 of the Onsite Intercept Survey Form is revised to include individuals 16-17 years of age.
- Survey questions on the mailed and onsite questionnaires are revised to be consistent in use of the scales for all Likert-type questions with higher ratings corresponding to higher levels of satisfaction.
- Facility inventory forms are revised to include the number and type of formal and informal campsites.
- Spot count forms are revised to document the number of cars double-parked and/or not parked in designated spots due to parking overflows.

- The site condition evaluation form is revised to include a not applicable column and scoring scales for the facility sites and visitor use impact monitoring are modified so that higher scores reflect better conditions.

30.2 Study Progress

Data collection for this study covered a 1-year period from March 2014 to February 2015, and all fieldwork has been completed for the study and most of the data has been compiled. Some data remains to be compiled in order to finalize the draft report which has been prepared.

30.3 Remaining Activities

A study report is expected to be filed in the fall of 2015 once all data has been compiled.

30.4 Study Results to Date

Data collected included public recreation area interviews (577 interviews), spot counts (2,702 counts), traffic counts (4,195 days with data), and mail surveys of residents living in the counties adjacent to the projects (2,400 surveys were mailed and 263 were returned completed).

Study results showed that the Connecticut River is a significant feature in Vermont and New Hampshire. For regional residents who do not recreate at the projects, the main reason is because they are not interested in these opportunities or are not able to participate in such activities.

More than 617,000 recreation days were recorded at the recreation study sites during the study period. TransCanada sites contributed 274,603 of the recreation days.

At all three projects, most public boat launch facilities were below capacity for most of the year. Public site users were satisfied with the type and number of recreation facilities; however, these users continued to make recommendations, such as a need for more boat ramps and launches, river access for shoreline fishing, parks (picnic tables and benches), and walking trails. Site maintenance and upgrades were documented by visitors at many of the public boat ramps.

Respondents provided mixed opinions about what types of water levels they preferred based on their activities. Anglers preferred water levels that were stable or higher for better fishing conditions. Boaters mostly did not have any issue with the water levels.

Seventeen primitive campsites (15 of which are recognized on the Connecticut River Paddlers' Trail) are available within the three project boundaries and were found to be in good condition and well used during the summer months.

30.5 Variance from Study Plan and Schedule

Only minor deviations from the study schedule occurred including carryover of interviews and surveys through the winter of 2014/2015 to cover each calendar month, but these deviations did not materially affect the study.

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31. Study 31 – Whitewater Boating Flow Assessment – Bellows Falls and Sumner Falls

31.1 Introduction

TransCanada conducted this Whitewater Boating Flow Assessment at Bellows Falls and Sumner Falls (ILP Study 31) in 2014 and 2015 to evaluate the suitability of whitewater boating opportunities in the bypassed reach below the Bellows Falls dam and to study the effects of Wilder Project operations on paddling opportunities at Sumner Falls. The goal of this study was to assess the presence, quality, access, flow information, and flow ratings for paddling opportunities in a stepwise manner. The objectives of the study were to:

- Identify recreational paddling opportunities at Sumner Falls and determine 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 study site;
- Describe potential effects of project operations on paddling at each location and identify boaters' 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 project operations;
- Determine the potential number of days flows for whitewater boating are available under the projects' current operations at each study site;
- Identify resource needs (e.g., aquatic habitat) and competing recreational uses (e.g., canoeing or fishing) that are or will 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.

The RSP for this study was modified by FERC in its September 13, 2013 SPD with the following specific changes.

- The study will assess at least three controlled releases from Wilder for the Sumner Falls evaluation and at least four controlled releases from the Bellows Falls dam with provisions for additional releases based on interviews with paddlers and study participants.
- The study includes at least 12 boater participants.

31.2 Study Progress

During late winter and early spring 2014, photographs and videography clips were taken at various natural flow levels at both study sites. A boater consultation meeting and field visits were conducted on May 27 and 28, 2014, to discuss the details and logistics of the flow evaluation studies for Sumner Falls and the Bellows Falls bypassed reach.

The Sumner Falls evaluation occurred on June 28 and 29, 2014. Stakeholders participated in a teleconference on August 22, 2014 to discuss the schedule, flow levels, duration, boaters and other logistics associated with conducting the Bellows Falls bypassed reach boating work. TransCanada consulted with interested parties during the teleconference to refine the survey tool and pinpoint the schedule for the Bellows Falls field portion of the study. Additional consultation with boating representatives and FERC occurred on September 5, 2014 to reschedule the field portion to the following spring due to low water conditions in the watershed (relevant consultation documents were included in Volume I, Appendix A of the ISR).

The Bellows Falls bypassed reach boating evaluation occurred on May 30 and 31, 2015. Data were compiled and analyzed and are currently being summarized for the study report.

31.3 Remaining Activities

A draft report is expected to be filed in the fall of 2015 once all data is summarized.

31.4 Study Results to Date

Sixteen boaters participated in the Sumner Falls flow evaluation on June 28 and 29, 2014. Boat types included play boats, kayaks, canoes, and stand-up paddle boards. Many of the boaters had never been to Sumner Falls. Five flow levels (4,000 cfs; 4,800 cfs; 6,750 cfs; 7,400-8,100 cfs; and 13,000 cfs) were boated with post-run surveys collected after each run followed by a close-out survey.

As part of the close-out survey, participants were asked to provide overall evaluations for the Sumner Falls area for a range of flows for their craft and skill level. In general, all participants reported all flows boated as ‘Marginal’ or higher with multiple preferred flow levels and only participant estimates that flows less than 2,000 cfs would be less than ‘Marginal’. Comments supplied as part of the close-out survey confirm these findings in that the Sumner Falls area is large enough and diverse enough to accommodate a wide range of flows allowing boaters of various skill levels and craft types to find boatable features that result in positive experiences.

Eleven boaters participated in the Bellows Falls bypassed reach flow evaluation on May 30 and 31, 2015. Boat types included play boats, kayaks, and canoes. Nine flow levels (in approximate ranges of 1,500 cfs; 2,000 cfs; 2,500 cfs; 3,000 cfs; 3,500 cfs; 4,500 cfs; 5,500 cfs; 7,500 cfs; and 10,000 cfs) were boated with post-run surveys collected after each run followed by a close-out survey.

As part of the close-out survey, participants were asked to provide overall evaluations for the Bellows Falls bypassed reach for a range of flows for their craft and skill level. Ten of the 11 participants reported all flows boated as part of the study as ‘Marginal’ or higher with multiple preferred flow levels. Less than marginal rankings were provided by a single boater at flows of approximately 1,500 cfs, 3,000 cfs, and 3,500 cfs. Comments supplied as part of the close-out confirm these findings in that the Bellows Falls bypassed reach does have 1-3 boatable features; however public access to the reach does not exist and the fish barrier dam proves a significant safety hazard.

31.5 Variance from Study Plan and Schedule

The schedule for the Bellows Falls bypassed reach evaluation was modified from October 18 and 19, 2014, to May 30 and 31, 2015. This variance was due to dry conditions throughout the watershed during 2014. There have been no other deviations from the study plan or schedule.

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32. Study 32 – Bellows Falls Aesthetic Flow Study

32.1 Introduction

TransCanada conducted this Bellows Falls Aesthetic Flow Study (ILP Study 32) to characterize the aesthetic conditions in the Bellows Falls bypassed reach at various levels of flow and to provide a range of aesthetic ratings that can be used to assess conditions relative to Vermont's water quality standards. The study objectives were to:

- Collect videography and still photography to document the appearance of the bypassed reach under various existing and 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 different populations.

The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

32.2 Study Progress

Photograph and video footage captured as part of the flow demonstration conducted during the whitewater boater study (Study 31) consultation meeting/site visit on May 27- 28, 2014, was used to support this study. Photographs and video footage taken of the flows during the Bellows Falls portion whitewater flow study in May 2015 and the instream flow study (Study 9) conducted in October 2014 were also used for this study.

Based upon the photograph and video footage captured as part of the flow demonstration, TransCanada conducted a focus group with local participants. Study participants convened at a single location on August 20, 2015 to view a series of videos of different levels of flow including existing conditions (leakage flows) in the bypassed reach taken from the Key Observation Points.

Each participant was asked to rate the conditions in the videos under the specified flow releases using a predefined rating form. After the single flow assessments, participants were asked to provide input comparing between flows. Participants completed a form to rate the leakage flow conditions and each of the controlled demonstration flows released in the bypassed reach. The actual flow in cfs was not disclosed and respondents were asked to evaluate flows by demonstration flow number only.

32.3 Remaining Activities

A draft report is expected to be filed in the fall of 2015 once all data has been compiled.

32.4 Study Results to Date

Only one participant indicated that aesthetics of the bypassed reach were extremely important; the average score was 1.8 ('moderately important'). No participants reported it as 0 'neutral' or lower. In general, participants reacted more favorably to higher flows; however, participants' preferred flow levels ranged within a few scores at each level and no clear preferred level was evident. Missing from the aesthetics flow study were visual representations of flows between leakage and the lowest whitewater boating flow of 2,500 cfs. Three of the participants (1/3) noted that there are no publically available viewing areas and questioned the need for specific aesthetic flows given lack of visibility.

32.5 Variance from Study Plan and Schedule

To ensure the focus group could view all flows during the scheduled meeting and participate in a meaningful comparison discussion, participants were shown only video clips rather than both video clips and photographs as part of the evaluation process. However, photographs will be included in the study report (video clips are extremely large files and will be made available from TransCanada.

33. Study 33 – Cultural and Historic Resources Study

33.1 Introduction

TransCanada is conducting this Cultural and Historic Resources Study (ILP Study 33) of the Wilder, Bellows Falls and Vernon Projects to assist FERC in complying with Section 106 of the National Historic Preservation Act, as amended and its implementing regulations (36 C.F.R. § 800). The study includes the following tasks:

- Complete consultation with affected Native American Tribes and other interested parties to determine the Area of Potential Effects (APE) for each of the projects;
- Gather 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; and
- Identify the methodology and a 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. The study objectives are to:
- Define the APE for the projects;
- Identify and evaluate historic properties (buildings, sites, structures, objects, and TCPs) that are listed or eligible for listing in the National Register within the APE; and
- Assess the potential effects of the projects on historic properties and resolve any potential adverse effects through the development of Programmatic Agreements.

The work is being conducted within the framework of the Section 106 process and in close coordination with the consulting parties. The RSP for this study was approved without modification in FERC's September 13, 2013 SPD.

33.2 Study Progress

Recommended APEs for each of the projects were developed through consultation among FERC and the Vermont and New Hampshire State Historic Preservation Offices during meetings conducted in the summer of 2013. The RSP for this study defines the recommended APEs as all land within the FERC project boundaries owned in fee simple by TransCanada and 10 meters (33 feet) of land inland from the top of bank in areas along the Connecticut River and affected portions of tributaries where TransCanada holds flowage rights.

On May 14, 2014, TransCanada sent letters to the Narragansett Indian Tribal Historic Preservation Officer (NITHPO) and The Nolumbeka Project, Inc.

(Nolumbeka), to request a meeting to discuss their participation in the TCP Study and archaeological investigations. After no response was received, TransCanada sent a follow-up communication on July 11, 2014, reiterating its request to meet with the NITHPO and Nolumbeka, and informing them that the archaeological investigations would commence. Copies of correspondence were included in Volume I, Appendix A of the ISR. TransCanada again sent request letters to the HITHPO and Nolumbeka on December 23, 2014 (filed with FERC as part of the Phase 1A Archaeological Reconnaissance Survey Update – Vernon). To date, there has been no response from the NITHPO or Nolumbeka.

The following is an update on the status of the investigations.

- Vernon Project 2013 Monitoring Program/Update of Phase 1A Archaeological Reconnaissance Survey Report:
    - The final report was submitted to FERC, VTSHPO, NHSHPO, Nolumbeka Project, and Narragansett THPO on December 23, 2014.
    - The NHSHPO agreed with TransCanada's recommendations for Phase IB survey in New Hampshire on February 23, 2015.
    - No response to the report was received from the VTSHPO within the allotted review time, so agreement with recommendations for proposed Phase 1B testing was assumed.
    - No comments from any other party were received.
- Phase IB Archaeological Identification Surveys – Wilder, Bellows Falls, and Vernon Projects:
    - Fieldwork on TransCanada fee-owned land has been completed.
    - All private property owners where Phase IB survey was proposed have been contacted by TransCanada and approximately 60 percent granted permission to conduct testing.
    - About 75 percent of the Phase IB testing has been completed on lands where permissions have been granted.
- Historic Architectural Resources National Register Evaluation:
    - The report was submitted to FERC, NHSHPO, and VTSHPO on May 25, 2015.
    - NHSHPO requested the report be provided in its Project Area Form format on June 29, 2015 and TransCanada submitted Project Area Forms for the Wilder, Bellows Falls, and Vernon Projects to the NHDHR on July 30, 2015.
- Traditional Cultural Properties (TCP) Identification Survey:

- o Background archival ethnographic material has been gathered and continues based on new information provided as part of the archaeological and historic properties surveys.
- o No meeting with NITHPO and Nolumbeka has been held due to a lack of response to TransCanada's invitations and solicitations to participate in this study. As a result, Tribal consultation and interviews have not been conducted at this time.
- o A TCP report is being prepared that will include categories of historic properties that could be considered TCPs including place names, resource collection areas, places associated with significant persons, and the like.

33.3 Remaining Activities

The Phase II Archaeological Site Evaluations for the Vernon, Bellows Falls, and Wilder Projects are scheduled to be conducted during the fall of 2015.

The TCP report will be finalized during fall and winter of 2015/2016

33.4 Study Results to Date

The Historic Architectural Resources evaluation resulted in recommendations that the hydroelectric power-related resources at Wilder, Bellows Falls, and Vernon are eligible for listing in the National Register as historic districts. Concurrence is pending from FERC, NHSHPO, and VTSHPO at this time.

33.5 Variance from Study Plan and Schedule

The schedule for completion of the cultural resource investigations is at variance with the RSP schedule due to prolonged Tribal consultation efforts, and ongoing negotiations with private landowners to access their lands in order to conduct Phase 1B archaeological investigations.

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APPENDIX A

Consultation Record

Meeting notes and copies of consultation communications for the studies below are included in the following pages, except where noted.

Date	Studies	Consultation
11/20/2014	22	FERC technical meeting on the use of hydroacoustics at Vernon (not included here, transcripts are available on the FERC elibrary)
12/17/2014	Aquatics studies 10, 11, 12, 14, 15, 16	Proposed study site selection meeting notes (see Revised SSRs in Vol. II of this USR)
12/23/2014	33	TransCanada additional letter request to Tribe and Nolumbeka for participation in TCP identification survey
02/10/2015	Aquatics studies 6, 9, 10, 11, 12, 14, 15, 16, 18, 19, 21, 22	Meeting notes covering Study 6 site selection and Sampling & Analysis Plan; Study 9 HSC and Sumner Falls Demonstration Flows (see also Appendix B), revised site selection reports for fisheries studies, and study planning for 2015.
03/05/2015	24	Meeting notes of proposal to develop Dwarf Wedgemussel HSI criteria and Delphi approach.
05/18/2015	25	Proposed odonates site selection meeting notes (see SSR in Vol. II of this USR)
06/26/2015 and 06/30/2015	6	Email requesting study modification and agency response.
07/14/2015	All studies	Meeting notes and presentation for stakeholder update on all ILP studies.
07/20/2015	4	Meeting notes and presentation for Study 4 discussing velocity transects and model calibration
08/27/2015	18	Meeting notes and presentation for Study 18, requesting study plan modification.
Various	19	American Eel importation (see Appendix C)

TransCanada Relicensing – Aquatics Working Group
Site Selection Consultation Meeting Notes
White River Junction, VT – December 17, 2014

Attendees:

Melissa Grader	FWS	Brandon Cherry (on phone)	FERC
Ken Sprankle	FWS	Steve Kartalia (on phone)	FERC
Eric Davis	VANR	Norm Sims	AMC
Lael Will	VANR	Tom Christopher	NE Flow
Rod Wentworth	VANR	Jason George	Gomez & Sullivan
Jeff Crocker	VANR	John Ragonese	TC
Owen David	NHDES	Jen Griffin	TC
Gabe Gries	NHDFW	Rick Simmons	Normandeau
David Deen	CRWC	Drew Trested	Normandeau
Katie Kennedy	TNC	Mark Allen (on phone)	Normandeau
Bob Nasdor (on phone)	American Whitewater	Maryalice Fischer	Normandeau

The purpose of the meeting was to review and discuss TC's proposed study site selection reports (SSRs) for six aquatics studies to be conducted in 2015. Action items from the meeting follow the meeting notes below.

Study 10 – Fish Assemblage Study

Drew Trested provided a summary of the site selection process which followed Revised Study Plan (RSP). Random sites selected for spring, summer, fall separately, and east or west bank random selection.

Gabe: It doesn't seem like there are many setbacks/backwaters in the final list.
Drew: The approach didn't specify for backwaters, but those that occur within the selected sites are identified in the SSR.

Lael: In a 500-m section w/ tributary entering, you will go into the tributary to sample?
Drew: Yes, within the project-affected area.

Gabe: In those particular (trib) sections, you aren't sampling in the mainstem?
Drew: We will sample the mainstem and the trib/backwater. Those sites were kept as separate samples from the mainstem sites.

Katie: For each segment, you will sample the whole area?
Drew: Yes
Katie: e.g., boulder habitat, you are really sampling all habitats?
Drew: Yes and no segments were dominated by boulder, but within that portion of the segment, our goal is to have one electrofish and one net-based sample.

Lael: The SSR mentioned quartiles by habitat type. You will note the actual habitat?
Drew: Yes, and "boulder" includes rip rap too.

Gabe: How far up a trib will you go, based on project influence in each location?
Drew: From the confluence to the upper bound of the project influence. We used impoundment bathymetry and LiDAR to set that upper bound, preliminarily.

John: In impoundments, you will use actual based on what you see, not the static elevation (e.g., 385 ft at Wilder)?
Drew: Yes, and we will mark positions in the field.
John: We don't know yet how far into a trib we can go, given boats, etc. for most tribs
Drew: We will look to see what overlaps with study 13 sites.

Gabe: It would be nice to have on a map, how far up tribs the project influence goes.
John: For most smaller tribs we don't influence very far up at all, due to steepness at the confluence. We are not surveying up every trib. We have some data points from studies like Study 13, but not all.
Gabe: Given bathymetry data, operations etc. can you do it?
John: Only if there are cross sections at each trib in the HEC-RAS model. Riverine won't have the same level of refinement as impoundments

Lael: How will you know where to stop surveying up at trib?
John: We will physically look at each site and determine the project influence, and will rely on sampling locations and modeling. We will go as far up the trib as we can, where we believe the project has influence. We will not be determining project influence in this study. We will note the extent of our sampling, not the extent of project operations – we won't be able to know that in this study, but the model is designed to do that where we have cross sections in the model.

Melissa: How will you know the extent of project influence?
John: In the field, you can see by observation. There are several issues with tribs – project operations, trib inflow, floods, etc.
Eric: Have you looked, based on field work where the project influence ends?
John: No, we will rely on the models for that. We will go as far up in tribs as we can in the field.
Eric: What about tying water level loggers/elevations?
John: Not all water levels were or will be in tribs so we won't have full data.
Drew: We used the full pond value at the dam (e.g., 385 ft at Wilder), which we recognize is not the same elevation further upstream.
Lael: Just clarify in the SSR on the ground, how you will determine the extent.

Lael: Of the map units selected, some will be sampled in multiple seasons. Based on my work, you get a lot of info if you go out to the same site in different seasons. It would be more informative than random selection by season.
Drew: The RSP specified seasonality, and we followed the RSP.
Katie: The way they sampled in the SSR, they should be able to get at seasonal differences by selecting the same habitats in different seasons. In Wilder, there are only 5 gravel bars, so they are pretty much sampling every season. You're going to get the same species at every habitat type.
Lael: You also have longitudinal differences along the impoundment.
John: The RSP is approved and we're trying to stick with that. I think we did take the right approach. Lael may be focusing on seasonal differences at one site, versus an overall assemblage.
Katie: It is more important to get broader picture than to understand the seasonal differences at one site.
Lael: Within a season, you may have different environmental variables, and operational differences.
John: There are no operational differences – spring high flows are not operational.

Katie: You should be able to get to Lael's interest via the data being collected.

David: Will the seasonal analysis be done – variability by season?
Drew: Yes, that will be included as part of the analysis.

Lael: On Table 3.1-2 (and similar tables in the SSR), please include the % composition of whole, and acres, rather than just acres (like in table 3.1-1).
Lael: Unknown substrate areas weren't included, nor Sumner Falls?
Drew: Correct.
Lael: Please add dominant substrate, to Table 4.1 where you have seasons, need summary of total number of dominant habitats by season.

Lael: Benthic trawling got dropped in study 12, and you were going to use that in this study? Now, not targeting deeper habitats?
Drew: We will use experimental gill nets with different mesh sizes to get at deeper habitats. For study 12, we will mostly use snorkel/SCUBA focused on darters/mussels.
Melissa: You are supposed to be sampling all habitats.
Drew: We will be sampling with gill nets, and can look at specific bathymetry in selected sites, maybe 10-12 feet, so 8-foot panel in gill net will get most of the habitat.

Ken: FWS uses downstream direction of electrofishing. RSP says upstream direction, agencies generally go downstream to increase the collection.
Rick: We can go either way, but going upstream gives you better control over the boat.
Ken: Using a serpentine or direct line?
Drew: We will follow the shore contour.

<u>Study 11 – American Eel Survey</u>

Drew Trested provided a summary of the site selection process which followed the RSP. The study excludes tailraces and bypassed reach (which are included in Study 18). There is no habitat component. About ¼ of the shoreline mileage in each reach will be surveyed. Mainstem sites were selected with a random sample bank, plus some of the major tribs (3-6 stream order), based on eel preference. Reach length in tribs is listed, but is not based on any actual project-influence extent. Like study 10, we will observe extent of project influence in tribs in the field.

Gabe: 24-hr eel pot is a standard approach?
Drew: Yes, it is what we've used in other studies.

Ken: From a management standpoint, we want to get data close to the dams. May want more direct sampling e.g., below Bellows Falls.
Drew: Study 18 will focus on those areas.
John: In this study, we have 3 sites below BF dam.
Rick: Study 18 will have eel pots, marking of eels, and temporary eel trap passes.
Jen: With a minimum of 10 traps.
Drew: We could easily shift one or two of these sites closer to the dams.
Katie: Move each upper-most polygon up closer to dams.

Gabe: How deep will the eel pots be? You can find them in deeper spots especially below Vernon. Electroshocking may not get at them. Will they be accessible in shallower water?

Melissa: Chesapeake Bay study – eels very attracted to eel pots, so they don't need to be located directly where the eels are. Eel pot collections will be a valuable part of the study.
Norm: What about bypassed reach?
Drew: The bypassed reach is included in study 18.

David: The West River not included.
Drew: If there are tribs people would like, in lieu of those randomly selected we can swap them out.
Lael: VANR submitted a table to FERC of where have been collected by VANR. Doesn't have coordinates, just points for all of Vermont. [Lael provided this table to TC who passed it on to the Aquatics working group] Based on that, this study should include White River, West River. There is a higher probability of finding them if you go where they've been seen before.
Gabe: Whetstone brook? There is a barrier there.
Lael: VT side – add White River, remove Jabes Hackett brook. Add Retreat Meadows/West River, Whetstone brook. Remove Ash Swamp brook and "unnamed V5.04T"
Gabe: NH side - add Sugar River, remove Mill Brook VT which is just across the river. Remove Sackett's brook and replace with Partridge brook.

Ken: Would like information on size distribution, relative abundance for management decisions.
Katie: Abundance will be biased high, if you look where you know they are, rather than using randomized surveys.
Ken: Downstream of Vernon and BF, want to have data below each that is the same, e.g. methods.
John: That Vernon data might be being collected by FirstLight.
Jason: No, FL is not doing an eel survey.
Jen: Ken seems to want to add one 500-meter map unit/sample site below Vernon.
John: We can add that just outside/downstream of Study 18 study area.

John: Question to FERC, will this need a study plan modification for adding the site?
Brandon/Steve K – No, just keep Steve K in the loop on any other changes.

<u>Study 12 – Tessellated Darter Survey</u>

Drew Trested provided a summary of the site selection process which followed the RSP. Same approach as Study 10, habitat based with the same set of 500-m map units. The RSP specified the number of sites, stratified by % of available habitat, with 3 samples within each unit. We randomly selected whether to start at the upstream or downstream end of each unit. We will verify in field that the habitat exists. 3 cross sections in each unit, with 5 points. We will look at mussels, bottom type, WQ, etc. per the RSP. We hope to use one technique - visual survey technique, but may also use backpack electrofish if needed.

Melissa: The RSP identified several methods.
Drew: We feel that we can use SCUBA/snorkel.

Lael: Are you going into tribs?

Drew: The RSP specified mainstem only.
Lael: Random map unit, randomly placed 3 transects within each. Some transects seem squished together, could just divide map unit into 3 equally spaced transects.

Melissa: In some recent studies, there was a preference of darters for habitat heterogeneity, e.g. island complexes. No map units are located w/in an island area. Trade out some – e.g., one per reach?
Katie: This is reasonable, as there are not very many island complexes. If island is equivalent to gravel/cobble then switch one out with the closest one with same habitat/substrate.

Melissa: For example, in Wilder riverine there are at least 2 and in BF impoundment, even more. Select one island in each reach. Vernon already has an island included. BF riverine looks okay (BR-019), has one island selected. Wilder riverine looks okay, has one selected. Wilder impoundment – needs one selected - W-073 has island downstream. BF impoundment – add Jarvis Island. Vernon impoundment V089, backwater area NH side just upstream of VY – just shift transects a little. Retreat Meadows, Rt 119 bridge. Move V-079 and V-080, move one of those.
Drew: We will also more evenly distribute within the map unit for the ones needing it, and then verify that the habitat is there in new sites and within map unit transects.
Katie: Vernon riverine, will you survey across the whole river, e.g., not just one side channel?
Drew: We'd do the whole river width.
Gabe: There is nice cobble in the side channel.
Katie: You should consider as if Stebbins Island isn't there for purposes of transects.

<u>Study 14 – Resident Fish Spawning in Impoundments</u>
Mark Allen summarized the general approach to Studies 14 and 15. Spawning habitat is more restrictive than rearing habitat with more clumped distribution. We started with known information, literature review, and observations from 2013 and 2014. We still incorporate randomization as much as possible, narrowed to the most likely spawning habitat. We identified "species groups" based on spawning characteristics/habitats among some species. Deeper water is more difficult to find spawning behavior within, and deeper water won't be so influenced by project operations.

Gabe: Smallmouth bass should be included in the tributary late spring species rather than backwater species. If you see one in backwater, you should still collect the data but typically we see smallmouth in tributary gravel.
David – Smallmouth prefer moving water rather than still water.
Mark: Suggests looking outside heavy moving water, but looking at trib mouths.

Ken: For backwater sites, what methods will be used to examine the larger areas? We want consistency in coverage. For instance, 250-acre backwater in Vernon impoundment is very large.
Rick: Pickerel and pike spawn in shallower areas, and there are several methods included in the SSR. Once we find fish we will look for eggs, etc. and note the depth. Are those backwater species where found, can we determine that they spawned? We can assume that they spawned there if we see adults. We would be looking for pre-spawn fish, using backpack shockers or other methods. Mark had suggested using a drone, as we will struggle with finding pickerel and pike. We need to go in quietly, no motor boat. This will be easier for nesting species.

Ken: So for some setbacks, there will be marshy emergent vegetation – how will you deal with that?
Rick: We struggled with that, in smaller spots we may not find any fish. In larger areas, we have more chance to find them, as well as multiple species. That is why we weighed heavier for larger backwater areas.
Ken: A smaller area can be covered more thoroughly than a larger area. How to make it apples to apples with other areas?
Rick: We know that the water fluctuation will be the same over the backwater, so once we find some fish, we'll follow them. We can extrapolate across the larger area. It is based more on longitudinal location and water fluctuation.
Mark: That 250 acre site is an outlier. Some of the other backwaters may be too deep for visual observation. Likely much of the 250 acres would also be too deep.
John: Which site is the 250 acres?
Mark: VB-050 on the NH side just upstream of VY.

Lael: Are you going into Retreat Meadows/West River (VB-039)?
Rick: Yes. We tried to select backwaters that will fluctuate with the river (without a culvert pinch area), many sites, need to get in quickly with boats, etc.

JR: Let's go through each site to make sure people are okay with them [reviewing GoogleEarth sites].
Mark: Most backwaters are associated with tributaries.

Melissa (?): WB-016 shows on GoogleEarth at the lower end, but could move that site marker up to the upper end. And make sure it includes the Waits River.

Gabe: General comment – understands rationale for backwaters, RSP includes all of impoundments, but this SSR includes only tribs and backwaters.
Mark: We were motivated by how to focus on places where we might see spawning. Unlike nesting fish (appropriate for rearing fish), broadcast spawning fish will be more clumped based on specific habitat.
Gabe: It makes it seem like fish aren't spawning in the mainstem.
John: Which species?
Gabe: Some smallmouth, fallfish, yellow perch, pike and pickerel may.
Katie: There should be nest builders on the mainstem shorelines.
John: Valid point, is there a way we could keep the logistics somewhat controlled as well as the success controlled, where you go into backwaters/tribs and find spawning, do you just go outside into the mainstem?
Gabe/Ken: There would be a spawning delay based on temperature.
Rick: Impoundments are mostly sand/silt but if people have sites in mind, we could look at those. We're not saying fish don't spawn in impoundments, we are just trying to deal with logistics over the large area.
John: What is the goal? Distribution survey or evaluation of project impacts? We may not be capturing the whole picture.
Rick: We could select large cobble/gravel bars in the mainstem.
Gabe: You could see perch, etc. and slow moving shorelines could have largemouth nesting late.
Mark: Another option – if fish are observed nesting in the survey studies, we could swap out sites.
John: There is a lot of variability based on latitude, temperature.

Rick: We can reselect for smallmouth, as they will tend to go to trib mouths. We don't have to be in the mainstem to find them, just want to capture the river fluctuations.
Melissa: On the Housatonic River, a systematic shoreline survey was used to get at dewatering only, not other spawning/behavior.
Mark: What if we add some shoreline areas near trib mouths?
John: That might not be enough.
Gabe: We want to know if spawning is occurring on shorelines of impoundments.

Lael: For trib sites, you eliminated stream orders 1-3, but they can be productive, and more sensitive to flow fluctuations than larger, deeper streams.
Mark: Keep in mind that fish will be in gravel/cobble which would be smaller areas in smaller tribs and would limit data collection.
Lael: The goal is to determine project impacts,
John: Only going up into tribs as far as the project influence
Rick: If there is habitat, we will go up into the tribs. This is also species dependent (egg blocks vs. visual observations in shallower areas).
John: Small impoundment tribs are not likely to be depositing much cobble/gravel so not much habitat will be there.
Gabe: At the Rt 123 bridge, a large gravel bar has spawning habitat for smaller size brook.
John: that is in the riverine study (study 15). We want to focus more in impoundments on where the habitat exists, e.g., nearby trib mouths and backwaters. The primary impact that would be likely is flow fluctuation.
Katie: It depends on timing of flow fluctuations. An impact could also be a change in velocity, not just fluctuation.
Lael: Would like for smaller stream orders to be included. Oxygen interface, shallow but not too shallow. If you are only focusing on deeper habitats, you not capturing where fish may be spawning.
John: How does the RSP address these questions?
Mark: The RSP defines large streams as stream order 4 -6. If we just randomly select a stream order 1 stream, it will likely be a waste of effort, since we may not find anything at all if it's intermittent.

Rick: Lael, do you also want to include intermittent streams?
John: What will change is velocity, water level, and depth of water in the stream. We are not looking at streams themselves.
Melissa: An intermittent stream could have water during spawning season and be influenced by the projects
Katie: What about using 2nd order and higher?
John: Most spawning is probably occurring in larger streams based on habitat.
Eric: This study is not trying to get to magnitude of spawning.
Lael: Smaller tribs in the project area may still be wet and fish may be attracted there to spawn. You are not capturing the breadth of different habitat types by eliminating small tribs.
John: How to distribute across stream orders?
Rick: Lael indicated weigh toward larger streams.
Mark: We have 12 total sites, we could pick one from each reach (or maybe 2 in Wilder) and swap out larger streams.
Rod: Do we have the habitat info for smaller tribs?
Rick: We have that information.

Katie: Are there any sand spawners?
Gabe: Spottails are sand spawners.
Mark: Spottails, yes at trib mouths.
John: Let's just add some smaller tribs to the 12 sites.
Lael: Add 2nd and 3rd order.
Mark: We should look at habitat first to make sure it is there, then do selection.
Katie: You also want to eliminate confounding factors (obstructions etc).
Mark: So we will add 2 in Wilder, and 1 each in BF and Vernon?
Group: Yes.

Gabe: The SSR says 4 tribs in Vernon section, but only 3 were selected.
Mark: 4th was added in Bellows Falls, not Vernon. This is a typo in SSR and we will fix that.
John: We will look at habitat in mainstem area and see if there is potential for spawning, near tribs.
Mark: Yes, we can tie mainstem areas in with trib mouths, for bass.
Group: Agree to do that.

After the meeting TC received an email request from Gabe (attached) requesting that spottail shiner be added to the list of backwater species in addition to it as a tributary species.

<u>Study 15 – Resident Fish Spawning in Riverine Sections</u>

Mark summarized the SSR. Four target species, early spring vs. later spring spawners. We have existing information for walleye, and know they accumulate below dams. The study focuses on riffle habitat, and we selected the first riffle below dam as sites. There isn't really a riffle below Vernon, but below the first island is a run that comes out of dam plunge pool is a likely site. We have 12 sites total, others based on riffle size (more likely to observe spawning in larger riffles), distributed by length of reach. Also, at the riffle below Sumner Falls, at the lower end we could put egg blocks just below the whitewater area where it would be safe to do so.

Rod: That might also work further upstream at Sumner Falls,
Mark: We could look at it, but work there is based on safety.
Rod: Below Wilder dam there are some transects for Study 9.
Mark: We did not see riffle there during transect selection for study 9, but during field work we did see some riffle-like area. So we included that site (WR-002) in study.
John: People fish there for walleye.

Rod: Walleye use fist-sized cobble more than gravel.
Mark: We did underwater video just upstream, it is not all bedrock – there is a variety of substrate types.
Lael: Clarification: The RSP says shallow water shoal habitat is prioritized over deeper water areas. Is that w/in the site? It doesn't seem like sites were selected based on that criterion.
Mark: The riffles tend to be the shallower areas and dominated by gravel/cobble. This is consistent with the RSP, except the first one below Wilder which is a little different, but closest to the dam.

Gabe: Why in this study are areas > 10 ft excluded, and in study 14 impoundments > 5 ft are excluded?
Mark: Riverine sections fluctuate more than impoundments.

Rick: Some of that info is from the water level logger data. We will have egg blocks strung out in shallow to deeper water. Some of these fish spawn early, at ice out.
John: This is during high water and spill, not project operations.
Gabe: Can go into late April, early May.

Mark: In the BF reach, only one site is classified as riffle. We added a large gravel/cobble bar at the mouth of the Cold River; and a 3rd site at the base of BF bypass reach. In spring, most of the reach won't be safe to sample, but this site would be representative of the bypass and influenced by it.
Gabe: The VT side by Mill St. has walleye, steeper bank, more steady flow, NH side is sandier. If you are not finding much at the point, you could look there too.
John: Depends on whether BF is spilling or not.
Lael: The VT side will be influenced by project operations more than spill.
Melissa: Let's move the bypass location and put it on the VT side.

Mark: In the Vernon reach, only 1 small raffle in side channel, that does get dewatered.
Gabe: What is the substrate in that side channel?
Mark: General description is gravel/cobble.
Gabe: Reported only catching walleye during like 60,000 cfs (spill) when the side channel is flooded. Worth a try there, but…
Mark: Do you want to keep that side channel or swap it out?
Ken: The side channel might be good for white suckers, but not walleye.
John: At the head of Stebbins?
Mark: We've seen lamprey nests at the head and at the VT side bar at the lower end of Stebbins. They are classified as runs not riffle. We could move the side channel down to the head of Stebbins. The side channel is affected a lot by changes in flow.
Rod: Agree, whether or not it is spawning habitat, it could be velocity refuge.
John: In high flows, not so much velocity refuge.
Mark: There are also study 9 transects in that side channel.
Rick: We could just look around below Vernon. If we don't find them from egg blocks, then we will have to move them around anyway. Setting egg blocks shallow to look for dewatering under low flow.
Lael: There could also be behavioral impacts based on velocity vs. just depth itself. For instance nest abandonment.

Mark: We focused on island complexes (after locations where we had observations) which have more diverse habitat than main river. Heads of islands have gravel/cobble bars and we've seen fallfish nests here. Random selection was based on perimeter of island complex, weighted to larger complexes.
Gabe: Is there any bias against smallmouth bass if observed sites were based on location of fallfish?
Mark: That's why we clumped species into spawning groups. Most sites are islands with eddy habitat for bass. You are not as likely to see bass nests where fallfish nests are.

Mark: In BF, there are only 2 islands and we wanted a 3rd site, so we picked the point between the bypassed reach and tailrace. That might have eddy habitat with firmer substrate.
Gabe: That spot gets pretty deep, 10+ ft. not great habitat.
Mark: Suggest another?
Gabe: Bar just below Saxtons River, VT side

Mark: We'd survey whole bar area and can move BI-001 to this site. This bar could provide fallfish and bass habitat.
Melissa: What if you don't find bass spawning at any site?
Rick: We'll see bass at lower ends of islands.

Study 16 – Sea Lamprey Spawning Assessment

Mark summarized the SSR which used same approach for studies 14 and 15. In impoundment reaches, at selected trib mouths, and in riverine sections, we selected for islands. We will be radio tagging lampreys, and will let them show us where they are spawning. We also know where some sites are based on observations in 2013/2014. We propose that if we find new sites from tagged fish, we would swap one-for-one with randomly selected sites. We eliminated the area above Wilder dam (in RSP). Island areas are pretty much the same as in study 15.

Ken: We want to understand frequency of sampling, initially.
Rick: When we start seeing them come up the Vernon ladder and FL's tagged fish coming up to Vernon. Once we know a number of adults have moved upriver.
Mark: There is likely to be overlap with bass spawning in same areas.
Ken: Lamprey spawn in fast water.
Rick: Our crews will be out every day. We'll have for instance, a Vernon crew on multiple studies, using a plane, etc. Overlap on spawning times, it is really a daily thing, but we are not going to go out until we start seeing adults moving around.
Ken: There is variability of timing. This year, it didn't pick up until June, can be in early May. At Stebbins Island, for instance which ones you are going to monitor? Cross representation or based on shallowness, or what?
Rick: We will use an RTK unit to measure along an area where they are. Lamprey come back to their natal areas. If a tagged fish goes above Wilder, we will follow it.

Lael: Add in a few of the smaller tribs with good habitat. 2 in Bellows, 1 Vernon
Rick: Would those be the first to drop if we find spawning from tags?
Lael: No, swap out similar stream order streams.
Gabe: Would be good also to keep an eye on the Cold River.
Melissa: Within selected tribs, you will survey the whole project-affected trib?
Rick: Yes, once we find them then we will focus on those.
Melissa: What about the Black River?
Rick: If we don't find any at the mouth we will go up as far as we can in a boat, looking at both sides of the stream.
John: I want to make sure this is clear: at the Williams and Black rivers, project influence goes pretty far upstream. At the mouth, habitat would be larger substrate.
Rick: We will go up to where the proper habitat is.

Drew: Would like to discuss radio tag frequencies in RSP 16, which says we'd operate on 20 frequencies. That was based on older manual technology. We'd like to use Sigma 8 tags to align with FL's study and that don't require 20 frequencies. Are there any problems with this?
Ken: No, that's fine.
Lael: VANR has a Lotek receiver (from prior TC smolt studies).

Rick: We will use the same receivers we've used in the past. We can hook up VANR with a receiver if needed, to track outside the project area.

John: TC wants to note that we will be filing for extension on the licenses, of one year. We want enough time for meaningful discussion of project effects, that won't even be ready until early 2016. Would like agency support and will send TC's rationale to agencies.

John: We will also be filing revised SP 22 – juvenile shad that specifies using wild fish, smaller tags, etc.

Maryalice: Summarized upcoming reports and consultation needed.

Aquatics: Proposed timeframe - February 2015

1. Study 6 – Water Quality: Sampling and Analysis Plan, including tributary and upstream site selections to be provided to VANR and NHDES for comment.
2. Study 9 – Habitat Suitability Curves (HSC) available now for working group review. Consultation on HSC and VANR revised Sumner Falls DFA proposal.
3. Study 24 – DWM Phase 2 study report to be provided for comment, and consultation on FWS modified counter proposal.
4. Study 21 – Adult Shad telemetry design changes, if needed, based on USGS study information.
5. Study 22 – Juvenile Shad modified study plan, and turbine selection for survival study.

Terrestrial:

1. Study reports for terrestrial studies (26 – Cobblestone Beetles, 27 – Habitat Mapping, 28 – Fowler's Toad, and 29 – Northeastern Bulrush, will be available for stakeholder review in late January or early February.
2. Study 25 – Dragonfly and Damsel Fly Survey. Proposed site selection (4 of 11 sites) to be provided to the terrestrial working group for comment – by March 2015.

John: We will want to request extension for the Study 24 DWM study report, so as not to write a report if the study isn't done. Propose DWM consultation and Study 9 revised Sumner Falls DFA proposal from VANR, and HSC consultation for January rather than February.

Action Items:

Study 10:

1. Clarify in the SSR, how we will determine the extent of project effects up tributaries – just add some text around that process.
2. Clarify in the SSR, that we will include analysis of seasonal variability.
3. Table 3.1-2 and the other 3.x-2 tables, and Appendix tables, add % contribution of each substrate type rather than just acres.
4. Add dominant substrate, to Table 4.1 - you have seasons, need summary of total number of dominant habitats by season.

Study 11:

1. Move each upper-most polygon below dams, up closer to dams.

2. Add White River (11-WR002T), remove Jabes Hackett Brook (11- B029T)
3. Add Sugar River (11-B002T) and remove the Mill Brook on VT side (11-WR018T)
4. Add West River (11-V040T) and Whetstone Brook (11-V042T), and remove Ash Swamp Brook (11-048T) and unnamed (11-V004T)
5. Remove Sackett's Brook (11-V042T) and replace with Partridge Brook (11-V018T).
6. Add one 500-meter map unit/sample site below Vernon dam, just outside/downstream of the Study 18 study area.

Study 12:

1. Clarify in SSR that we will survey the whole river width.
2. More evenly distribute transects within each map unit where needed, having verified that the selected habitat remains within the transect area.
3. Wilder impoundment: Move 12-W073 to the downstream island area.
4. BF impoundment: Add Jarvis Island
5. Vernon impoundment: 12-V089, shift transects.
6. Vernon impoundment: Move either 12-V079 or 12-V080 up to the Retreat Meadows area (b/t Route 119 and Route 9 bridges).

Study 14:

1. Change SSR to reflect that smallmouth bass should be a tributary/late spring species rather than a backwater species.
2. Correct typos in SSR - 4 tribs in Vernon (should be 3) and 3 tribs in BF (should be 4).
3. Clarify in SSR that we will survey the mainstem areas associated with the tribs too (for bass at least).
4. Move 14-WB-016 site marker up to upper end of backwater, and make sure the site includes the Waits River.
5. Add stream order 2 and 3 tribs with the proper habitat: add 2 in Wilder impoundment, 1 each in BF and Vernon impoundments.
6. After the meeting and at the request of Gabe: Add spottail shiner as a backwater species in addition to tributary species; and add Jarvis Island based on early comments from Gabe. Jarvis had not been included originally since the habitat didn't meet the criteria.

Study 15:

1. Clarify in SSR about survey approach to be used below Vernon. Move VR-006 to another location, likely around Stebbins Island if no eggs are found. Move 15-BR bypass site over to VT side of river.
2. Move 15-BI-001 to the bar just below Saxtons River (VT side) and survey the whole bar.

Study 16:

1. Add stream order 2 and 3 tribs with proper habitat: 2 in Bellows and 1 in Vernon.
2. Clarify in SSR that we will swap sites with observed/tracked fish one-for-one by similar stream order.

From:	Maryalice Fischer
To:	Maryalice Fischer
Subject:	FW: Habitat Suitability Curves
Date:	Tuesday, January 06, 2015 1:16:05 PM

-----Original Message-----
From: Gries, Gabriel [mailto:Gabriel.Gries@wildlife.nh.gov]
Sent: Friday, December 19, 2014 8:27 AM
To: Jennifer Griffin
Subject: RE: Habitat Suitability Curves

Hi Jen,

I forgot to mention this at the meeting, but if no one disagrees I would like to add spottail shiner to the backwater/setback spawner list for study 14 (spottails would be in both backwater and tributary confluence spawner list). Could you forward this on the John and Rick and Drew for review as I still don't have my computer back and don't have my contact list.

Thank you,

Gabe

US Northeast Hydro Region
Concord Hydro Office
4 Park Street, Suite 402
Concord NH 03301-6373

tel 603.225.5528
fax 603.225.3260
web www.transcanada.com

December 23, 2014

VIA FEDEX
John Brown, Tribal Historic Preservation Officer
Narragansett Indian Tribe
4425-A South County Trail
Charlestown, RI 02813

Re: TransCanada Hydro Northeast Inc.'s Revised Study Plan, Project Nos. 1892-026, 1855-045, and 1904-073 – Phase IA Archaeological Reconnaissance Survey Update, Vernon Hydroelectric Project (1904-073)

Dear Mr. Brown:

TransCanada Hydro Northeast Inc. ("TransCanada") is the owner and licensee of the Wilder Hydroelectric Project (FERC No. 1892), the Bellows Falls Hydroelectric Project (FERC No. 1855), and the Vernon Hydroelectric Project (FERC No. 1904). The current licenses for these projects each expire on April 30, 2018. On October 31, 2012, TransCanada initiated the Integrated Licensing Process by filing with the Federal Energy Regulatory Commission ("FERC" or "Commission") its Notice of Intent to seek new licenses for each project, along with a separate Pre-Application Document for each project.

TransCanada submitted its Revised Study Plan for the three projects, as required by 18 C.F.R. §5.13(a) on August 14, 2013 and in accordance with Revised Study 33-Cultural and Historic Resources Study, enclosed please find the report entitled *Phase IA Archaeological Reconnaissance Survey Update, Vernon Hydroelectric Project (FERC Project No. 1904-073), Windham County, Vermont, and Cheshire County, New Hampshire*, for review and comment. Also, we would like to again request your participation in the Traditional Cultural Properties (TCP) identification survey being undertaken for the Wilder, Bellows Falls, and Vernon hydroelectric projects as part of Revised Study 33. Please contact me at your earliest convenience to set up a meeting with our TCP consultant.

If there are any questions regarding the information provided in this filing or the process, please contact John Ragonese at 603-498-2851 or by emailing john_ragonese@transcanada.com.

Sincerely,

John L. Ragonese
FERC License Manager

Enclosure: Technical Report, Phase IA Archaeological Reconnaissance Survey Update, Vernon Hydroelectric Project (FERC Project No. 1904-073)

Cc: Kimberly D. Bose, Secretary, FERC (w/o encl.)
Joseph Graveline, President, The Nolumbeka Project Inc. (w/o encl.)
Laura Trieschmann, VT SHPO (w/o encl.)
Elizabeth H. Muzzey, NH SHPO (w/o encl.)

US Northeast Hydro Region
Concord Hydro Office
4 Park Street, Suite 402
Concord NH 03301-6373

tel 603.225.5528
fax 603.225.3260
web www.transcanada.com

December 23, 2014

VIA FEDEX
Joseph Graveline, President
The Nolumbeka Project Inc.
88 Columbus Avenue
Greenfield, MA 01301

Re: TransCanada Hydro Northeast Inc.'s Revised Study Plan, Project Nos. 1892-026, 1855-045, and 1904-073 – Phase IA Archaeological Reconnaissance Survey Update, Vernon Hydroelectric Project (1904-073)

Dear Mr. Graveline:

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Cc: Kimberly D. Bose, Secretary, FERC (w/o encl.)
John Brown, Narragansett THPO (w/o encl.)
Laura Trieschmann, VT SHPO (w/o encl.)
Elizabeth H. Muzzey, NH SHPO (w/o encl.)

TransCanada Hydro Northeast Inc.
Aquatics Working Group Consultation Meeting – February 10, 2015
Meeting Notes

Meeting Date/Time: February 10, 2015; 9:00 AM
Web-Ex/Phone Info:
Call-in toll-free number (US/Canada): 1-866-469-3239
Meeting Number: 921 749 400
To join the online meeting, go to: Join WebEx meeting

Attendees:

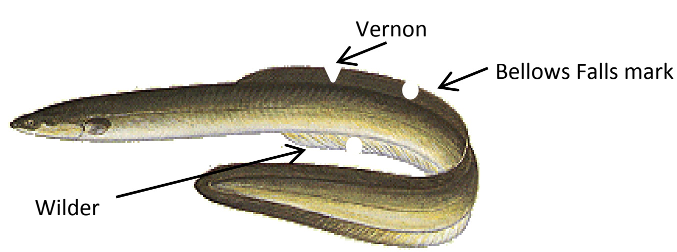
Melissa Grader	FWS	Bill Connelly	FERC
Ken Sprankle	FWS	Steve Kartalia	FERC
John Warner	FWS	Nick Ettema	FERC
Eric Davis	VANR	John Baummer	FERC
Lael Will	VANR	Bob Nasdor	American Whitewater
Rod Wentworth	VANR	Rick Simmons	Normandeau
Owen David	NHDES	Drew Trested	Normandeau
Gabe Gries	NHFGD	Mark Allen	Normandeau
Garret Graaskamp	NHFGD	Maryalice Fischer	Normandeau
Matt Carpenter	NHFGD	Steve Leach	Normandeau
Katie Kennedy	TNC	Doug Royer	Normandeau
Jim McClammer	CRJC	Steve Eggers	Normandeau
John Ragonese	TC	Chris Gurshin	Normandeau
Jen Griffin	TC	Bernward Hay	LBG
Shawn Keniston	TC	Matt Burak	LBG

Action Items from the meeting (as discussed in notes below):

Study	Lead/Tasks	Status as of March 30, 2015
Study 6 – WQ	NHDES and VANR: provide comments on Sampling & Analysis plan by March 1.	NHDES comments received 03/23/15
Study 6 – WQ	Maryalice/Bernward: Put study sites geodata online. Provide the summary Excel table that was presented in the call and put that online too.	Geodata posted to TC secure website 02/11/15 Excel table posted to TC secure website 02/17/15, and attached herein following meeting notes.
Study 9 – Instream Flow	VANR - R. Wentworth: lead agency coordination and get back to TC on comments on HSC curves.	Nothing received from VANR as of 03/30/15
Study 9 – Instream Flow	Steve E/Mark A: Write up a narrative of the Sumner Falls observation/ identification approach ideally to locate transects for low flow measurements.	Sumner Falls approach document attached herein following meeting notes.

Study	Lead/Tasks	Status as of March 30, 2015
Study 18 – Eel Upstream Passage	Rick: provide eel fin clipping protocol (1 type for Vernon, 1 type for Bellows Falls.	See image below: All eels will be examined for existing fin clips, all un-marked (> 1 g wet weight) eels will be marked with a site-specific fin clip using a 'V' punch and a standard hole punch: Vernon = 'V' punch in dorsal fin; Bellows Falls = circle punch in dorsal fin; Wilder = circle punch in anal fin.
Study 19 – Eel Downstream Passage	Steve L: Provide eel collection and health guidelines. TC to set up a call about this.	VTDFW discussion topics document received 03/25/15 (attached herein following meeting notes). Draft guideline under internal review. Newer issues include possibility of obtaining eels from Newfoundland (KA is leading).
Studies 21 – Adult Shad and 22 – Juvenile Shad	Doug R/Steve L: Relocate upstream VY receiver closer downstream to Vernon Forebay	Revised Figure from Study 21 Plan attached herein following meeting notes. Receiver will be located at the forebay and used for both studies.
Study 22 – Juvenile Shad	Doug R: Contact FirstLight consultants about total number of HiZ tagged hatchery fish needed for both TC and FL studies and get to Ken Sprankle.	Information emailed to Ken S. In total, 2,500 juvenile hatchery shad > 120 mm will be needed.
Studies 10, 11, 12, 14, 15, 16	Maryalice: Repost final versions of SSRs (clean versions) and correct Study 12 SSR table typo that Lael pointed out (acres).	SSRs reposted on TC secure website 02/17/15 and correction made to Study 12 SSR report table (SSR attachment - Excel table of substrate calculations was correct).

Study 18: Fin Clipping Protocol



Meeting Notes:

1. Normandeau staff summarized changes to the 2015 studies Site Selection Reports (SSRs) in accordance with the December 17, 2014 consultation meeting. Revised SSRs had been provided to the working group in marked up versions.

   - **Study 10 – Fish Assemblage**
     Lael: p 5, misclassification of substrate
     Drew: in that one reach, the data column was off so we corrected and re-ran it. Boulder habitat is still boulder/riprap.
     Lael: question about stream order -99
     Drew: that is the code provided, it likely means a seasonal stream, less than stream order 1.
     No further changes, SSR accepted.

   - **Study 11 – American Eel Survey**
     No questions/comments - accepted

   - **Study 12 – Tessellated Darter Survey**
     Lael: page 25 of the SSR – and Excel spreadsheet Vernon-76 says 33.6 acres in SSR, spreadsheet says 18 acres.
     Drew: We will double check that [note: it was a typo in the SSR which has been updated in the final version. The Excel spreadsheet was correct].
     No further changes, SSR accepted.

   - **Study 14 – Resident Fish Spawning in Impoundments Study**
     No questions/comments, SSR accepted.

   - **Study 15 – Resident Fish Spawning in Riverine Sections Study**
     No questions/comments, SSR accepted.

   - **Study 16 – Sea Lamprey Spawning Assessment**
     No questions/comments, SSR accepted.

2. **Study 18 – American Eel Upstream Passage Assessment (15 min)**
   - Juvenile eel marking – discuss possible methods other than elastomer tags
     Rick – described elastomer tag methods and issues - with low numbers of eels, marking material will dry out in the tube. We would like to do fin clipping instead.
     Lael: to make sure not double-counting fish?
     Rick: yes.
     Ken: makes sense as long as they are large enough.
     Lael: How would you discriminate individual eels that pass multiple dams?
     John R: It is not part of the study to look at that.

Gabe: You could do multiple clips, one at each dam.
John R: we will try to have an identifier in the clipping protocol to distinguish b/t dams
Rick: We could do a V for Vernon, half-circle for Bellows Falls, etc.

3. Study 19 – American Eel Downstream Passage Assessment (15 min)

- Discussion of the number of eels required for both TransCanada and FirstLight studies and collection locations including out of basin

Doug: We are pursuing how/where to get enough eels for both TC and FL. Combined, we need about 935 adult silver eels. Looking at out of basin, Maine and Delaware suppliers feel they can provide a substantial number of eels (likely enough, but there may be environmental variables that come into play).

John R: Would like 1 common pathology testing approach b/t NH, VT and MA. Trying to avoid holding aspect by certifying eel health in their own basin, maybe do something in advance.

Steve L: similar to what Ken S has done with shad in CT River, assess before transport, rather than collect all eels, sample for pathology and hold for 30 days.
Lael: Adam Miller VANR is the fish culture ops manager. He may not approve this in VT. He sent email to Lael today. His questions are where eels from, and their local pathogens, e.g., swim bladder parasite.

Steve L: We've considered those and are still working on specific pathogens. We do know that some of the Maine sources have been tested.

Lael: Will discuss with Adam, but he will likely want a subsample of fish tested.
Steve L: Based on timing, and in concert with FL, we will have to collect all the fish to be used, then do the 30-day testing. Not sure where we will be seasonal for the study at that point.

John W: That has not been the FWS protocol for shad. The equivalent would be to collect eels very early and then test those, then go collect the rest.

Lael: We should follow broader Northeast protocols.
John W: can we come up with a protocol that all states will accept?

John R: Right, Lael should not have to shuttle the conversation, but with 900+ eels, we're not sure how we will be able to accomplish it with 30-day testing. We will have that conversation.

Lael: you need an importation permit from VT
Gabe: probably for NH too. Has Steve L heard back from Scott Decker yet?
Steve L: No, but Scott passed it along to the pathologist.

Lael: you should draft up something and send to Adam Miller to review.
John W: You should find the Northeast fish health guidelines and address each point as best you can. The original plan laid out Holyoke, and other places. We don't expect 900 eels from Holyoke. If we have to go through protracted holding period and that eats into getting enough eels. Would you still look at Holyoke as a backup plan?
John R: Probably not, we are trying to go down a single path, use a single approach/method.

John W: If it comes out that you need 30 days holding, and if that means you hold for a long time or don't have time to do the studies, you could spread out a smaller number of eels b/t all studies. You will know with 30 days to figure it out.
John R: Prioritizing may be the most rational solution. We can't spend endless effort to go out of basin, wait at Holyoke to collect, etc. The eels are for 2 purposes (survival and route selection). We need to revisit the study plans regardless and identify priority of where fish would go either by project or by study goal. If we can get eels early in the run, we could have enough time for the 30 days holding – if we can take the first fish to the lab, not 1 of every 10, etc. If none of those eels pass pathology tests then we also have a problem. We may still need to allocate b/t studies and locations, including FL studies.
John W: Agree. Should look at the expected pathogens then may want to pull a sample of yellow eels if pathogens are the same to see if that pathogen is in the river, which might reduce the timeline by clearing the waterway so that silver eels can be collected as need.
Ken S: we don't have good data on the CT River population, could get additional information on the CT river pathogens first, since they may already be here. That would then allow imports from other basins.
John R: Test eels from the CT River?
Ken S: FWS would be interested in that baseline data.
Melissa: Could use juvenile fish for samples.
Ken: Those fish would have been in the river for a couple of years.
John R: if FWS can test, we can collect younger eels.

Steve L: Those fish could be collected at Holyoke eel traps.
John R: Would FWS collect/test or expect TC to do that?
Ken S: yes, FWS would collect/test. It needs to be acceptable to VT, NH – e.g., Holyoke rather than farther up-basin eels.
Lael: Adam had brought up that point – re: parasite in CT River eels, would have to discuss with him about it. Not sure about testing yellow eels vs. silver eels that have been in the basin for several years.
John R: Agree – would they be considered the same risk profile?
Lael: How does the testing affect the study? We want to make sure that we aren't affecting the original study plan goals.
Ken S: FWS would do the testing, with 60 fish sample protocol for statistical purposes. Same number used for shad. All 60 would be sacrificed.

John R: The next step then is to identify right personnel – Jason Smith in NH, Adam Miller in VT, and Ken S for a call. Steve L should put together health guidelines and set up call.

John R: If we only get 300 eels that are available/acceptable – what do we do with those eels? The agencies need to give TC a priority perspective on that.
John W: Need to get Mass. involved too. Give the agencies some time to evaluate this issue.

4. Study 21 – American Shad Telemetry Study – Vernon (45 min)

- FWS proposal to collect fat content data from the adult shad collected for this study at Vernon fish ladder (50 fish)
- FWS potential proposal to collected fecundity data on adult shad collected for this study at Vernon fish ladder (50 fish
- Review of telemetry design to address any questions or concerns

Doug: What is expected of TC to support the FWS proposed studies (first 2 bullets above)?
Ken S: The fat study is being funded by FWS conducted by Conte (Steve McCormick) to obtain fat measurements as proxy for energetics.
John R: Isn't FWS doing another study there?
Ken S: No, Conte would like to sample the tagged fish for condition – 20 fish each - early, middle, late run.

Jen G: What about the fecundity proposal (2nd bullet above)?
Ken S: That study has not been funded yet, NOAA study - would remove females for testing, again during early, middle and late run samples.
Gabe: if funded, that wouldn't impact TC studies.
Ken: no, it should not impact the studies.
Steve L: The fecundity study would have no overlap with TC and/or fish to be radio-tagged.
Ken S: correct.
John R: Okay if it only takes a few seconds.
Ken S: is the fish lift at Vernon functional?
John R: We test the fish lift every year when we inspect the fish ladder before operating for the season.

Doug: Described telemetry set up.
Ken: We are interested in both near field/far field. You don't really have a far field design – a single far field receiver that will cover the entire forebay area for when fish first arrive. FL has both in front of Cabot Station.
Doug: is the station upstream of the VY discharge too far upstream?
John R: the one above at the VY location goes back in time on multiple prior studies. We can move it downstream, but we don't want to add an extra one.
Ken S: FWS would support moving it closer to the forebay.

Steve L: So the Vernon forebay only, not the full river width?
Ken S: correct.
Gabe: sounds good
Lael: Yes.
John R: Like FL, we will be doing range testing of receivers etc. to make sure they cover the areas depicted.

[Adjourn for lunch]

5. Study 22 – Downstream Migration of Juvenile American Shad - Vernon (30 min)

- Overview and discussion of TransCanada's revisions to Study 22

John R: Summarized recent changes to Study Plan (SP), filed with FERC.
Ken S: Likes it, question about release site – updated plan says along river wide transect. Can you describe more?
Steve L: 3-5 points across the river, closer to VY discharge structure (rather than farther upstream) and across the river. A group of 20 would be released across a transect, 2 releases a week, and we'd rotate the release locations across river.
Ken S: far field receiver coverage. Move VY receiver closer downstream for adults would also be in place for juveniles too.
Steve L: That is not defined in the study plan, but yes we can do that.
Ken S: yes, FWS would like to have that.
Agreed.

John R: have people read the SP, do we need more discussion on telemetry?
Melissa: I haven't had a chance to look at it in depth. If we have additional feedback, we'll send it directly.

Lael: HA (hydroacoustics) portion – we haven't heard anything back from FERC yet? You are not responding to FERC? You have just provided more details from original proposal?
John R: We've simply provided greater specificity on how we will employ HA. We aren't proposing anything fundamentally different, what we have done is describe how telemetry will improve the study goals. We did the fish trial, showing that wild fish would be preferable.
Chris: The HA portion that also changed was going from 2 months to 3 months.

Ken S: Visual observations and netting that will occur, and deriving relative abundance (CPUE), I would like to see comparison between inside of and outside of the fish louver.
John R: HA, sampling and collection are all designed to monitor seasonality of the run, not all will be used for relative abundance.
Ken S: Still some unknowns about the wild fish runs, talking about doing some summary comparisons.

John R: There may not be comparisons, just 2 sets of data. We may not get at relative abundance differences b/t inside and outside the louver. That's not what we're trying to do. We will present the data. We are not doing the same type of sampling inside and outside of the louver. The SP says "inside and outside".
Rick: We are sampling fish inside boom for HA, while electrofishing outside the boom for tagging purposes. We will document where we catch them and the numbers.

Matt C: Tag numbers/frequency of tagging?
Rick: 20 fish in a group, 2 x/wk over 2 months
Matt C: Is HA for timing?
Chris: It is for timing and temporal evaluation.

Matt C: What about route selection?
John R: That's the telemetry portion.
Matt C: Telemetry works very well, but we are still left with questions (e.g. like on the Merrimack) a small proportion of the run, and a lot of variation of flow and operations.
John R: I disagree. We increased the seasonality, expect some flow variation but not an infinite number of flow variations. We have stated repeatedly that telemetry is appropriate for route selection. We have addressed stakeholder concerns related to wild vs. hatchery fish by using wild fish and spreading more across the season.
Matt C: There will still be some questions after this due to variability.
John R: Let's see what the study shows first. Our methods are the ones typically used, and to add many millions of dollars for additional HA is senseless.
Matt C: True, but the typical methods often come up short. But I don't have any experience with HA.

John R: We will still be using hatchery fish for turbine survival study.
Doug: Yes, we need 450 test fish, and will hold more than that.
Ken S: In the SP it says 1500 – 2000 needed.
Doug: Anywhere b/t 1500 – 2000, we don't know what we will lose in transport/handling.
Ken S: Will FL's HiZ tagging done by Normandeau? Would the 1500 fish be for both studies?
Doug R: FL has not contacted Normandeau on HiZ tagging for shad, only eels.
Ken S: FL is doing a juvenile survival study with 425 HiZ tagged fish.
Rick: Was FL also looking to NAI to do their juvenile shad study? We are not aware of that.
Doug: Will contact KA/Gomez and Sullivan about this and get total number needed for both studies to Ken S.

6. Study 9- Instream Flow (45 min)

- Overview of HSC methodology and results
- Discussion/agreement with proposed HSC's
- Discussion on VTFWD Sumner Falls DFA proposal

Steve E: Summarized HSCs
Katie: Use of generalized habitat approach for mussels – habitat guilds to account for unknowns.
Steve E: It is usually a good idea to do the guild runs which are often used to make decisions. We can link species to guilds.
Katie: FL had included general habitat (guild) curves (Mark Baine work) to have habitat represented that is important to multiple species and unknown species, for example shallow-fast, shallow-slow, deep-fast, deep-slow.
Rod: 22 species and life stages = more complications down the road, best to keep number small with still providing coverage.
Steve E: Longnose dace has not been found yet in the study area, normally found far up in tributaries, that may be an example of a species not necessary to run.
John R: We mostly carried over from the established list that came from FL, since there was no other starting point. If there is a better set available….

Rod: Species of particular interest (e.g., walleye spawning) those should be included. Beyond that other questions may be answered by scrutiny on curves and we can use curves for more than on species/life stage or the other option is to use guild curves (e.g., shallow slow) and determine the species/life stages for each. Do we have those or have to create those – may be some redundancy that could be trimmed.
Katie: agree with Rod.
Steve E: That's a matter of how we prioritize the species/life stages of interest.

Lael: Why is trout, rainbow trout not included? We've seen them in fish ladders.
Steve E: Trout just hasn't been brought up as a species of interest.
Lael: Should it be included?
Gabe: NH stocks brown and rainbows below Bellows Falls (BF) dam, 800 each year. A few get caught below Vernon each year, may come in from tributaries. Not highly prevalent species in this portion of the river.
Lael: It is more common than bass, fallfish, walleye in the ladders at Vernon and BF.
Melissa: We may not be ready to have this conversation yet, agencies need to talk to give TC more definitive feedback.

John R: Trout based on stocking or habitat?
Gabe: NH is stocking, in VT there may be some from tributaries. We don't see trout in NH surveys, except for below Vernon in spring and below BF only. Don't hear much about them from anglers.

John R: Back to Melissa's point – if agencies don't know what species/life stages are of interest, need to get back to TC on that.
Steve E: And get back to Rod's thought about too many species/life stages.
Rod: Does someone have guild curves?
Katie: FL is using some, someone also did a study on the Deerfield River.

Rod: Other studies in VA, MN, not sure they had guild curves.
Mark A: There are many different sets of guild curves, it is a generic term. Sounds like FL has a set that they have chosen. What species/life stages would be represented in which guilds?
John R: Agency folks - please get back to us.
Steve E: Especially if people have specific curves for specific species. We presented some e.g., small mouth bass and there are several curves, so a decision needs to be made on that.

Rod: I have various comments on certain curves. Agencies need to agree on an approach at a higher level. Some species curves, there are many versions (from other places, etc.) and some are old and basis is lost. Precision on those is not very tight, we can only do the best we can with them.
Mark A: One decision agencies need to make is whether to continue what we first thought they wanted by using FL curves and adding some extras. If that is not the case…

Rod: Related question about substrate coding. Did you end up using the Bovee substrate coding?
Steve E: We did %s of eight different substrate categories, which can be converted to a Bovee code or other codes. The way substrate is presented in the HSCs, it looks binary but if you use %s then each % is multiplied by the suitability of that type.
Rod: In the Study 9 HSC document, it looks like if dominant type is gravel then.
Mark: The way the substrate was coded by % - either use Bovee code, dominant/sub-dominant only, or use all the %s with suitability of each weighted using all the data that is available. So there are alternative ways of assessing. Visual assessment of substrate across a large river, introduces some uncertainty.
John W: The biggest concern is always – when in patchy habitat, you don't always capture the variability. Having more nuanced data makes sense.
Rod: e,g, walleye spawning – the best substrate is fist size rubble. If a boulder area has sub-dominant rubble then would want to capture that.
Steve E: That is why using %s is better to capture that variability.
Mark: We've already collected all the data which can be assessed in different ways.

Rod: The report lists some seasonal periodicities for different life stages that look off, where are they from?
Steve E: That information came from various sources (PA, CT, NH). This is a working table, and based on people's input and this spring's studies, that may change.
Rod: What about the fish assemblage study?
Steve E: That one probably won't work time-wize. States must have data on primary species.
Rod: Yes, but not the level of data we will have later.
Mark: We are hoping to have the rest of the flow data collected this spring and by that point would hope to have the species/guilds selected so that we can run the models.
Rod: Periodicity table in the report, question about definition of some of the life stages.

Mark: We are using existing curves that include size/life stage. Fixed in the curves, but not fixed in the periodicity table. It is difficult to work with existing curves that don't have the metadata.
Rod: Some may be available from VT.
Mark: That information would be good to share with TC.
Rod: Agencies should get together so we can get back to TC in a timely manner.
John R: We'd appreciate that and would like you, Rod to spear head that.

Steve E: Let's move on to Sumner Falls and VANR's revised proposal. From a standpoint of trying to create a topo map, depends on how detailed a map is needed, how many points it would take.
Rod: Agencies had concern over the 1st version, so I developed the 2nd more quantitative approach.
Steve E: There are very rapid changes in elevation and longitudinal differences there. We would need so many points to capture that variability.
Rod: It is a pretty irregular formation, so you'd need quite a few measurements. I was envisioning someone with a total station and shoot lots of points.
Steve E: Or an RTK, and it would be very difficult to get any data at the center channel (fast/deeper).
Rod: You could measure at low flows, or at several thousand cfs and drag ADCP across?
Steve E: We have run ADCP across on static lines but it wouldn't pick up the bottom very well, nor accurate depths. The only real option is to map at low flow.
Rod: If accessibility problems at current minimum flow, agencies could potentially approve a temporary reduction in minimum flow for this study.
John R: I thought it wasn't wadeable in low water
Rod: I think it is, mostly.
Mark: It seems like most of the flow is on the VT side
John R: Yes, from early canal area.
Mark: That area will be fast, slippery, difficult to get data.
Rod: At least the upstream portion of the red rectangle (from 11/10/14 proposal photo) is wadeable. The bottom may not be.

Mark: We want to keep in mind, response of stage to flow, given variability in that area. Even with a lot of gages, the precision won't be what we are used to.
Steve E: Will we be able to pick up enough detail to show depth at different flows, given the conditions?
Rod: The issue of stranding, would be more of an issue at areas that are measureable.
John R: I am not sure about the level of resolution we can get, rather than taking measurements to create a "grid", is there a priority of considerations for the crew? E.g., holes, stranding locations, under low flow try to visually detect depth and concentrate on the areas that are shallowest, most reactive to flow changes. Is the concern stranding, is it depths less than 6 inches? It seems like we are trying to characterize something that is unique but doesn't represent most of the river – is this small area going to drive it?

Rod: See the proposal. 7/10 ft depth for juveniles, 1 foot for adults.
Garret: You could use Google Earth photo, scan gray shade/contrast, then could ground truth it - go out and more or less identify which gray scale corresponds to which depths.
Mark: We did look at images over time, for that idea, but there is so much turbulence it is still hard to identify. Another option – we could do a series of transects to get a precise profile along the transects to get idea of depth at different flows. If stranding is an issue, we could look at bottom profiles at different flows.
John R: Sounds similar to what Garret was saying. If we can somehow identify the shallower areas and concentrate effort on those, is that what we want to do?

Katie: It is more than just min flows – areas like this tend to be more diverse with multiple habitat types, more species abundance, based on ecological theory. It would be good to know what the distribution of habitat types is and how that changes with flows.
John R: The area is definitely unique, but so scoured that it might have unique species there, but I don't know about diversity. The point is, we are trying to describe depth and velocity, wetted perimeter, etc.
Katie: We are interested in the adjacent habitat. We want some assessment/characterization of habitat – we don't have that information.
Rod: The original VANR proposal included further downstream areas that are likely to be more important fish areas, but to characterize those areas could be difficult. If the smaller, new area stranding issues addressed, then that can be a proxy for the rest of the area.
Katie: We need to keep in mind the study goal.
John R: We will collect the data, present it, and agencies may come back and want to see different flows – couldn't we just do that?
Melissa: We went this way to get back to a quantitative approach. It would be beneficial to go out there.
Rod: We could change around the plan – start with some ledge maps from aerials, go out and look at areas that warrant measurement, measurements could be more focused.

Bob Nasdor: The whitewater (WW) boating study also has a lot of video.
John R: Those WW flows were higher than minimum flows. Use Google Earth for rough mapping first. Maybe we should fly it and photograph it. It is still a lot more qualitative than quantitative. The measurements are kind of meaningless due to variability. We need to put this into context of other flow needs in other parts of the project (e.g., other studies). We can do a lot of that through the HEC-RAS and ops models.
Katie: It would be a high level of error.
John R: We've done a lot of work in this area – Jesup's Milk Vetch, Cobblestone tiger beetle, etc
Katie: We are looking to find a way to evaluate hydrologic project effects on this area.
John R: What are you trying to study and how can you study it - just trying to characterize the area?
Katie: Yes.

Melissa: We don't want to take measurements for their own sake if precision is not good. Other habitat mapping/IFIM makes the assumption that one transect is representative of a larger area. This area is not all that different from other areas.

John R: If we concentrate on the shallowest areas, then it may have more meaning to project effects as opposed to areas that are always wetted. The problem is you can't run transects through that area effectively. Rod's approach is good – shallower, less turbulent, etc.
Rod: Again, maybe start with demo flows, identify areas of concern, might be able to measure at DFA flows, or maybe measure later at lesser flows (e.g., with approval by agencies).
Garret: Rate of change? The impact would be from project operations changes.
John R: We can correlate to project operations.

Mark: What if we combine Rod's low flow viewing idea to select data collection sites, then do 3-5 transects and put in some staff gages. At higher flows, we could look at those gages from the bank and look at depth changes and result in detailed transect profiles. It might even be possible to collect velocity data at low flow.
John R: The first step is to look at the data and then see if there are places we can get into.
Mark: We hope we could get to at least parts of the area.
Katie: That sounds fine, understanding we are not getting all the data we really want.
John R: If we got 2-3 transects with great detail at low flow with a profile, then put it into the HEC-RAS model to see what it looks like at higher flows.

Melissa: Can you attach water level loggers to ledge for a little bit?
John R: Yes, staff gage might not stand up to the flows/turbulence anyway. We want to pick those locations so they provide meaningful data. If you can put a logger every 100 ft or so across the transect.
Rick: Loggers do need a little bit of depth.
John R. Hydraulics of the falls itself will drive the approach.

Rick: The ledge itself is not good habitat, the better habitat is around the edges.
Melissa: Some ledge areas can provide velocity refuges or benthic habitats.
Katie: We just don't know at this point.
John R: I'm not sure we will ever know. Have to find a means of feeling that it is adequate within the larger context of all the other studies. We will write up a narrative of this observation/identification approach ideally to locate transects for low flow measurements.

7. Study 6 – Water Quality Monitoring and Continuous Temperature Monitoring (30 min)

- Overview and discussion of site selection report and sampling and analysis

Owen: Are monitoring locations available as a shapefile?
Bernward – Yes, we can do that and put it online. Share the summary Excel table that was presented too.

John R: When setting tailrace monitors, you will set under low flow condition?
Matt B: Yes.
John R: “7Q10” represents operations minimum flows?
Matt B: What we mean is a 10-day low flow period.
John R: We always run minimum flows, but that won’t be 10 continuous days.
Matt: Yes, we understand that.
Jen: Temperature is what we’re really trying to get here?
Matt: Yes, 25 degrees C,
John R: Really trying to monitor river conditions, aren’t we?
John Baummer: July/August?
Owen: Yes, August.
Matt B.: FWS and Normandeau have done studies, they show generally July/August even above VY when it was operating.
John R: In the SP we’ve identified the 23 degrees C as the period potentially between July and September with continuous monitoring during that entire period.

Eric: Question about frequency of monitoring.
Bernward: In the shoulder seasons weekly at first to check, then biweekly.
Matt B: From June – September it will be weekly.
FERC: Question about minimum flow vs. higher generation.
John R: We do generate above minimum flows in the summer.
FERC: Question about using the same approach/methods as 2012 study?
Matt B: Yes, we are using the same methods as the 2012 study.
John R: 2012 was a very low flow year.
Owen: How long do we have to comment?
John R: March 1? The earlier the better.
FERC: Section 5.1 of the SP discusses calculating water level changes – how accurate is that approach?
John R: The water elevations are fairly accurate or as accurate as we can get them through the hydraulic (HEC-RAS) model.
Rick: Along with the logger data from study 7 in 2013 to correlate to hydraulic model.
John R: We will have calculated elevations and flows.

Jeff: How were the tributary sites selected?
Matt B: Based on size and how much they contribute to the river.
Jeff: Aerial photos in the SP appendix – are the actual sample stations identified or are they approximate?
Bernward: They are the actual sites.

[FERC]: The QA protocol is excellent, how will lab samples be treated during the field day?
Bernward: Dark bottles, 4 degrees C in cooler of ice on board boat, filtered, then frozen until pick up for lab.

Jeff: No more questions
Owen: No more questions.
Jonn R: If you can get us anything else for comments within the next 2-3 weeks, we may have an additional smaller group call if needed.

8. Upcoming Consultation (Jen G)

- Study 24 – DWM Phase 2 study report to be provided for comment, and consultation on FWS modified counter proposal.
- Study reports for terrestrial studies (26 – Cobblestone Beetles, 27 – Habitat Mapping, 28 – Fowler’s Toad, and 29 – Northeastern Bulrush, will be available for stakeholder review.
- Study 25 – Dragonfly and Damsel Fly Survey. Proposed site selection (4 of 11 sites) to be provided to the terrestrial working group for comment.

TransCanada - Connecticut River: Study 06 - WQ, Field Activities 2015

17-Feb-15

Station ID	Wilder	Bellow Falls	Vernon	Location (1)	Week of... (Monday)														
					Mar 30 to May 25 (9 weeks)					May 30 to Sep 28 (18 weeks)					Oct 04 to Nov 09 (6 weeks)				
					Deployed			Instant.		Deployed			Instant.		Deployed			Instant.	
					Temp. sonde	Temp. transect	Multisonde	Vertical profile	Water Sample Core	Temp.	Temp Transect (2)	Multisonde (3)	Vertical profile (4)	Water Sample Core	Temp.	Temp. transect)	Multisonde	Vertical profile	Water Sample Core
Connecticut River																			
06-W-04	●			upstream	●					●	7Q10	7Q10	●		●				
06-W-03	●			upper	●					●			●		●				
06-W-02	●			mid	●					●			●		●				
06-W-01	●			lower	●							●	●	●	●				
06-W-TR	●			tailrace	●							●	●		●				
06-BF-04		●		upstream	●					●	7Q10	7Q10	●		●				
06-BF-03		●		upper	●					●			●		●				
06-BF-02		●		mid	●					●			●		●				
06-BF-01		●		lower	●							●	●	●	●				
06-BF-BR		●		bypass reach	●							●	●		●				
06-BF-TR		●		tailrace	●							●	●		●				
06-V-04			●	upstream	●					●	7Q10	7Q10	●		●				
06-V-03			●	upper	●					●			●		●				
06-V-02			●	mid	●					●			●		●				
06-V-01			●	lower	●							●	●	●	●				
06-V-TR			●	tailrace	●							●	●		●				
Tributary Rivers																			
06-W-T02	●			Waits	●					●					●				
06-W-T01	●			Ompomp.	●					●					●				
06-BF-T05		●		White	●					●					●				
06-BF-T04		●		Mascoma	●					●					●				
06-BF-T03		●		Sugar	●					●					●				
06-BF-T02		●		Black	●					●					●				
06-BF-T01		●		Williams	●					●					●				
06-V-T03			●	Saxton	●					●					●				
06-V-T02			●	Cold	●					●					●				
06-V-T01			●	West	●					●					●				
Total instruments					26					19	108	16	2		26				

(1) Upstream of the impoundment, section along length of impoundment (upper, mid, lower), tailrace, bypass reach, or name of tributary, respectively.

(2) Three stations per transect with 3 loggers each (1 m below surface, mid-depth, 1 m above river bottom). At 10 day low flow conditions only.

(3) Multisonde will be used at these stations only during a 10 day low flow period. At other times only temperature will be recorded with a temperature probe. Parameters are: temp, DO, conductivity, turbidity, and pH.

(4) Instantaneous measurement with multisonde, at 1 m increments (surface to bottom). Parameters are: temp, DO, conductivity, turbidity, and pH.

Study 9 – Instream Flow - Sumner Falls Flow Assessment Approach

March 9, 2015

As proposed by VTDFW and others (November 10, 2014) the flow assessment at Sumner Falls would involve creating a detailed topographic map of the study area with elevation contours of 0.5 feet. Based on this map, a wetted area and depth delineation map would be produced at different flow levels using depth suitability criteria of 0.5 foot, 0.7 foot and 1.0 foot.

The study goal put forth by VTDFW and others is to assess flows in the upper portion of Sumner Falls and determine an appropriate flow to:

1. Minimize dewatering or stranding, and
2. Maintain water depths that provide suitable aquatic habitat conditions.

The draft proposal was discussed during a conference call on February 10, 2015 with TC and the aquatics working group. There was concern that acquiring topographic elevations within the proposed study area (Figure 1) with enough detail to distinguish between areas of 0.5 foot, 0.7 foot and 1.0 foot depths may not be feasible. It was suggested that 3-5 representative cross-sectional bottom profiles may effectively provide similar information over a range of observed flows.

The steps needed to complete this study will involve the following (days are not necessarily consecutive):

<u>Step 1 (1 day)</u>

Under low flow conditions (e.g., July or August) TC and agency personnel will identify 3 to 5 representative transect locations within the study site that encompass areas where shallow water depths and dewatering and/or pooling may occur.

<u>Step 2 (1 day, may be accomplished on same day as transect selection if flows remain low)</u>

Transects will be established at the selected locations and bottom profiles surveyed across the channel under low flow conditions (Figure 1). All surveyed points will be referenced to a common geo-referenced benchmark or using established elevations from pins in the vicinity of the local Jesup's Milk Vetch population. In areas too deep or swift to survey, an estimate of the bottom profile will be made based on readings as close to the thalweg as possible.

Staff gages attached to rebar would be installed near both banks and in locations across each transect where multiple water surface elevations are anticipated (Figure 2). The preferred method is to drill holes deep enough to drive in rebar so that gages will not be affected by water velocities.

There is a degree of uncertainty in the ability to establish staff gages in all selected locations. Fewer gages would be needed if waters-edge is surveyed on each bank at each target flow.

Where possible, measure representative water velocities at low flow in accessible channels and near edges. Representative photos will be taken.

<u>Step 3 (2 days following transect placement/profiling)</u>

Target Flows: Up to four target flows may be assessed. Since the time of travel for flow from Wilder dam to Sumner Falls is about two hours and additional time is needed for conditions to stabilize, it is anticipated that only two flows can be assessed in a day. Target flows of 2,000 cfs and 3,000 cfs will be assessed on the first test day, though these flows may be adjusted depending on discharge measured at the site prior to flow releases. If the PHABSIM study results for the reaches between Wilder dam and the upstream end of the Bellows Falls impoundment are available (expected by late July if high flow work is completed in early June), they may be used to revise the target observation flows. Depending on the initial results, 1 or 2 additional target flows may also be assessed on the following day. Target flows will be provided by controlled releases from Wilder and the quantity will be measured with ACDP equipment downstream of Sumner Falls at the time of each assessment.

Where possible, representative water velocities will be measured in accessible channels and/or near waters-edge. Representative photos will be taken from the same locations at each flow level.

Participants will observe conditions in the area and may use copies of aerial photos (Google Earth maps) to make notes. Upon completion of flow releases and observations, wetted width will be calculated for the various depth criteria at each flow.

Upon completion of study staff gages will be removed and rebar will be cut or bent.

Figure 1.

Figure 2.

VERMONT

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Agency of Natural Resources

March 25, 2015

Steve Leach
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Through:

Lael Will, Fisheries Biologist
Vermont Agency of Natural Resources
Fish & Wildlife Department
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Re: TransCanda Hydro Northeast Inc.'s Revised Sturdy Plan, Study19 Modifications

Dear Mr. Leach,

On February 5th, 2015 it was brought to the attention of Vermont Fish & Wildlife Department (Department) staff that as part of a downstream passage assessment of American Eels (Eels) in the Connecticut River (River) a certain number of Eels would need to be imported into the River from an inter-basin source. It is the Department's primary recommendation that all efforts be made to obtain Eels from within the River basin. While the Department is supportive of the downstream passage assessment as documented in the August 14, 2015 TransCanada Hydro Northeast Inc.'s Revised Study Plan, the Department has a number of fish health and aquatic nuisance species concerns involving the implications of the proposed modification to the study.

The Department views inter-basin fish importation of wild-acquired fish as a high risk activity for extending the geographic distribution of dangerous fish pathogens and aquatic nuisance species which could compromise a number of aquatic organisms in the receiving water basin. Enclosed are a number of topics and recommendations that the Department would require to be addressed in order to authorize the movement of inter-basin, wild-acquired Eels into the River for the downstream passage assessment.

The Department would request that the research team for the Eel downstream passage assessment provide the Department with a revised study plan for review that would address the Department's concerns involving the risk of spreading fish pathogens/aquatic nuisance species into the River.

If you have any questions or concerns, please do not hesitate to contact me by phone at 802-793-6781 or by email at tom.jones@state.vt.us. We look forward to reviewing your proposed modifications.

Sincerely,

Tom J

Tom Jones
Fish Health Biologist
Vermont Agency of Natural Resources
Fish & Wildlife Department
1 National Life Drive, Davis 2
Montpelier, VT 05620-3702

Enclosure: American Eel Importation Proposal Review – Recommended Topics of Discussion

Cc (electronic only):
Adam D. Miller, Fish Culture Operations Manager, Vermont Fish & Wildlife Department
Eric Palmer, Fisheries Division Director, Vermont Fish & Wildlife Department
Rod Wentworth, Fisheries Biologist, Vermont Fish & Wildlife Department

American Eel Importation Proposal Review - Recommended Topics of Discussion

The following are a list of questions and topics that Vermont Fish and Wildlife Department (Department) would like to see discussed in a proposal to import American Eels (Eels) for the downstream passage study. The proposal would be presented to the Department for review and subsequent approval, denial, or additional questioning prior to the start of the proposed research activities. Although not specifically outlined in this document, researchers should coordinate with other states of regarding fish health management on the Connecticut River to obtain concurrence with the study (i.e. New Hampshire, Massachusetts, Connecticut).

Topic #1: Donor water source information. Including:

- The specific location of the donor waterbody (HUC-10). ***Recommendation**: The Department understands that a similar inter-basin importation of Eels (2011) was conducted in New York from the Sebasticook River – East Branch in Maine. Although not required, it would be the preference of the Department that researchers collect Eels from the same source since they were effectively imported into New York from this location*.

- Fish pathogen / aquatic invasive species (ANS) profile of the donor water basin (HUC-2).

  - Status of the listed fish pathogens in the donor water basin (HUC-2) (presence, absence, unknown). Please describe listed pathogens detected, the detection date, and the pathogen distribution in the basin. To include: Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), *Ceratomyxa Shasta*, Spring Viremia of Carp virus, Proliferative Kidney Disease (*Tetracapsuloides bryosalmonae*), Whirling Disease (*Myxobolus cerebralis*), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus.

  - Status of the listed fish pathogens in the donor water sub-basin (HUC-4) (presence, absence, unknown). Please describe the listed pathogens detected, the detection date, and the pathogen distribution in the sub-basin.To include: Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), American eel swimbladder parasite (*Anguillicoloides crassus)*.

  - Status of ANS in the donor sub-basin (HUC-4) (presence, absence, unknown). Please describe the ANS detected, the detection date, and the pathogen distribution in the sub-basin.

  - Have there been any fish kills which have resulted in the detection of a specific pathogen in the specific watershed (HUC-10)?

Topic #2: Fish health testing / biosecurity protocols of the individuals to be imported.
***Recommendation:** The Department would require the imported Eels to undergo fish health screening and stringent biosecurity protocols prior to stocking in the Connecticut River. Review of a fish health certificate outlining fish health screening results of the tested Eels would be required prior to stocking.*

- The number of Eels to be collected

- The number of individuals to be sacrificed for disease testing. ***Recommendation:** Sixty (60) individuals*

- The specific fish pathogens that the individuals will be tested for. ***Recommendations:** Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), Anguillicoloides crassus – nematode (testing by gross observation), any bacteria growth of significance shall be identified and reported as well as any cytopathic effect (CPE) producing agent identified and reported.*

- Who would be doing the fish health testing? Would the Department be granted consent to communicate with the testing laboratory? ***Recommendation:** A laboratory that is experienced with regularly conducting fish health diagnostics and inspections (i.e. Kennebec River Biosciences, USFWS Lamar Fish Health Center) would be recommended. The Department would desire the ability to communicate with the testing laboratory.*

- The location and facility that the collected Eels would be held at while awaiting fish health testing results. ***Recommendation:** An isolation facility in accordance with the New England Fish Health Guidelines (https://www1.maine.gov/ifw/fishing/health/newengland_guidelines.pdf) if fish are held in the donor watershed (HUC-10). If fish were held in the receiving basin (HUC-2) effluent disinfection would need to be incorporated into the facility design. Fish should be held in an approved isolation / quarantine until disease inspection results were shared with the Department.*

- Explanation of the transportation method of fish from the donor water source to the holding facility to the receiving water source. ***Recommendation:** Transportation should be conducted in clean, pathogen/ANS free water.*

- ***Analysis of ANS. Recommendation:** Presence of any ANS species during the fish health assessment shall be noted on the fish health assessment report.*

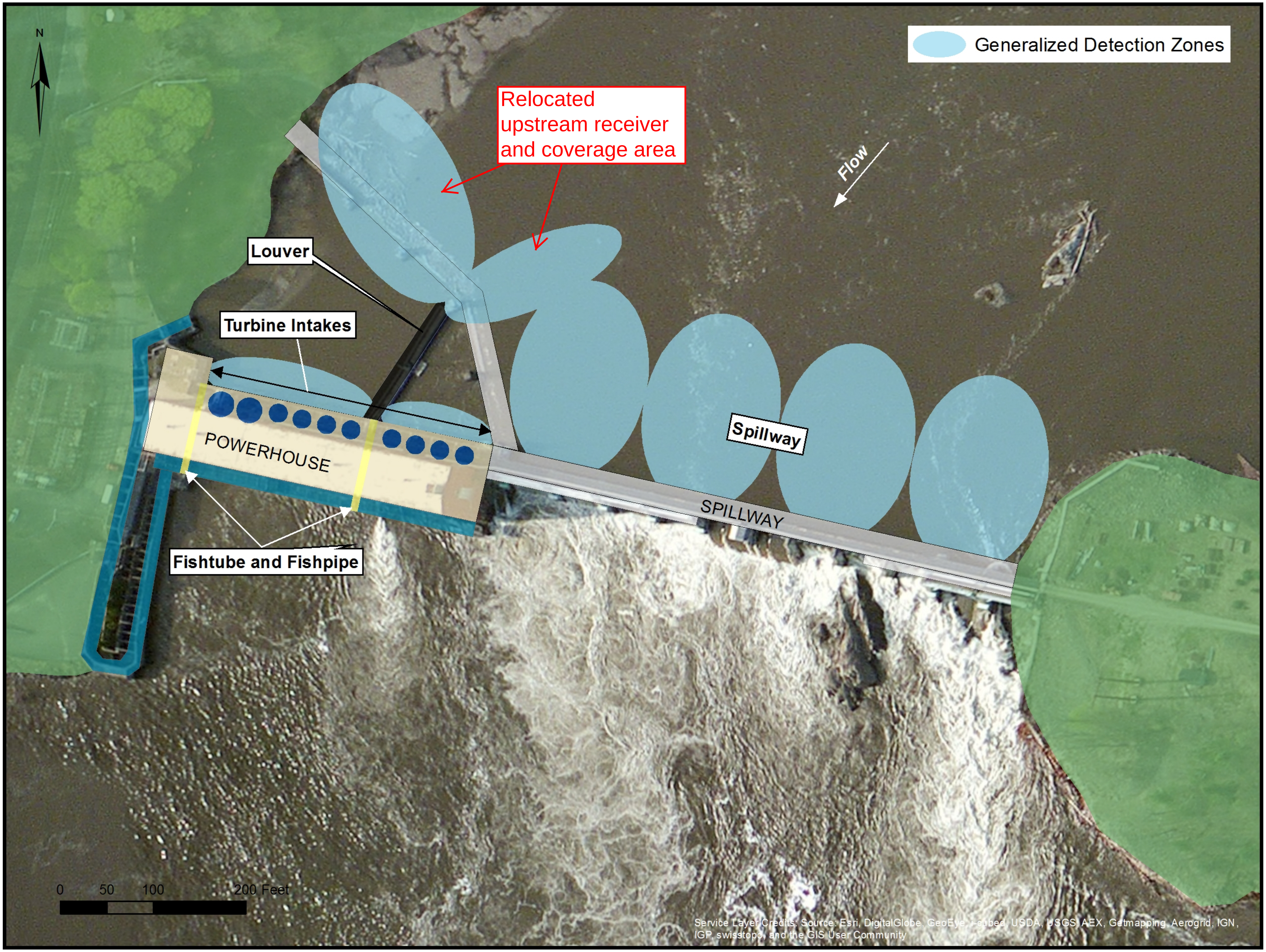
- Explanation of how a detection of the above tested pathogens in a fish health screening would affect the final stocking of the Eels. ***Recommendation:** It would most likely be recommended*

that the fish being held be destroyed and holding facility properly disinfected in a manner that would prevent the spread of the detected fish pathogen. Stocking would more than likely be prohibited but could be authorized if the affected states were in general consensus that stocking diseased fish would be an acceptable risk.

Topic #3: Receiving water source information. Including:

- Status of fish pathogens and ANS in comparison to the donor water source (presence, absence, unknown). ***Recommendation:*** ***Comparison of the status of ANS and fish pathogens including but not limited to: Anguillicoloides crassus, Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Ceratomyxa Shasta, Spring Viremia of Carp virus, Proliferative Kidney Disease (Tetracapsuloides bryosalmonae), Whirling Disease (Myxobolus cerebralis), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus, Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri).***

Study 21 - Revised Figure 21-3 (from RSP)



TransCanada Hydro Northeast Inc.
Dwarf Wedgemussel Consultation Meeting – March 5, 2015
Meeting/Call Notes

Attendees:
John Warner, FWS
Melissa Grader, FWS
Owen David, NHDES
Jim McClammer, CRJC
Katie Kennedy, TNC
Jeff Crocker, VANR
Mark Ferguson VANR
Eric Davis, VANR
John Ragonese, TC
Jen Griffin, TC
Ethan Nedeau, Biodrawversity
Maryalice Fischer, Normandeau

Ethan summarized the proposal to develop HSIs criteria from Appendix B of the Study 24 Phase 2 Progress Report (03/02/15 FERC filing).

- Information sources - We continue to include co-occurring mussel species as they do provide value, to use all the information we can.
- Approach - Develop HSC framework for wide variety of parameters, develop questionnaire for panel to complete (Delphi process). We need to reach out to the experts we have identified, likely many of the same experts involved with the FirstLight mussel study, to reach consensus on the HSI criteria. Summarize results of Delphi process in document shared with stakeholders.
- Outcome – HSI criteria for DWM, likely some will be more qualitative (category 1) and some would be quantitative (category 2), depending on amount of empirical data. Other parameters may be either.

Melissa: May need to adjust proposed schedule. Given that there is going to be another field season, it would be beneficial to wait to incorporate data from that.
John R: Which study do you mean?
Melissa: TNC submitted an application to the Upper Connecticut River mitigation/enhancement fund (MEF) and received funding to conduct a DWM study in the upper CT river. The information from that study would be beneficial to include in the data analyzed for HSI. The intent is to conduct the MEF study this field season and provide the deliverable towards the end of 2015. There is a possibility that the raw data could be provided to TC before the final report.
John R: We won't exclude any source of information, but we don't want to wait for that study to assemble a Delphi panel or look at the data that is currently available. Any information from that study might go to adjusting the HSI criteria only.
Katie: Yes, end of 2015. The intent was to coordinate with TC knowing that the information could be useful to TC. A lot of the probable Delphi panel will also be working on the MEF study.
John R: We will consider information from the MEF study, but don't necessarily believe that study constitutes the bulk of the data needed for our HSI. The Delphi panel doesn't need to wait for the MEF study. It is just a matter of the time when the MEF data will be available for evaluation.
John W: Since there are low numbers of DWM within the TC projects, the MEF study will provide additional data to help with management decisions.

John R: We have prior data within our project area where DWM have been found.
Katie: We don't have good habitat data from the prior studies, which is more important than project operations data. What we see today isn't exactly what was there when the DWM were found.
John R: Habitat does change, e.g., tropical storm Irene changed habitat. We are not trying to jump to a conclusion, but there is habitat information available. We will bring that information forward, but we would also argue that habitat information is not the only important information. Timing is the issue here.
Melissa: Round 2 in your schedule (08/01) might need to be later by a month or two.
Ethan: The intent is that the HSIs are available for when TC's study 9 (IFIM) needs them for analysis.
John R: Study 9 fieldwork, Study 9 PHABSIM modeling, or the hydraulic/operations modeling studies?
John W: There is no expectation that the schedule would affect any Study 9 field work. We can plug in new suitability curves anytime until 2018. FWS will want to see as robust an evaluation of DWM as possible and if that means delaying it until after all the MEF data are available for developing HSI and modeling , then that is what we need.
Ethan: clarifying, not Study 9 field work, but the modeling related to Study 9 and other models.
John R: We have to establish transects but the HSI criteria has more to do with the operations model.
John W: I don't see a conflict here. Move forward to get the best information you can, and if it takes a little longer to get that for DWM from the MEF study, it still won't change the field work.
John R: Katie – are there experts identified already?
Katie: Yes, we can touch base with Ethan to have the same experts on both.
Ethan: Agreed.

John R: What's the study plan for the MEF study?
Katie: We were waiting for this call today to understand where TC is and the DWM study planning so that the MEF study is aligned with TC's. Bottom line is habitat suitability for DWM as a species within the CT River. The MEF study is to understand habitat at the smaller scale [Melissa: the MEF committee had identified areas important to DWM]. The MEF study area was identified as important based on prior robust populations, to provide information to inform the Delphi process and HSIs to supplement the TC study since we don't have that information.

John R: We'd like to see the study design, etc. We haven't seen it yet.
Melissa: The majority of the MEF study area that is outside of the Lower CT project area, but there may be parts of the upper Wilder impoundment that may be included.
John R: Have these areas been surveyed? How do we know that's the right habitat?
Katie: Yes, some DWM were found there, but habitat was not evaluated. We are hoping to find robust populations/high abundance and density where more habitat variables will be described in the upper basin.
Ethan: for the Phase 2 transects in 2014, we only went as far up as Bedell Bridge. We had done semi-quantitative surveys above there, and we did find some DWM above there and some that were documented at the upper end of Moore reservoir, Gilman dam, etc.
John R: We'll wait and see what data you get.
John W: We can provide the MEF study proposal.
John R: We'd rather see the study plan.
Katie: It would benefit us to ensure that whatever data the MEF study collects is useful for the TC process.
Ethan: If we get the Delphi panel going, it opens up the collaboration.

John W: It would be good to have the technical folks in the MEF study get together with Ethan (maybe that is part of the Delphi panel) to walk through the MEF study plan together to come up with the best criteria we can.
John R: I don't disagree, but am concerned about assuming that what occurs in one location is the same as another location and how that is reflected in the ability to model.
Katie: I agree.
John R: When will you have a study design?
Katie: That is the next step, plan to start in mid-March.
Melissa: The hope is that within a month, the study design is pinned down enough to put out a scope of work.

John R: So you are saying the approach TC is taking is fine, just the timing/coordination of information? From our perspective it (the MEF study) is another set of data.

Melissa: Questions about 2014 study. Data table C-3, is that detailed habitat data for every DWM found, or only for those found within the quadrat.
Ethan: Generally, for every DWM found, we collected habitat information. We also collected that information for all DWM locations whether or not we found the DWM in the quadrat.
Melissa: So it looks like individual habitat data is not included for DWM collected outside of the quadrats in the progress report.
Ethan: Yes, it would be a separate table entirely of information for individuals outside of the quadrats as that data didn't fit into the quadrat table easily.
John R: So there is some information not in the report that FWS would like to have?
Melissa: Yes.
Ethan: We already have it pulled together, and if it is not in the report we can provide it easily (provided as a privileged attachment to these final meeting notes and constitutes an addendum to the Phase 2 Progress Report filed with FERC on March 2, 2015 – to be filed separately with FERC).

Melissa: I don't understand how use of a visual method of velocity goes to velocity at the benthic level.
Ethan: We used SCUBA diving, and the particles being tracked for velocity were on the bottom along the quadrat. We have used flow meters in the past both with and without divers, and found that having a diver present greatly increases the quality and precision of the data.

John R: Any other questions, Melissa or anyone else?
Melissa: Where does the FWS modified proposal stand?
John R: Our take on it is that FERC answered that for you.
Melissa: Wasn't FERC saying that TC would need to seek a determination if there wasn't agreement?
John R: I think what FERC is really asking is that TC develop HSIs, similar to the FirstLight approach and consult on that.

[FERC not on the call to clarify]

Katie: Regardless of what is or not required by FERC, it would be useful to have data collected in the project area at the same time the MEF study data is being collected, for direct comparison and better data for development of HSIs.
John R: So the MEF approach will be the same as what TC did already?

Katie: We had raised several issues in the FWS revised counter proposal like bank-to-bank transects with more gradient information to develop curves.
Ethan: I don't refute that bank-to-bank would help with that, but with all the habitat data being collected for relicensing you can get good data for HSI development without conducting more field studies.
Katie: Yes.

Melissa: It is important to the MEF study design to have close consultation with Ethan and TC to make that data as useful as possible to TC. We need to find out where the habitat is where we can have a robust DWM population. What is good habitat, where does it occur within the project reach and is it affected by project operations?
John R: We have the entire Wilder impoundment downstream to Vernon mapped – all habitat has been mapped. What is missing? You are developing habitat indices outside of the project area, we've collected data within it.
Katie: The only thing different is the year of data collection between TC and the MEF study. All we'd lose by not doing TC data collection this year is year-based consistency. I understand why TC wouldn't want to collect more data, but it would be preferable to have a complete dataset within one year.
Ethan: We're not making comparisons, we are developing HSIs and with a Delphi panel, we can accommodate differences in datasets without doing additional collections in the TC project area.

Melissa: To get back to collaboration, John R – how would we best accomplish that?
John R: I would want to be involved, Ethan and definitely someone from TC. If there is some parameter that we are expected to base suitability on, that we have the data or can model it. We want to make sure there is a robust understanding of what project operations are and are not in relation to DWM. For example, the upper Wilder impoundment is hardly affected by operations at all. Whatever you are trying to do with the MEF study may or may not hold the same level of meaning within the TC Lower Connecticut project area.

Maryalice: For clarification, are people saying TC does not need to do additional field work this year?
Katie: I am okay with not doing additional field work.

John R: If 2014 work found more individuals, there might be more rationale for additional gradient type work. But we didn't find many, and the habitat probably hasn't changed much. There could be an unknown/unexplained reason we didn't find many in 2014.
Melissa: What has been collected by TC is limited since the number of DWM were limited in 2014, so the MEF study is an opportunity to collect more information.

John R: Anything else to discuss?
[No] Call adjourned 2 pm.

TransCanada Hydro Northeast Inc.
ILP Study 25 Dragonfly and Damselfly Survey – Site Selection
Consultation Meeting – May 18, 2015
Meeting/Call Notes

Attendees:
- Marie Caduto, VTDEC
- Melissa Grader, FWS
- David Deen, CRWC
- Kelly Stetner, Black River Action Team
- Nick Ettema, FERC
- John Ragonese, TransCanada
- Sarah Allen, Normandeau
- Joanne Theriault, Normandeau
- Maryalice Fischer, Normandeau

Sarah Allen summarized study plan – inventory assemblages, life history, ecology, behavior to assess potential project influence on odonate larvae. The 8 species VT identified as SGCNs (Species of Greatest Conservation Need), and are river dependent species. Odonates leave the water to eclose, and are vulnerable to water level fluctuations during that time. Site selection includes 11 locations. Agencies requested increased sampling to 6 times from early June – end of July or early August. Sites based on Pam Hunt's 2007 survey (she will work on this study too). We selected 9 of Hunt's sites to be geographically representative and added 2 sites to fill in gaps in Hunt's sampling. Sites are in impoundments and riverine reaches.

This study more quantitative than Hunt's which was primarily qualitative. We will identify 100-m section of representative habitat at each study site (fine substrates, silt, sand, etc.). Five transects perpendicular to river 3-m wide extending from low water area or top of bank or 1-m into dense vegetation. Within each transect sampling will include surveys of individuals, id in field or in lab. Species, time collected, surface collected from, vertical and horizontal distance from water lines. Pam Hunt believes they eclose early in the morning, we plan to be out early in the morning, document water levels and attempt to understand conditions when larvae emerge. We are also placing HOBO water level loggers at each site.

Melissa: Will you time the sampling based on flows?

Sarah: Not sure we will have that luxury. We won't be timimg sampling to any particular time frame or flow range. It is more important to sample different sites and different times. HOBO loggers will help us to correlate river actions to what we see on the ground.

Odonates may cluster, and if found between transects, we will qualitatively document that too. Photos, document habitat conditions (soil type, % cover, vegetation type, slope conditions, bank conditions, large woody debris, etc). Will also look at mature larvae that have not yet emerged and count the first 50 larvae with wingbuds (ready to eclose, and helps to identify by species). Prey species will be estimated qualitatively by counting abundance classifications by prey species. If adult odonates are observed, will attempt to capture and identify to species.

Kelly: Can you describe how the distance walked will be measured?

Sarah: Yes, if we encounter a larva in the process of climbing up the bank, we will put a location pin, continue work at the site, and then return at the end of our work period to measure distance over time.

David: If you can do that, would the data be correlated to river operations/flows during that time period?

Sarah: We don't know if it takes hours or days to get to a site, which we want to understand better before we can correlate to flows, but yes, we can correlate to the Hobo data.

John R: the logger will capture that information, in post-processing.

Marie: Part of the problem identified is emergence during really low water levels, they can't reach appropriate habitat for eclosing. Is there access to reach the appropriate habitat?

John R: I don't think the study is intended to get to that question directly – a lot of assumptions – time they have, if they can reach it in time, etc. We will observe, and based on what we find, perhaps movement or timing related behavior based on the ones we find (not the ones we don't find).

Melissa: SSR states habitat is relatively uniform, but when you are collecting qualitative habitat information – is it a possibility to stratify by habitat type (e.g. bank slope).

Sarah: That's a good point, the study plan focuses on steep slopes and Pam suggested that they prefer slightly undercut slopes. Depending on the slopes within the 100-m and/or 5-m transects we will try to compare to less steep slopes. We will also be qualitatively looking at the entire site and will make note of other habitats used.

John R: The primary goal is to find specimens in the 100-m site. I'm not sure the sample size is large enough to draw conclusions based on bank slope/substrate. We will characterize those sites, but don't think we can answer the preference question – we can only observe on the sites we're out at.

Melissa: I understand it is not the intent of the study, but if you are primarily focusing on steep gradients, those sites are likely less affected by flow fluctuations.

John R: The CT river is more steep gradient than shallow, in general. We're not doing a habitat-stratified sample.

Sarah: Other questions, concerns?

Nick: I made a note of the discussion about different habitat types. The first 50 larva – will they be preserved and returned to a lab?

Sarah: Our preference not to collect them. We think we can identify them in the field, but if not, we will collect for lab identification.

Nick: Species presence – will you take samples along 100-m reach and pool them together? How will sampling be representative by habitat type and species?

Sarah: We will sample representatively, with a combined sample looking for diversity and size differences, etc. I note a correction to what I said earlier - we are proposing to bring all larvae back to the lab, but in reality we will attempt to id them first in the field.

Nick: Will you be looking at just the 8 SGCN species or all species?

Sarah: If we encounter a larva moving, we will follow it and then disturb it to see what it is.

Nick: Transects, one continuous transect or maybe split?

Sarah: We envisioned a single 100-m transect, not looking to include widest habitat diversity, but rather a representative habitat stretch. We don't know exactly what they are searching for when they eclose, among other things we don't know. We can't second guess well enough to subdivide transects. Goal in transect placement – select generally favorable characteristics, and within that will be micro or more variability and will select sites to sample that variability. If we find a cluster of exuvia at a location that is different (habitat, slope, etc) then we will qualitatively collect sufficient data to describe the habitat, just won't target the permanent transects that way.

Melissa: FirstLight's study meeting, they have state-listed species and there are so many, not sure why you say they will be hard to find.

Sarah: We're not saying it is hard to find the exuvia, but it may be hard to find the larvae in the process of moving up the bank to eclose.

David: Agrees, has never seen any moving himself.

Any other questions?

No – adjourned 10:15 am.

From:	Crocker, Jeff
To:	John Ragonese
Cc:	Brandon Cherry (Brandon.Cherry@ferc.gov); Jennifer Griffin; Maryalice Fischer; Burak, Matthew (MBurak@louisberger.com); Hay, Bernward; gregg.comstock@des.nh.gov; David, Owen (NHDES); Davis, Eric
Subject:	RE: Study 6 WQ Study Plan Variance Request
Date:	Tuesday, June 30, 2015 9:32:15 AM

John,

The VT DEC and NH DES have reviewed TransCanada's proposed modifications to the Water Quality Study. We agree with TransCanada that the installation of 3 temperature loggers is not practical where the depth does not permit. TransCanada's suggested modification to the study plan should adequately cover the overall objectives of the study, therefore study modification are approved.

Thanks,

Jeff

Jeff Crocker, *River Ecologist*
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www.watershedmanagement.vt.gov

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
RIVERS PROGRAM

From: John Ragonese [mailto:john_ragonese@transcanada.com]
Sent: Friday, June 26, 2015 5:15 PM
To: gregg.comstock@des.nh.gov; David, Owen (NHDES); Crocker, Jeff; Davis, Eric
Cc: Brandon Cherry (Brandon.Cherry@ferc.gov); Jennifer Griffin; Maryalice Fischer (MFischer@normandeau.com); Burak, Matthew (MBurak@louisberger.com); Hay, Bernward
Subject: Study 6 WQ Study Plan Variance Request
Importance: High

Gregg, Owen, Jeff and Eric:

We have run into an unanticipated situation that requires a modification in our Sampling and Analysis Plan (S&A) for our Water Quality Study 6. It is necessary to make minor modifications in order to accommodate the water depths at some monitoring sites that are shallower than anticipated. The requested modification pertains only to the vertical temperature profiles during the 10-day low flow period , where a "tri-level" monitoring scheme was proposed and approved (see Study Plan Approach below). Detailed water depth measurements during our recent field work (we are presently monitoring the sites with a single mid-channel, mid-level monitor) show that the upstream and some upper and mid impoundment stations are too shallow to reasonably require three vertical monitors. If three were deployed, the loggers would be spaced in a very tight vertically spaced arrangement that would yield little depth-sensitive information. For example, at a water depth of 3.0 m or less, the spacing between each logger over a depth of 3.0 m would be 0.5 m (1 m below surface, 1 m above the bottom and one at a mid-level). In our opinion, at such a depth, three is overkill and will not provide data of additional value to the study. We are proposing a modification when we encounter depths less than 4 feet at the time the crew is placing the continuous monitors, where if 3 m or less, one monitor would be placed mid-depth; if between 3-4 m two monitored would be places (1 m below surface and 1 m above the bottom).

Study Plan Approach: Three transects consisting of three moorings to be placed across the river at the following stations during the 10-day low flow period 1) upstream of impoundment; 2) upper impoundment; 3) mid- impoundment; and 4) lower impoundment. According to the study plan and the more recent Sampling & Analysis Plan, each mooring was to have 3 vertically placed temperature loggers: at 1 meter below the water surface, at 1 meter above the bottom, and at mid water depth (S&A Plan p. 4; Revised Study Plan p. 68 and Table 6-2).

Proposed Modification: Therefore, we propose the following modification to the study:
- One logger per mooring for water depths shallower than 3 meters
- Two loggers per mooring for water depths between 3 and ~ 4 meters
- Three loggers per mooring for water depths deeper than ~ 4 meters

The resulting number of loggers per station are shown highlighted in the table below.

Please review and provide comments or your approval for the requested modification.

If possible, please provide comments by July 3 next week as the summer low flow period could start at any time after the current high water levels recede.

Thank you for your prompt attention to this matter

John L. Ragonese, FERC License Manager
TransCanada
One Harbour Place, Suite 330; Portsmouth NH 03801
CELL: 603.498.2851 (best option); 603.559.5513
Email: john_ragonese@transcanada.com

Suggested Modification of Temperature Loggers - Vertical transect for 7Q10 Flow

TransCanada - Connecticut River Projects - Relicensing Study 6 Water Quality

26-Jun-15

	Lowest Water Depths measured during recent field work (meters)**			Originally Planned Number of Instruments per Vertical Transect			Suggested Revised Number of Instruments per Vertical Transect		
Station ID	Riv. Left	Center	Riv. Right	River Left	Center	River Right	River Left	Center	River Right
Wilder *(measured 6/19/2015, 11:41 to 13:00)*									
06-W-04	1*	1*	1	3	3	3	1	1	1
06-W-03	2.7	2.4	3.5	3	3	3	1	1	2
06-W-02	3.6	6.8	8.1	3	3	3	2	3	3
06-W-01	8*	10.2	8*	3	3	3	3	3	3
Bellows Falls *(measured 6/18/2015 13:43 to 15:48)*									
06-BF-04	3.1	3.6	1.9	3	3	3	2	2	1
06-BF-03	2.7	1.8	4.1	3	3	3	1	1	2
06-BF-02	3.2	3.4	3.7	3	3	3	2	2	2
06-BF-01	8*	10.6	8*	3	3	3	3	3	3
Vernon *(measured 6/17/2015 14:46 to 15:21)*									
06-V-04	1.2	2.3	1.3	3	3	3	1	1	1
06-V-03	3.5	3.5	2.6	3	3	3	2	2	1
06-V-02	4*	5.6	4*	3	3	3	3	3	3
06-V-01	8 - 17*		16.6	3	3	3	3	3	3
Totals				**36**	**36**	**36**	**24**	**25**	**25**

* estimated depths.

** Note that the water depth during the 7Q10 study may be lower.

TransCanada Lower Connecticut Relicensing
Meeting Notes
July 14, 2015
Conference call with Stakeholders to provide an update on field studies

Attendees:

- FERC – Steve Kartalia, Brandon Cherry, John Baummer, Bill Connelly
- FEW – Melissa Grader, Ken Sprankle, John Warner
- NPS – Kevin Mendik
- NH – Owen David, Matt Carpenter, Gabe Gries
- VT – Eric Davis, Jeff Crocker, Lael Will
- TNC – Katie Kennedy
- CRWC – David Deen
- TC and Consultants – John Ragonese, Jen Griffin, Joe Avery, Maryalice Fischer, Mark Allen, Doug Royer, Rick Simmons, Steve Leach, Semiu Lawal, Stu Bridgeman, Lissa Robinson, Bernward Hay, Matt Burak, Drew Trested, Steve Olausen

A power point presentation (attached) was shared providing update status for each of the 33 studies, and was given over WebEx and a copy of the presentation was emailed to participants shortly after the call.

Studies 1-3 - Maryalice presented: David Deen (DD) – when will the Study 1 report be out? John Ragonese (JR) and Maryalice Fischer (MF) – with the September filing of the Updated Study Report.

Study 4 – John presented: JR – In accordance with the study plan, an agency consultation is being set up (a Doodle Poll email) to review selection of flow ranges and selection of reservoir velocity transects. This needs to occur before the Sumner Falls Study 9 work scheduled for early Aug, so looking at late July. DD said he hadn't received the Poll email. Jen Griffin (JG) forwarded the Poll email to David and Katie. Brandon Cherry (BC) said he would check with Patrick and Mike to see if they're interested in participating in the July call. [Brandon later replied via email that FERC staff are not planning to participate]. John Warner (JW) said he asked Brett Towler, USFWS engineer, to attend. [Brett later responded to the Poll]. JW asked that TC provide a summary of proposed changes before the call, JR agreed.

Study 5- John presented: Katie Kennedy (KK) – what's the time frame for each step? JR – initial run of ops model with hydraulic model in August. Lissa Robinson (LR) – the August time frame is contingent on collection and QA/QC of the Sumner Falls data.

Study 6 – Bernward and Matt Burak presented: tributary temperature monitors installed in May, all sondes were installed by end of June, lost some pH data in the Bellows Falls bypassed reach (during high flows which damaged the pH sensor) and in the tailrace (sensor had failed), sondes were replaced asap.

Study 7 – Maryalice presented: Logger data will be refiled with FERC, a calibration error was found to have affected some data.

Study 8 – Maryalice presented: No comments.

Study 9 – Maryalice presented: HSC received from stakeholders, in TransCanada's court to review and provide any comments back. JR- we'll provide bathymetry from upstream before the Sumner Falls demonstration flows. JR asked if FERC staff would be attending the Sumner demonstration flows. BC – will check.

Study 10 – Rick presented: DD – what's a pram? Rick Simmons (RS) efishing generator carried on a small "boat" that's pushed or pulled through the water. Gabe Gries (GG) anything of interest, noteworthy or surprising? RS – no, not really, pretty much what you'd expect.

Study 11 – Rick presented: field effort will start late this week or next, high flow restricted ability to fish, have lost some pots. Matt Carpenter (MC) – any difficult location to get into? RS – during high flow there were some difficult spots, below Wilder in particular.

Study 12 – Rick presented: Melissa Grader (MG) – wasn't there potential for assemblage study to influence site selection locations for the darter study? Would like consultation if there's a change. Drew Trested (DT) – will take a look at the collections for tessellated darter. JR – don't want to change protocol for site selection from what has been approved but want to do what makes sense. We'll review that protocol.

Study 13 – Maryalice presented: around 20 sites evaluated, 5-6 that may be subject to some project affects, waiting on model to help fine-tune that review. Report to be filed in Sept. DD – is this the study that desiccation of spawning areas is addressed? MA – No, spawning is included in studies 14, 15 and for sea lamprey, 16. MC – Did you look at trib and backwater areas in Spring and Fall? There could be changes in those seasons, will model address that? JR – logger depth information relative to tributaries combined with cross sections in the hydraulic model will get to that. A few area affected by project, some are not but they dry out. We can call these critical, include them in the model and run spring flow scenario, though it won't include tributary flow, then change operating scenarios to see project changes. MF – field data was collected from July to November, so only Spring is missing and it can be modeled.

Study 14 – Mark presented: no comments.

Study 15 – Mark presented: 1 to 1.5 weeks to get egg blocks out, a lot of effort – visual and angling. Started after high flow. Loggers at all backwater spawning locations. MC and GG– Rosyface shiner – never of heard of it in Connecticut River, were they positively identified? MA/RS – samples were collected, so have in hand for further review and have lots of video. GG – understand difficulty of study like this in one year. So for pickerel, pike, walleye and sucker were collections unsuccessful? MA/RS – not necessarily. Walleye and sucker likely went upstream or to deep areas. We are pretty confident they weren't in the collection sites, we would have found eggs if they were.

Study 16 – Steve Leach presented: One redd cap removed because it was changing the mesohabitat of redd, ended up with ~1 ft of sand over the redd which is more than was observed at other redds. Partridge Brook was a bit of a hot spot. One lamprey went into the West River, moved into then Connecticut River, then to Partridge Brook where it spawned and died. Lael Will (LW) – we tracked one in Black River it went to Townsend Dam.

Study 17 – Rick Simmons presented: GG – you're recording resident passage? RS- yes, interestingly, white sucker were viewed in the BF ladder when it was opened and then we picked up eggs. Not much activity in the fish ladders now. LW – more eel passage this year that past. KS – when will all shad data be available? RS – in about two weeks.

Study 18 – Steve Leach presented: Below Wilder dam is not possible at night due to safety concerns. KS – KA now seeing eels at TF. MC – any eels in community surveys? RS/SL – not that I'm aware of.

Study 19 – Doug Royer presented: eel importation, FWS will be the "import organization". JR reviewed turbine operation settings slide. Will provide operation in chart format. MG – when running min flow only, can you show what unit is running at what level? JR – good point; you'll see that in the charts. JW – this is averaged hourly data for the year? Eels more likely to move at night, assume you're looking at that. JR – no, this is a year of hourly data but we can filter to evening and season. JW – if throttling occurs when eels are most likely moving down would need to know/see that.

Study 20 – Maryalice and Doug presented: no comments

Study 21 – Doug Royer presented: Field work ended last week. MC – how are you documenting spawning? Doug Royer (DR) – collected eggs where shad aggregations were found via telemetry.

Study 22 – Doug Royer presented: JR- are all tags in hand? DR – yes they arrived last week. FWS is holding juveniles as long as possible to grow fish to ~120mm, maybe late Sept. KS – I'll get an update.

Study 23 - Maryalice presented: No comments.

Study 24 - Maryalice presented: No plan to do additional field work this year. KK – TNC is finalizing its study plan for upper Connecticut River work, will then contract with field consultant and will provide to TC, hopeful field effort will start shortly thereafter.

Study 25 – Maryalice presented: working with Pam Hunt, NH Audubon. No comments.

Studies 26, 27, 28, 29, 30 – Maryalice presented: no comments.

Study 31 – John Ragonese presented: no comments

Study 32 - John Ragonese presented: DD – will we be notified when you go out to do aesthetics assessment? JR – study group members are being identified, they'll look at video and photos. DD – will we be able to look at the video? Location it was take, angle, etc. JR – locations are described in the SP. Not sure if videos will be part of the report due to their size, but will have snippets or something.

Study 33 – Steve Olausen presented: no comments.

General Discussion

LW – are any study reports on the sharepoint site? JR – yes, study reports for studies 7 and 8, and public versions of study 24 Phase 1 and Phase 2 are on the public web site.

JW – some study reports will be filed in September, some won't be completed by then, have you heard from FERC on your license term extension request? BC – can't talk specifics but we are working on the review and anticipate a response shortly. Process plan and schedule will be revised based on final decision on extension request. DD – what will the schedule look like since the license expires 2 years after the new year? BC – can't answer as it goes directly to what plan and schedule might look like.

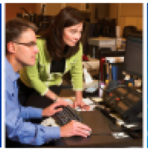
JR – is there anything USFWS can do to move along the eel importation process? JW – it's in the hands of the states.

Lower Connecticut Relicensing Study Update

July 14, 2015

TransCanada
In business to deliver

Erosion Studies 1-3



- Studies 1, 2, 3: Erosion Studies
- Study 1 – Historical Erosion report is being drafted
- Study 2 – Erosion monitoring work is ongoing, with 2nd round occurring in July. High water delayed installation of water level loggers but not later than they were installed in 2014.
- Study 3 – Causes of Erosion maps and GIS shapefiles are being created, data being analyzed. Study depends in part on the results of Study 2.

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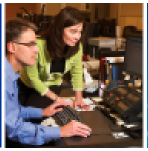
Study 4 Hydraulic Model

- Model approximately 80% complete; Newbury application [Wilder} test shows very accurate results
- Model development delayed by low water conditions in 2014 which canceled high flow riverine survey (Study 9) transect surveys needed.
- Three locations had additional bathymetry conducted, results provided for model this week:
  1. Reach between Ottaquechee River and Sumner Falls
  2. Sumner Falls
  3. Reach between Bellows Falls fish barrier dam and station tailrace

Study 4 Hydraulic Model



- **Remaining Work:**
  - **Agency consultation: selection of flow ranges; selection of reservoir velocity transects; conduct ADCP survey**
  - **Run model using selected flows and compare to ADCP results, Hobo elevation data, gage data**
  - **Develop stage / flow, velocity / flow rating curves for resource cross-sections**
  - **Mesh resource study observation and model cross-section results to characterize determine extent project influence if any**

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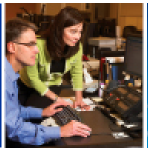
Study 5 Operations Model



- Model is built; not final version ready for scenario runs
- Developing nodes for every 1 hour time step, run model
- Compare flow travel time with hydraulic model and adjust
- Developing reporting-results template
- Identify the critical project influenced resource cross section (flow / stage-velocity curves) to appropriate hourly travel time segments.
- Re-run model and compare model reporting results with field observations
- Model is available to examine other alternatives

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Study 6 Water Quality

- Field work is in progress
- TC requested and received approval for minor modification to base the number of vertical profile samples on water depth, which is shallower in some locations than anticipated
- Preparing for the 10-day low flow monitoring later this summer

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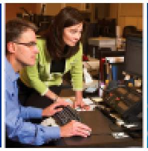
Study 7 Habitat Mapping



- Study was completed in 2013
- Final report was filed with FERC on March 2, 2015
- Additional overwintered water level logger data was collected for 2014/2015. Data is being processed now.

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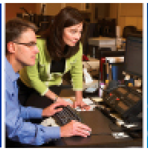
Study 8 Channel Morphology



- Study was completed in 2014
- Final report was filed with FERC on March 2, 2015
- Additional project affects evaluation is pending completion of models

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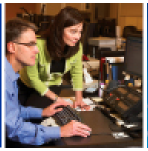
Study 9 Instream Flow Study



- **High flow data was collected in May 2015**
- **Preliminary results for Wilder Riverine will be shared prior to Sumner Falls field visit**
- **Sumner Falls field visit scheduled for August 3-6**
  - Identification of transects
  - Pre-demo-flow transect layout, survey
  - Demonstration flows based on preliminary flow results for Wilder riverine
- **Recently received HSC documents from agencies, under review**

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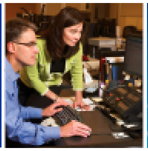
Study 10 Fish Assemblage



- **Spring sampling period (May-June) completed except BF bypassed reach (due to spill in late June) and included:**
  - 42 boat electrofish samples
  - 40 experimental gill net samples
  - 24 pram samples
  - 26 beach seine samples
  - 12 tributary pram/backpack samples
- **Summer sampling period (July-August) being initiated mid-July**

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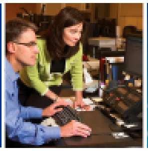
Study 11 American Eel Survey



- Study plan identified timeframe as July-September
- Anticipate sampling to begin during second half of July, 2015 since higher flows lately aren’t conducive to sampling, and to capture middle of season
- Eel pots are ready to go, other pre-mobilization effort is underway
- Planned date for deploying eel-pots or electro-fishing based upon water flow conditions

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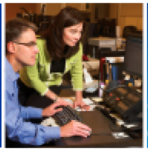
Study 12 Tessellated Darter Survey




- Study plan identified timeframe as August-September
- Anticipate sampling to begin during latter part of August, 2015 based on availability of divers and to capture middle of season
- No issues identified

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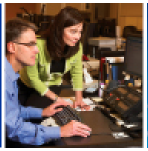
Study 13 Tributary and Backwater Access

- **Study was completed in 2014 and data was analyzed in winter/spring 2015**
- **Report is going through final internal review**
- **Final Project effects analysis pending completion and application of models**

Studies 14 and 15 Reservoir and Riverine Fish Spawning



- Block deployments occurred between 16-30 April at water temperatures of 4-8^{o}C
- Egg blocks were deployed in 16 reservoir tributary sites and 12 mainstem riverine sites,
- Set at 262 individual locations
- Blocks were fished a total of 4,420 block-days

- Sucker eggs were captured on three visits from 5-11 May in two tributaries in the Wilder impoundment (Olivarian and Hewes Brooks)

- One walleye egg was captured from a Bellows riverine riffle on 1 May
- All other egg captures represented perch, cyprinid, bass, or amphibian species

- Most egg blocks were removed between 20-27 May - Vernon ranged from 18C to 22C; Bellows 17C to 20C; Wilder 17C to 19.5C. The blocks were pulled after no more sucker eggs were collected up at wilder, which had the lowest water temps

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Studies 14 and 15 Reservoir and Riverine Fish Spawning

Backwater Spawning - yellow perch, northern pike, chain pickerel, largemouth bass, bluegill, pumpkinseed, black crappie, spottail shiners, golden shiners
backwater surveys commenced on 28 April at water temperatures of 5-13^{o}C
12 backwaters ranging from 5 to 250 acres were surveyed 2 times/week
yellow perch egg masses were observed in most backwaters on 30 April, few egg masses remained by 12 May
some early egg masses were partly suspended out-of-water on tree branches, likely due to early spawning during high flows and water surface elevations the previous weeks
numerous chain pickerel and northern pike were observed in shallow water habitats, but no spawning activity or eggs were observed and no angled fish appeared gravid
largemouth bass and sunfish spawning activities (nest guarding) began in mid-late May at water temperatures of 15-20^{o}C
most spawning activity appeared to have ceased by mid-June at water temperatures of 20-25oC (although high flows and turbidity made observations difficult through late-June)
gravid spottail shiners and/or golden shiners were occasionally captured by electrofishing or minnow traps in June, but no spawning aggregations or eggs were observed - except for rosyface shiners on fallfish nest
no black crappie nests were observed (a few were angled)

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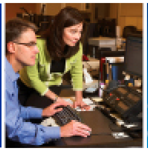
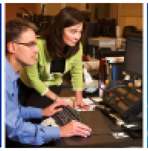
Studies 14 and 15 Reservoir and Riverine Fish Spawning



Riverine Spawners - smallmouth bass, fallfish

Reservoir tributaries (lower reaches) and riverine island habitats were surveyed from 20 May to early July at water temperatures of 11-23oC
17 reservoir tributary sites and 12 riverine island sites were surveyed 2-3 times/week (flow and turbidity permitting)
Fallfish nests were observed at many locations in late-May
Smallmouth nesting activities were observed in late May, fry were observed at nests by following week
Sampling in the mainstem riverine sites and many tributary mouths was intermittent through most of June due to high flows & high turbidities

Study 16 Sea Lamprey Spawning Assessment



- 40 Sea Lamprey were tagged and released 20 each, above Vernon and above Bellows Falls. All were collected from Vernon fish ladder – unable to collect from Bellows (safety, low abundance, trap configuration).
- Manual tracking events identified fish throughout the study area to near Wilder Dam and in several tributaries and included at least one position on ~18 fish tagged for FirstLight studies.
- Probable spawning habitats via telemetry occurred in discrete locations throughout the study area. Nests were identified in several areas, particularly in the lower section of small tributaries, and on gravel / cobble bars.
- High river discharge levels hampered efforts to observe spawning and nest condition.
- Redd caps were deployed in four locations where adults were observed on nests. To date no ammocoetes have been collected from redd caps. Caps were observed to modify meso-habitat conditions of nests.

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Study 17 Resident Fish Passage

- **Bellows ladder opened 4/15, Wilder 4/16 and Vernon 5/5**
- **No unexpected results, except for the beaver that passed**
- **Shad count thus far has surpassed last year's total count passing Vernon (reviewed through June 1)**
- **Reported counts are being provided to agencies, and lag real time due to amount of video being reviewed**
- **One computer was not powerful enough to handle video review (not capture) on high count days. We replaced it within 2 days. No data loss, but needed to re-review that data.**

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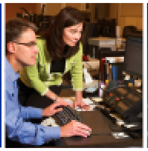
Study 18 Upstream Eel Passage



- Weekly nighttime visual surveys and overnight eel pot sets at each project commenced during the first week of May (ongoing).
- 10 baited eel pots set overnight once weekly at each project. During spill periods, the number of baited pots sets was reduced due to gear loss and unsafe conditions in certain areas.
- To date only one eel has been caught in pot sets, a 13 inch long yellow eel was caught in the Bellows Falls Bypassed Reach and only a few eels (10 inch long +) have been observed in the Vernon fishway and a deep gate below a Vernon taintor gate. All since flows have receded.
- Spill conditions have prevented ideal eel trap placement for the last month and eel viewing at night – flows have receded now making this easier.

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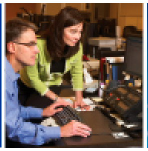
Study 19 Downstream Eel Passage



- Normandeau and KA have been working on eel pathology testing and importation plan agreed to by agencies in June. Eels will be flown to Logan airport and delivered to TC and FL.
- Summary of Joint Normandeau/KA Eel Importation Plan
  - Source is from Newfoundland - North Atlantic Aquaponics Ltd
  - Health assessment to be conducted by AVC-UPEI.
  - Fish will be held in quarantine, air shipped to Boston, and transported to TC and FL for local holding.
- Still finalizing an import broker and obtain a federal import permit
- TC will propose turbine operation setting based upon high probability and efficiency set point
- Finalizing response letter to agencies on importation plan.

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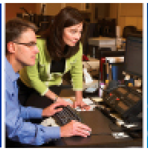
Study 19 Downstream Eel Passage



Turbine Operation Settings

Vernon

Units 1-4	900cfs
Units 5-8	1500 cfs
Units 9-10	1500 cfs

Bellows Falls

Units 1-3	4000 cfs

Wilder

Units 1-2	4500-5000 cfs
Unit 3	700 cfs

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Study 20 Eel Downstream Migration

- Preliminary literature review in progress
- Study depends on results from other eel studies including FirstLight studies

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Study 21 Adult shad upstream passage

- The field studies have been completed May – July 10th
- Normandeau also monitoring FirstLight tagged shad
- Shad were present, passed Vernon and spawning was documented above Vernon, observed congregating, egg blocks from studies 14, 15
- Data are now being analyzed

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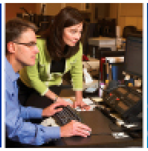
Study 22 Juvenile Shad Downstream Passage



- Study to begin in mid-August with installation of hydroacoustic transducer, install and recalibrate telemetry gear already in place
- USFWS service is rearing the needed fish for turbine survival tests and hold as long as possible. May be late September for testing. Fish are growing well (per K. Sprankle)
- Tags are onsite and ready, will set up holding tanks
- and hold as long as possible. May be late September for testing. Fish are growing well (per K. Sprankle)
- Tags are onsite and ready, will set up holding tanks
- Will electrofish in Vernon forebay for route selection
- TC will propose turbine operation setting based upon high probability and efficiency set point

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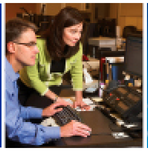
Study 23 Impingement/Entrainment



- **Preliminary literature review in progress**
- **Gathering turbine specifications**
- **Study depends in part on results of other studies**

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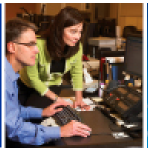
Study 24 Dwarf Wedgemussel



- **Phase 2 report was filed with FERC on March 2, 2015**
- **Subsequent meeting with working group discussed Delphi approach to developing HSI**
- **Delphi panel members to be identified and convened late summer pending participant availability**

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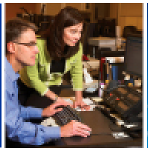
Study 25 Dragonflies and Damselflies



- Field work in progress.
- Fourth of six field surveys is occurring this week
- Video of an eclosing dragonfly was taken

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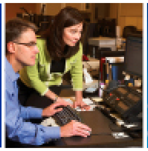
Study 26 Cobblestone Tiger Beetle



- Field work was completed in 2014, report was drafted in early 2015
- Crews are collecting additional elevation data in July, to link sites to water levels where logger data is available and hydraulic model cross-section.
- Report will be finalized once that data is processed.

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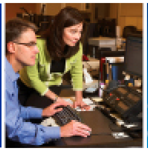

Study 27 Floodplain, Wetland, Riparian and Littoral Vegetative Habitats

- **Field work was completed in 2014, report was drafted in early 2015**
- **Draft Report undergoing revisions**

TransCanada

Study 28 Fowlers Toad

- Field work was completed in 2014, report was drafted in early 2015
- Crews are collecting additional elevation data in July, to link sites to water levels where logger data is available and hydraulic model cross-section.
- Report will be finalized once that data is processed.

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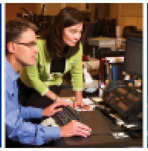
Study 29 Northeastern Bulrush



- Field work was completed in 2014, report was drafted in early 2015
- Crews are collecting additional elevation data in July, to link sites to water levels where logger data is available and hydraulic model cross-section.
- Report will be finalized once that data is processed.

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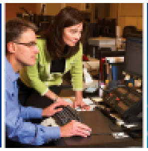
Study 30 Recreation Inventory and Future Needs Assessment



- **Fieldwork was completed in early 2015**
- **Report is drafted and undergoing internal review**

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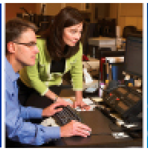
Study 31 Whitewater Boating



- Sumner Falls boating demonstration was completed in 2014
- Bellows Falls bypassed reach demonstration occurred the end of May
- Report is currently being drafted

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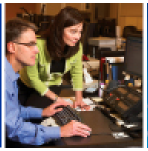
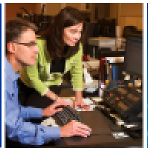
Study 32 Aesthetic Flow in BF Bypass



- Study required video collected during Study 31 in May
- Local focus group participants are being recruited now
- Anticipated study group meeting dates in August, may be a daytime and a nighttime meeting to ensure participation

TransCanada

Study 33 Cultural and Historic Resources



- Historic Architectural Resources Survey completed and submitted to SHPO's for review. Revisions underway to address comments received to date.
- Phase 1A completed at Vernon, others underway. Phase 1B surveys still underway in portions of Wilder Bellows Falls and Vernon (monitoring only) Projects.
- Will go into any Phase II work needed by this fall.
- Traditional Cultural Properties investigation also underway. Tribes and representatives of tribal interests have not responded to repeated requests for introductions, meetings, consultation and interviews.

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TransCanada Hydro Northeast Inc.
ILP Study 4 Hydraulic Modeling Consultation call
07/20/15 1:00 – 3:00

Attendees:
John Warner, Brett Towler -FWS
Gregg Comstock, Owen David - NHDES
Eric Davis, Jeff Crocker, Blaine Hastings - VANR
Katie Kennedy - TNC
David Deen – CRWC
John Ragonese, Jen Griffin - TC
Lissa Robinson – GEI
Semiu Lawal, Stu Bridgeman - Hatch
Steve Eggers, Maryalice Fischer - Normandeau

Action items follow the meeting notes.

The purpose of this consultation is to describe method of selection of the 6 proposed velocity transects: 1 in each of three riverine reaches 2 in impoundments (1 each in BF and Wilder, and 1 mainstem USGS gage (W. Lebanon or N. Walpole-N. Walpole preferable since there is a more direct association with Bellows Falls discharge) for hydraulic model (Study 4) velocity comparison. And to discuss calibration of the model and methods – minor change from the study plan description that should provide more reliable calibration. The velocity comparisons will be between model average velocity results and velocity information derived from ADCP transects. Riverine ADCP information has already been collected within Study 9 field work and we hope to conduct remaining ADCP work when the Normandeau crew returns from CA to complete the Sumner Falls field work set for first week in August. This consultation is necessary so that we can identify the two remaining impoundment comparision locations and perform the work in August.

Reviewed final Study 4 Study Plan (highlighted sections): NHDES asked how the velocity info from model will be compared with field velocity data. Velocity isn't really a calibration variable but we are providing the information in response to NHDES's request. We will be comparing model simulated velocities with velocity measurements collected using ADCP data. Study 9 related ADCP data in was collected immediately following Spring runoff in 2015 and additional data needs to be collected in the first week of August 2015 for the reservoir model velocity comparison and at a USGS gage. Bathymetry was not collected in riverine sections. Sufficient cross-sectional information for riverine sections was collected also in Study 9 instream flow transect field work with the exception of two areas. Additional channel bottom information was collected in June/July 2015 in the river section around Ottaquechee to Sumner Falls and downstream of the fish barrier dam at Bellows Falls bypassed reach.

We plan to deploy the new ADCP at medium-high station discharge levels. The USGS location is a "control point". We are currently reviewing preliminary information from Study 2 (erosion study) sites to identify hydraulic model cross-sections locations that will utilize existing riverine ADCP information and additional reservoir ADCP data to be collected in August, specifically where observed erosion activity has been noted and reliable water level Hobo data is available. Essentially we hope to correspond to Study 9 ADCP locations and Study 2 monitoring locations in order to select locations for riverine velocity comparisons and primarily to locate the additional reservoir ADCP locations where erosion appears active.

In response to questions:

So far the model is operating very accurately and we have a high level of confidence in it. The question originally from agencies relative to requesting velocity transects seemed to be related to erosion, so that is why we are looking at erosion study sites as locations to collect or use existing ADCP data. The HEC-RAS model computes average velocities across a cross section. Field-collected ADCP data will produce a velocity dataset across the transect. We can provide the actual locations for riverine and reservoir comparision transects once finalized. The main output from the HEC RAS model will be rating curves not velocity. The Study 2 study plan did not include field velocity measurements. We are not calibrating to velocity, we calibrate to stage, flow and timing.

Lissa (slides 8-16) Model calibration description – The purpose of calibration is to demonstrate that the model reasonably characterizes observed river conditions (flow and elevation). This is accomplished by compiling observed and simulated information as rating curves, elevation vs. time, and flow vs. time. We want to look at two conditions over about a 5-day period - a spill condition (just above project operations) and typical flow within the projects' operational ranges.

John R: We are looking for agencies confirmation of this approach: Using actual inflows at specific moments in 2014, run the hydraulic model and compare with actual observations at gages and water level logger data for the same time period. We are selecting 2 distinct historical inflow or total [dam] discharge sequences of approximately 5 days in length corresponding to a 1) spill situation just above station discharge capacity (20,000 cfs) and 2) up to station capacity where natural inflows are relatively stable and station discharge will range between minimum flows to medium-full station discharge.The model will be calibrated in segments associated with each project, that is to say it will run inflow into and through Wilder Reservoir, discharge from Wilder through Bellows Falls Reservoir, discharge from Bellows Falls through Vernon Reservoir and discharge from Vernon through the affected downstream reach.

Any other questions?

Stu: Are you also doing a peak flow in the spring?

John R: We are not planning to do that, since once we use the model to develop a rating curve and flows are above TC's ability to control the impact, then resource impacts are not a TC impact.

Brett: If you produced a rating curve at USGS gage, and then we could use that to get that information to fit the model at the higher flows?

John R: That's why we've picked flows just beyond operations to provide confidence that the model accurately reflects high flows just beyond TC operations (about 20,000 cfs). There aren't gages in the reservoirs to model reservoir operations.

Brett: So there will be a later comparison b/t ADCP data and HEC-RAS output? What are the limitations of ADCP, e.g. on deeper flows may not be a true cross section; and in the model itself are you modeling velocity across each cross section location (multiple Manning N's) or a compound/average cross section over the whole cross section (single Manning's N) ?

Lissa: modeling operational flows within the channel using a single Manning's n.

TransCanada Hydro Northeast Inc.
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Steve E: our ADCP is a 4 beam, each sends out "pings" so the depth and velocities are very accurate. While collecting data, the ADCP isn't collecting true velocities, but that happens in post processing – it produces a mean column velocity at each vertical location and can then calculate average velocity over the transect.

John R: The purpose of the comparison between ADCP and the model is average (model) to average (observed) velocity.

Eric: The study plan notes 3 flow events (wet, dry and normal) so is this a variation from the study plan?

John R: Yes that is the variation in the study plan we want you to be aware of and agree with. The operations model has been chosen to do the time series, since that's what it is good at. For the HEC-RAS model, we can create a very refined picture based on historic inflows and calibrate to field-collected data (level loggers, gage data, etc.). It makes more sense to use real historical data and make the model match that.

Eric: If you are capturing lower flows over a 5-day period, and calibrating over the full range of flows, then that would be okay.

John R: Our goal would be to select a period where we observe a full range of operations over a 5-day period. There are sub-daily changes in flow, water surface elevation, and operations from low flows to full generation.

Eric: How will the actual transect be picked, particularly the riverine ones from the available data?

John R: We have preliminary information from the erosion study where there was, as an example, some bank slippage observed at one of the Study 2 monitoring sites. We would suggest it made sense to select and utilize an ADCP (study 9) transect for the velocity comparison at such a location as long as we have good water level logger data also. Similarly in reservoir reaches, it makes sense to select and collect additional ADCP data where active erosion has been identified and where we have good water level logger data. This is only for comparing velocity in the model, not to solve resource impact questions of all the other studies. We are not planning more ADCP transects for the purpose of the HEC-RAS model, since we have plenty of comparison information in the riverine sections.

John R: What we really need is approval for the reservoir ADCP locations.

- John W: Pretty sure we're okay with this
- Brett - agreed.
- Owen – Gregg had to leave but it looks okay to me

Eric – when you do select the transects, can you just let us know where they are?
John R (TC) – Yes we will

<u>Action items:</u>

1. TC will send final powerpoint to participants.
2. TC will provide the actual locations for riverine and reservoir comparision transects once finalized.

Study 4 Hydraulic Model Consultation

July 20, 2015

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In business to deliver

Purpose of Meeting

Consult with FWS, NHDES and VANR (Study 4, Section 2):

- **Location of five transects for velocity comparison**
- **Selection of mainstem gage for velocity comparison**
- **Calibration of flows and elevations**

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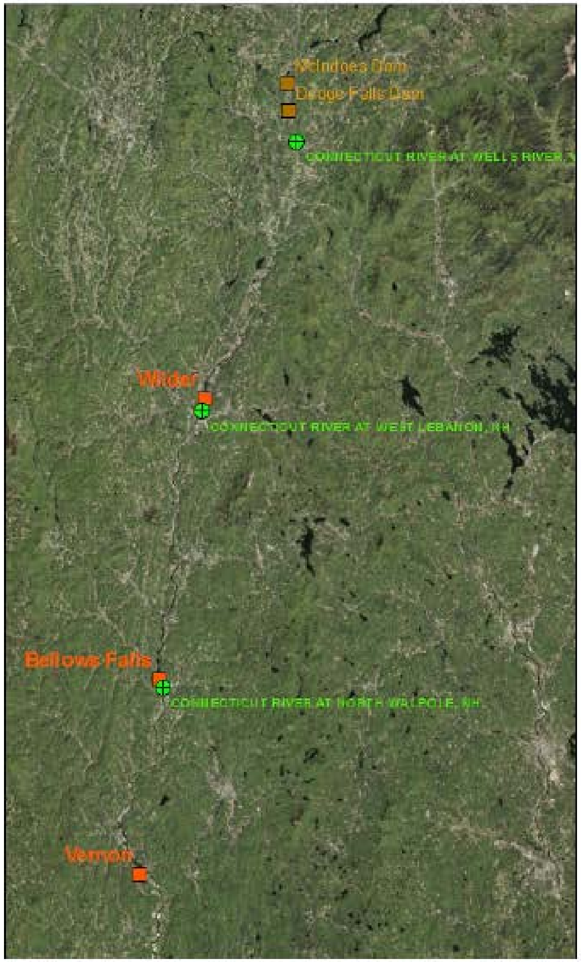
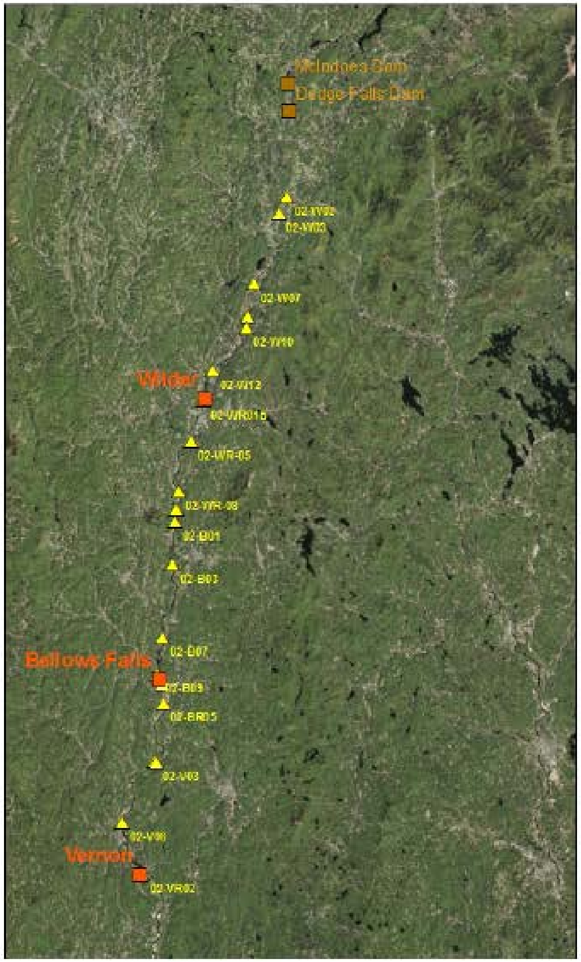
Locations of gages, bathymetry, loggers

USGS gages



Bathymetry

2014 Loggers



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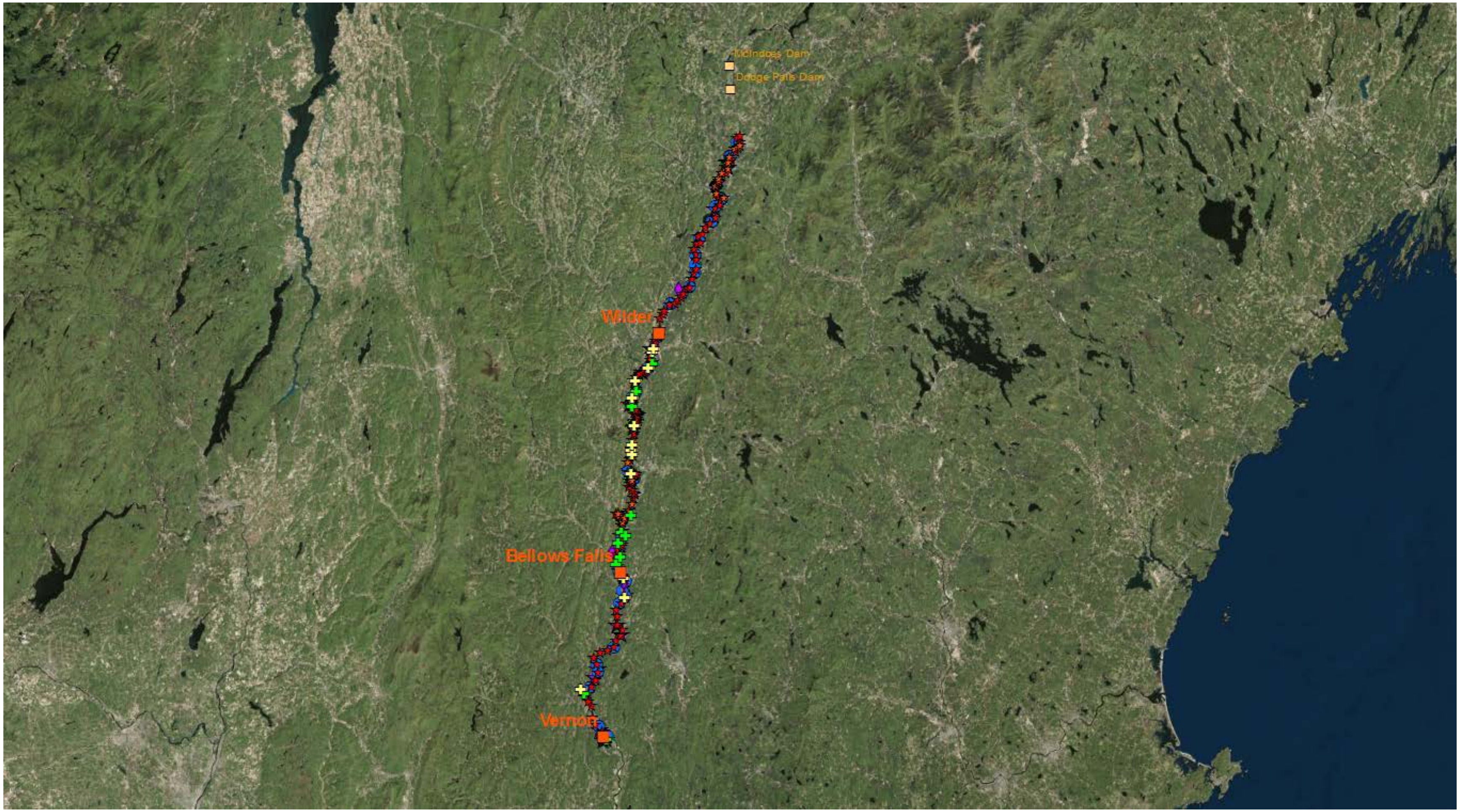
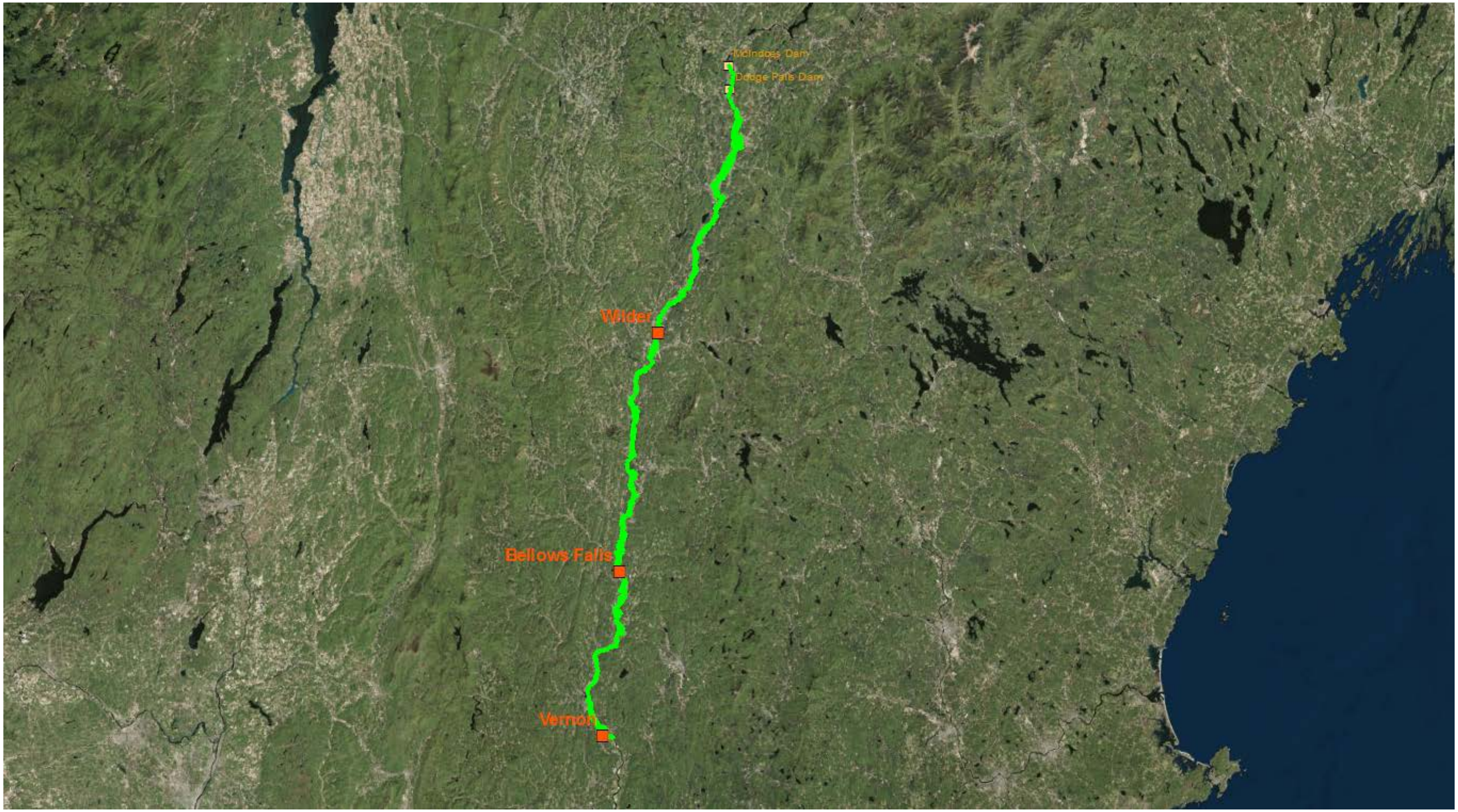
Resource Locations



Hydraulic Model Cross Sections



Study 4 Hydraulic Model
Section 2 Velocity and Calibration

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

2. Hydraulic Model Calibration, Validation and Field Comparison:

   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 identified and selected in consultation with FWS, NHDES and VANR 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, travel time of operational pulses, 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. 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 travel times of operational pulses 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 (Studies 2 and 7) will be used for validation of the calibrated HEC-RAS model, as necessary, applicable, and available.

      i. Three flow events (wet, dry, and normal) will be identified for the period July through November 2013 using USGS gage data.

      ii. The HEC-RAS unsteady flow model will be used to simulate up to three flow events.

      iii. Water surface elevations computed using the HEC-RAS model will be compared to water-level logger and/or USGS gage data.

   c. Velocities measured at selected transects will be compared to average velocities computed by the HEC-RAS model. Up to five transects will be selected in consultation with FWS, NHDES and VANR with a focus on transects selected for other studies, namely Riverbank Transect Study

(Study 2) and Instream Flow Study (Study 9). A sixth, additional velocity comparison transect will be identified at a mainstem gage location.

   d. Travel time of operational pulses and flow attenuation information will be provided to operations model (Study 5) for operations model routing.

   e. Consultation with FWS, NHDES and VANR on the selection of calibration flows and velocity transects will occur as follows:
      1. Hydraulic model will be setup per Step 1 above. Scheduled Winter-Summer 2014
         a. Proposed range of flows will be sent to FWS and the Water Resource and Modeling Working Group. Spring-Summer 2014
         b. Comments from the Water Resource and Modeling Working Group will be reviewed and responded to in the final selection of flows to calibrate the model.
      2. TransCanada will review initial model results with the Water Resource and Modeling Working Group including representatives from FWS, NHDES and VANR. Summer 2014
         a. Velocity transects will be discussed and five comparison transects will be selected from:
            i. Transects identified in Riverbank Transect Study (Study 2)
            ii. Transects identified in Instream Flow Study (Study 9)
            iii. Other key points based upon model results
         b. One mainstem gage will also be selected for a sixth velocity comparison transect.
         c. Velocity measurements using Acoustic Doppler Current Profile (ADCP) technology will be collected for the selected transects not previously surveyed (within the context of other studies) following selection. If ADCP cannot be used due to shallow depths, wading with hand-held flow meter measurements will be performed.
         d. Summary of comparative velocities will be reported in the draft and final study reports.

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 will provide hydraulic modelers with up-ramp and down-ramp flows across a 24-hour period for 5 scenarios.

      ii. Hydraulic modelers will perform sub-hourly HEC-RAS model runs to compute the flows and water surface elevations at locations of interest for each scenario.

      iii. Hydraulic modelers will provide the sub-hourly time-series flows and water surface elevations to Studies 3, 8, and 9 for five scenarios, 24-hours each.

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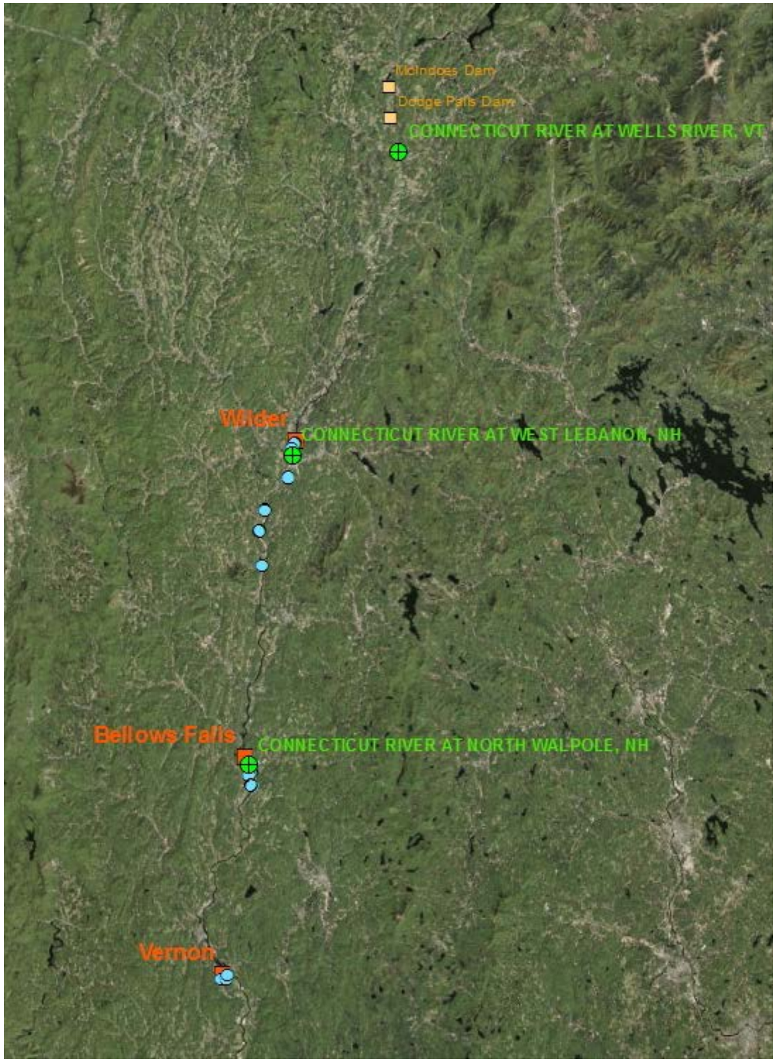
Velocity Comparison Locations

Study 9 ADCP locations



Suggested velocity comparison locations:

- **Three ADCP transects: one in each riverine section. Match data from Study 9 with locations from Study 2.**
- **Two ADCP transects: Wilder and Bellows Falls impoundments at Study 2 logger locations.**
- **One USGS gage: either West Lebanon or North Walpole.**

ADCP performed at medium-high station discharge levels.

ADCP = Acoustic Doppler Current Profiler

Hydraulic Model Calibration

Process to demonstrate that a simulated hydraulic model is a reasonable characterization of observed river conditions.

Involves comparing simulated model results with observed conditions and refining model inputs to optimize the model's replication of observed data for a range of conditions.

- **Inputs**
  - Hydrology (upstream flows and lateral flows)
  - Channel geometry (channel bottom elevation and channel shape)
  - Manning's n-value (channel roughness coefficient)
- **Conditions to compare**
  - Water surface elevation (ft)
  - Flow (cfs)
  - Time (mm/dd/yy hh:mm)
- **Types of comparisons**
  - Rating curves (Elevation vs Flow)
  - Elevations (Elevation vs time)
  - Flows (Flow vs Time)

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Calibration Flows and Locations

Flows

- Range of flows for rating curve comparison

- Two flows for each reach for elevation vs time and flow vs time comparison

Locations

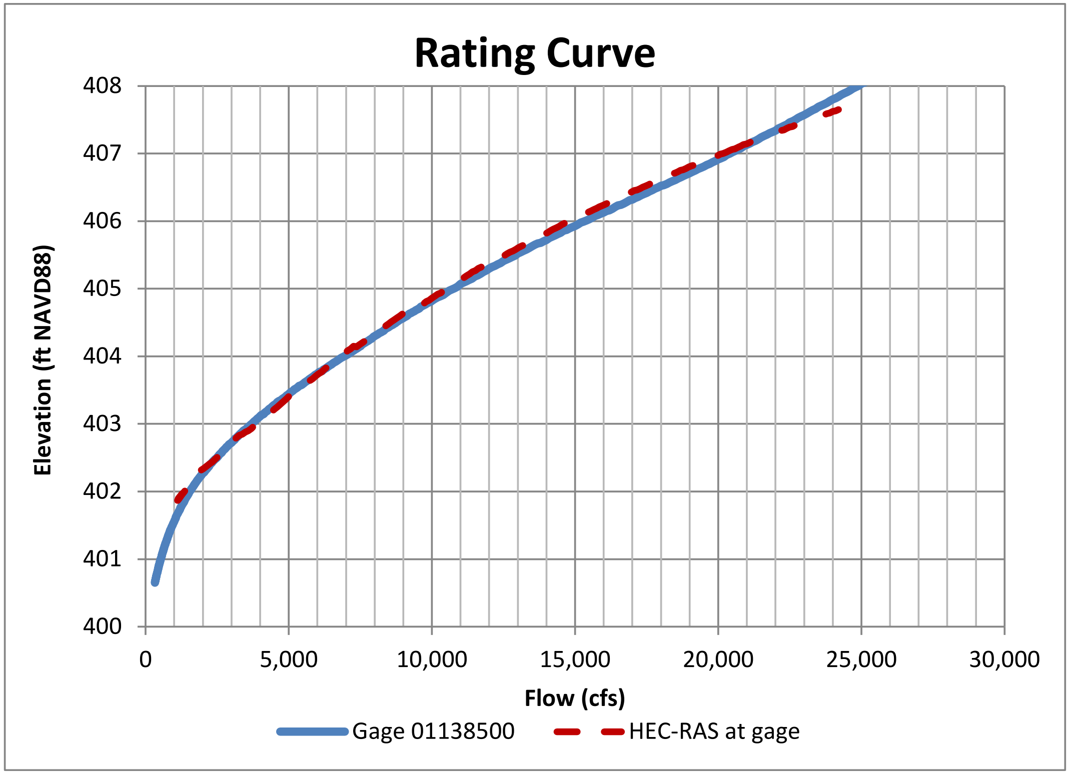
- Three USGS gages (Wells River, West Lebanon, North Walpole)

- Study 2 level loggers (21 loggers)

Calibration
Elevation / Flow

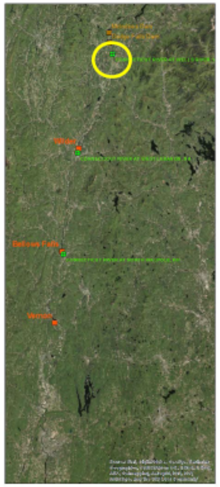
For a range of flows compare observed rating curve (elevation vs flow) with simulated rating curve.

Relationship demonstrates the model is simulating reasonable elevations for given flow range at given location.

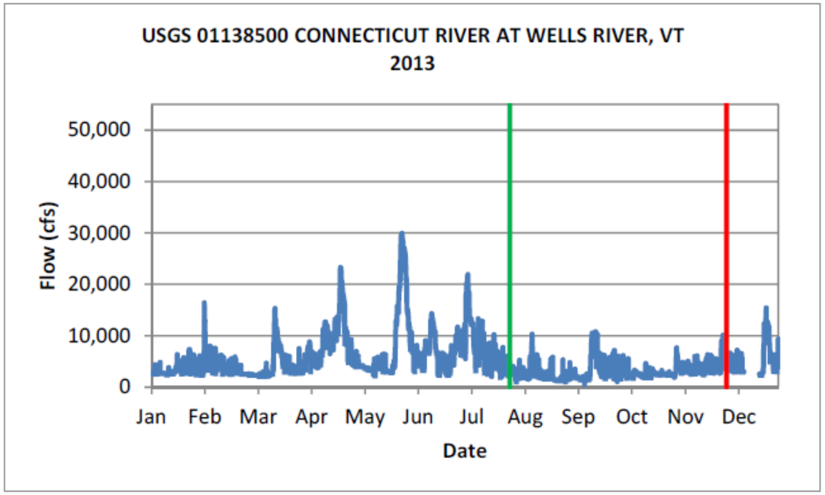


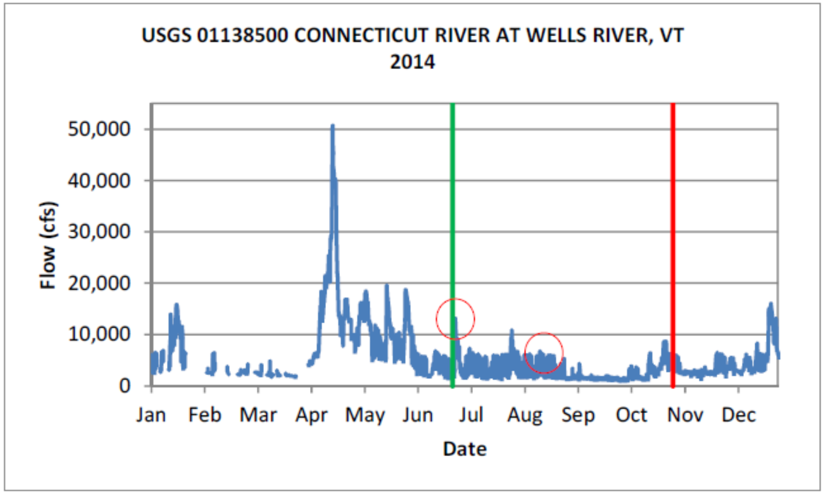
River Flows, 2013 and 2014

Connecticut River Gages and Loggers
2013 and 2014



gage flow   logger begin   logger end





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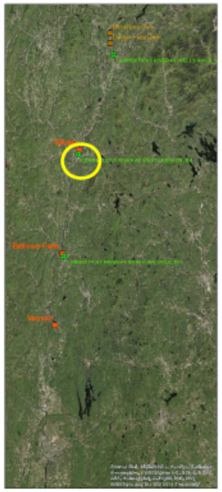
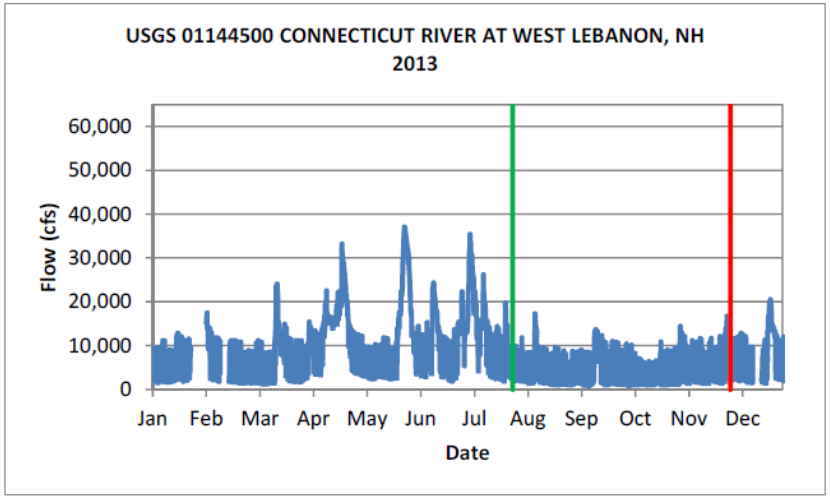
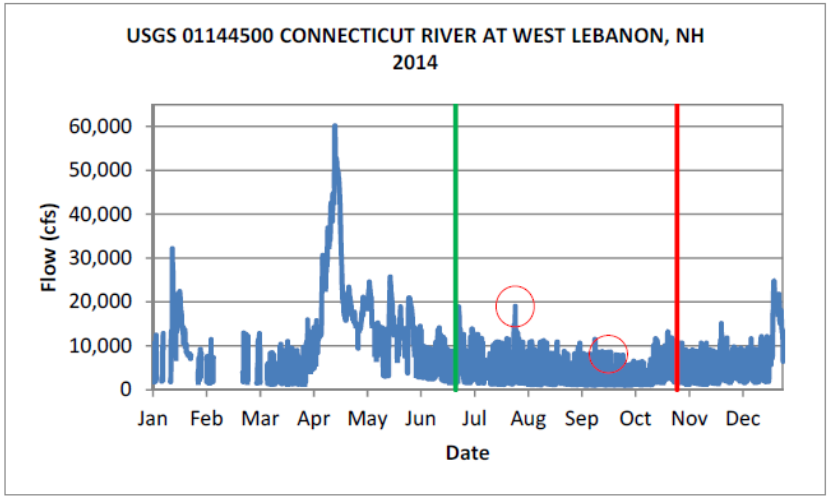
River Flows, 2013 and 2014, continued



gage flow logger begin logger end





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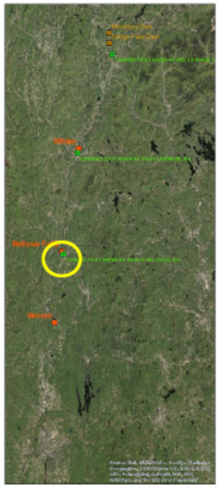
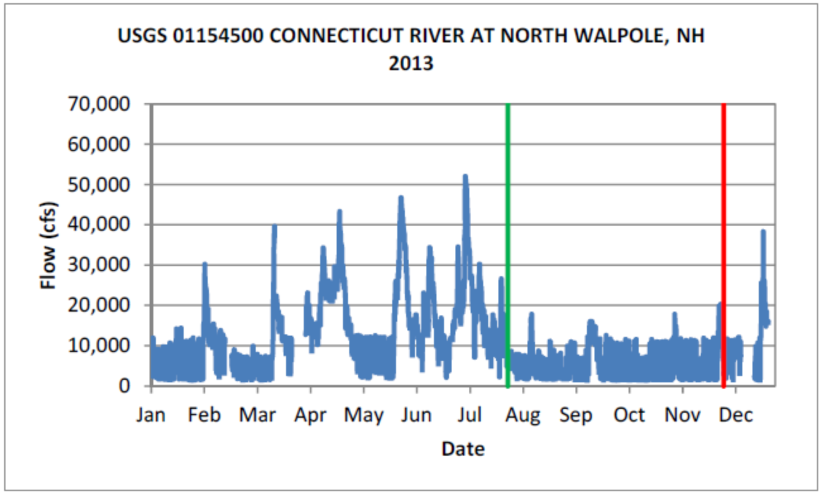
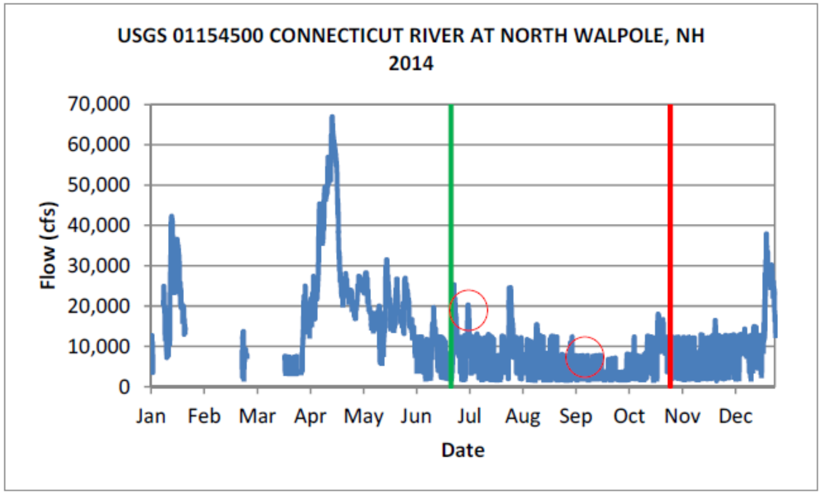
River Flows, 2013 and 2014, continued



gage flow logger begin logger end

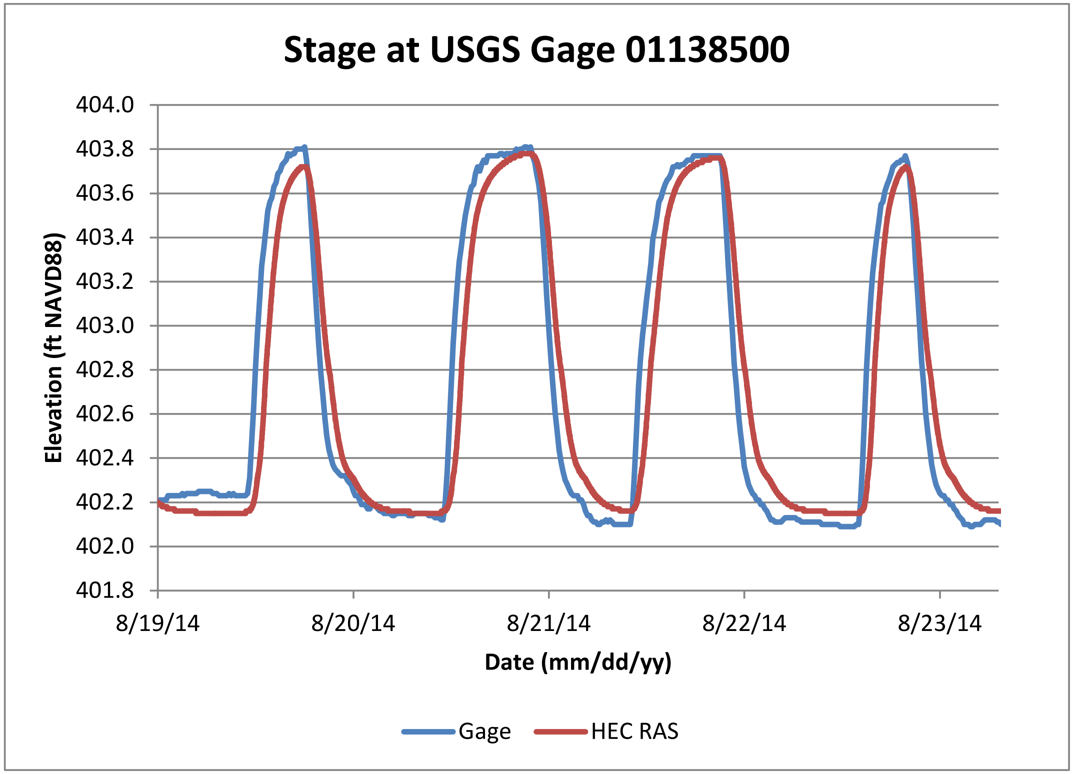




Calibration
Elevation / Time

Compare observed water surface elevation with simulated water surface elevation for the same date/time.

Relationship demonstrates the model is simulating reasonable elevation and timing at the given location.



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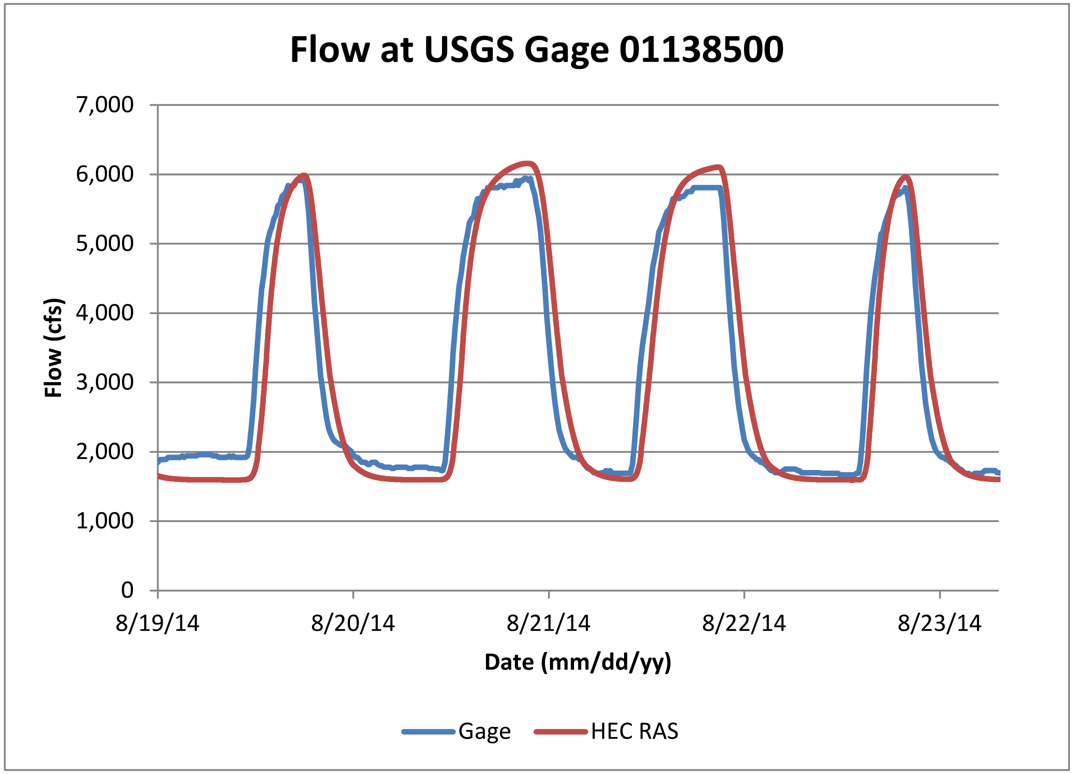
Calibration
Flow / Time

Compare observed flow with simulated flow for the same date/time.

Relationship demonstrates the model is simulating reasonable flow and timing at given location.



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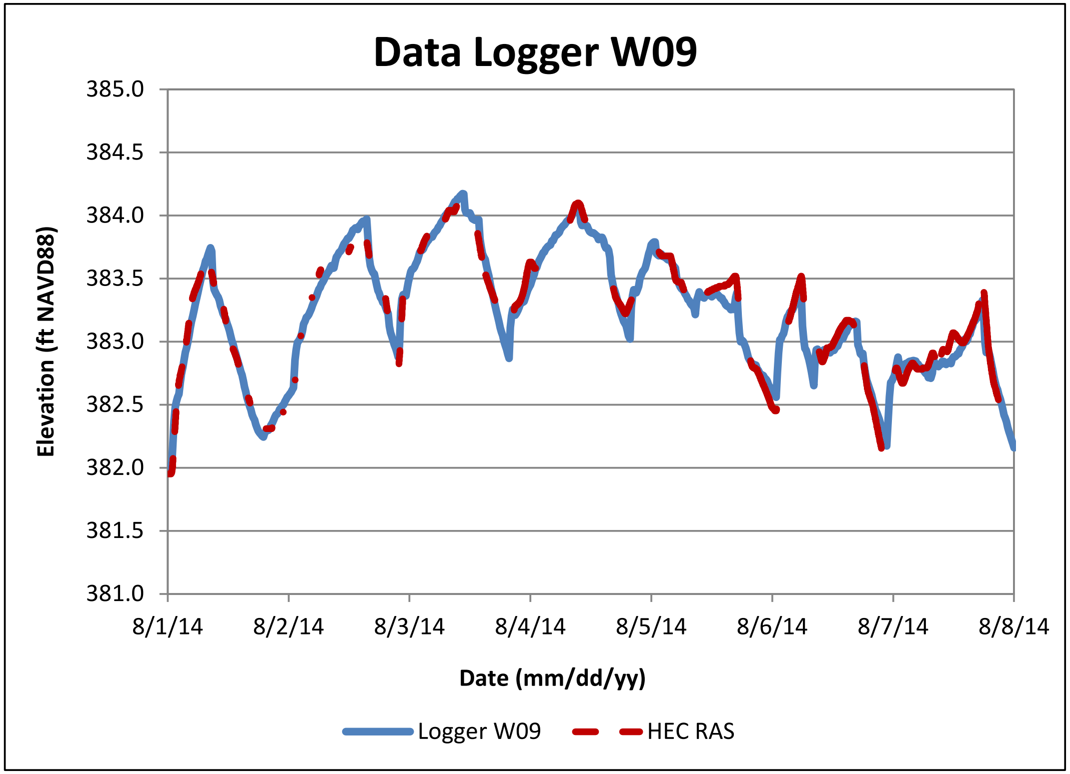
Calibration at Level Logger

Compare observed logger water levels with simulated water levels for same date/time.

Relationship demonstrates the model is simulating reasonable elevation and timing at the logger location.



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Summary

- **Six velocity transects**
  - Three riverine
  - Two impoundment
  - One USGS gage

- **Model calibration using 2014 data from project flows, gage flows, and Study 2 logger elevations**

Questions?

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TransCanada Hydro Northeast Inc.
Aquatics Working Group Consultation Conference Call
August 27, 2015

Study 18 – Upstream Eel Passage

Attendees:
FSW: Ken Sprankle, Melissa Grader, John Warner
NHFG: Gabe Gries
VANR: Eric Davis
NAI: Drew Trested, Rick Simmons, Steve Leach, Maryalice Fischer
LBG: Doug Hjorth
GEI: Lissa Robinson
TC: John Ragonese
KA: Chris Tomichek
FERC: Steve Kartalia, Bill Connelly
CRWC: David Deen

Rick: We're not seeing any eels trying to move upstream. At Vernon seeing a few at the deep gates. They seem to be just hanging around. While over 1,200 have gone up fish ladder. A lot of them are yellow eels. By end of June had about half of them. So they are moving up the ladder after the flows settled down. At Bellows, 1 eel at visual survey, 1 captured and 1 captured in the bypassed reach. Not seeing congregations of eels moving up. Nothing at Wilder. May be due to fish ladders operating with attraction flows. We've done weekly 24 hour sets with baited traps, w/ several types of bait (mostly canned herring, also fish food, cat food, Conte suggested clams which we tried). We don't feel that putting out temporary eel trap passes is worthwhile at this point in time.

John R: We will shut down the ladders next week for a few hours to check them and clean windows. We will do a survey of any eels in the ladders then.

David: will the numbers of eels at fish ladders be part of the study report?
JR: Yes, while also in the study 17 report too.

John R: Net total numbers also include downstream so the total net number includes both. We are seeing quite a bit of downstream movement.

John R: Any thoughts?

Rick: On the Merrimack River, we set up temporary eel passes after the main fish ladder was shut down and get between 600 and several thousand every year. At the CT River, the fish ladders are open all year for Study 17 so attracting them. Where there is no ladder at other sites in New England, eels do stack up at different spots.

Gabe: Have you seen this elsewhere with the ladder open?
Rick: We haven't done surveys where the ladders are open. Where we do see large congregations of eels are generally lower in the river system (e.g., Lawrence, Lowell on the Merrimack).
Gabe: the Asheulot first dam owner says they see tons of little eels down there.

Study 18 – Upstream Eel Passage

Steve L: Anecdotally, "tons of little eels" could be sea lamprey ammocetes, more upstream of Vernon than below Vernon. The average size at Holyoke is 3 year olds. Unless eel are using routes at Holyoke that we haven't seen, which is possible but unlikely, then they may not be migrating eels.
Gabe: yes, you could be correct.

John R: What sizes are we seeing?
Steve L: primarily, visually – 300 mm (12 inch) or larger.

John R: What are people's thoughts? Shut down ladders, keep them open? We're not saying we don't want to put out temporary passes but it just doesn't make a lot of sense to do it with such low numbers.

Melissa: We're just hearing about this now, so might want a bit of time to consider it. Obviously they are using the ladder and that's probably a good thing. What we don't know for sure is the relative efficiency of the ladders. Is there a way to get an idea of that by placing a ramp next to the ladder?

Rick: We thought of that but there is so little attraction flow in the temporary passes that we don't think they would be attracted to them.
John R: We're not trying to understand ladder effectiveness at this point, but it is a marker. If we were seeing a lot of eels in other locations we might wonder about ladder effectiveness but without those other eels, we don't know. We could consider shutting down the ladders for a week or something and see what happens.

John W: the studies are designed to evaluate resident fish passage through ladders, so doesn't make a lot of sense to shut them down, don't know how long you'd have to shut them down to get a sense of eels there. In the longer term (license condition) will have to evaluate how to pass eels either with the ladder or without. Not sure about efficiency of baited traps but the fact that the traps in the ladder didn't capture eels where you know eels are passing are they really an effective method? Not sure about operations of the stations for the period of study especially BF bypass flow – that doesn't seem a place where eels would even be able to find a route there.
John R: we haven't had high water lately, maybe 6-8 inches going over the fish barrier dam. The idea of baited traps was more about presence/absence.
Steve L: clarify – when BF is in spill we don't survey. We also don't visually survey the fish barrier dam at night due to safety issues. But we have been above at the dam and below the fish barrier at the bottom of the bypassed reach.

Melissa: Have you been picking up eels in the assemblage studies?
Drew: We did not collect any eels in spring, may have collected 1 in summer rounds for study 10. In the
John R: In the fish ladders themselves, nothing really standing out as a major thoroughfare. Not sure how important it would be to shut down the ladders and not advocating that we do shut them down.

Melissa: Do you have updated fish ladder data?
Rick: update coming this week will be into August. Even after the shad run dropped off, shading and light in July, the camera captures all those frames of video – thousands of frames each day.
Melissa: if the video shows the numbers slowing down at Vernon then that would inform the decision.

Study 18 – Upstream Eel Passage

Rick: we send updates weekly – this week's data will be through early August. We normally see the run slowdown in September.

Ken: FWS has observed a significant pulse of eel movement in fall at Holyoke where the passes run later.
Steve L: In years when we didn't see majority pulse in June for eels, we would often see it in October – again mostly 3 year olds. Normally we don't even know the magnitude of the pulses until after the season is over.

John W: On the Merrimack we're not seeing that in general. Based on what JR said about resident fish passage data, don't want to pre-judge that study but if the data is obvious that there is little resident fish movement in the summer/fall period then would expect TC not want to run the ladders all year. We either need to evaluate the ladders for eel now or later when not running.

John R: There are provisions in study 17 plan to shut ladders down for maintenance. So we thought we need to do that anyway to clean windows etc. and it might have value to see what we have for eels in the ladders. If you don't want us to shut them down, we won't. If there isn't a lot of value to resident fish by the ladders, then the ladders could be operating quite differently for eels. We don't want to re-configure the studies at this point, but we need to find out if there is a strong reason to put out the temporary passes.

Melissa: What time frame for our response?
John R: We're following the study plan, put in passage traps where we see eels, but we're not seeing them. So we just wanted you to know about the situation.
Rick: the study plan said we weren't supposed to put any out without consultation on where we were seeing them.
Melissa: Are you saying you baited pots at fish ladders and didn't get any?
Rick: Yes - we got one, and wondered if they don't like the bait so tried different baits. They don't seem to attract eels.
Chris: passing thousands at Turner's spillway ladder. Last year did surveys and found most going up the ladders. This year, installed ramps and the vast majority are going up them.
Melissa: The area of concentration is clearly at the ladder.

John W: Based on conversation - it would make sense if shutting down ladders for a short time for maintenance, it would be of interest but unless you shut them down overnight you won't see where eels are going. Agencies need to talk. With low numbers of eels, they could be dispersed and might not see them at the upstream dams even with high numbers at Turners Falls.

Rick: Since baited traps aren't working well is there agreement that we should stop? We may still try some different bait at Vernon anyway. On the Penobscot we captured hundreds of eels in pots in some locations where eels can hide out during the day (e.g., timber cribs, boulder areas). That site could have been mostly males. Not sure that on the CT if they are actively migrating upstream that they are even interested in food.

Study 18 – Upstream Eel Passage

John W: It doesn't seem like pots are much benefit, would rather put the effort into the nighttime observations.

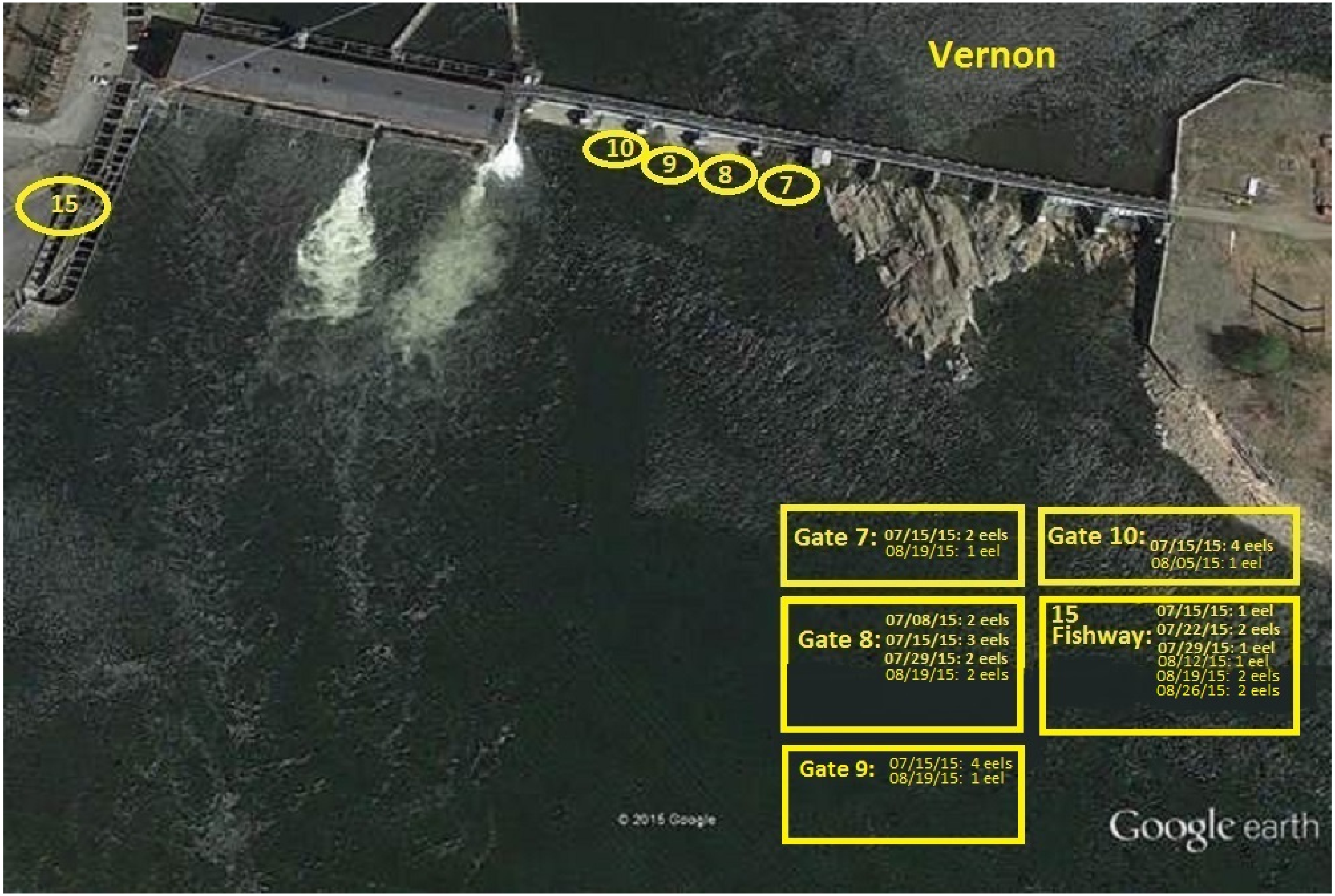
Agencies – we will have a call/email consultation and get back to you on installing temporary eel passes.

Study 18 American Eel Consultation Call

August 27, 2015

TransCanada

Vernon 8-26-15



TransCanada

Bellows Falls 1; 8-26-15

TransCanada

Bellows Falls 2; 8-26-15

Fish Ladder Counts

as of 7/9	Vernon	American eel	748
		American shad	39791
		ATS, Released	5
		Sea lamprey	2516
as of 7/9	Bellows Falls	American eel	2
		American shad	44
		Sea lamprey	971
as of 7/9	Wilder	American eel	29
		Sea lamprey	2

Vernon as of 07/20/2015:

Atlantic salmon: 6

American shad: 39779

Sea lamprey: 2519

American eel: 1206

Bellows Falls as of 07/20/2015:

Atlantic salmon: 0

American shad: 44

Sea lamprey: 971

American eel: -18

Wilder as of 07/20/2015:

Atlantic salmon: 0

American shad: 0

Sea lamprey: 2

American eel: 28

[D:\My Documents\JLRDOC\LC Relicensing\2014-2015 Studies\Study 18 American Eel upstream passage]()

TransCanada

APPENDIX B

Study 9 – Instream Flow Study

Habitat Suitability Curve and Sumner Falls Demonstration Flow Supplemental Documents

TRANSCANADA HYDRO NORTHEAST INC.

ILP Study 9
Instream Flow

Habitat Suitability Criteria

Draft for Stakeholder Review

In support of Federal Energy Regulatory Commission Relicensing of:

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)

Prepared for
TransCanada Hydro Northeast Inc.
4 Park Street, Suite 402
Concord, NH 03301

Prepared by
Normandeau Associates, Inc.
25 Nashua Road
Bedford, NH 03110

December 15, 2014

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1. INTRODUCTION

Operations at TransCanada's Wilder, Bellows Falls and Vernon hydroelectric projects (projects) may affect fish and aquatic resources in the riverine sections downstream of each project dam. The goal of the Instream Flow Study (Study 9) developed in support of the relicensing for these three hydroelectric projects, is to assess current project operation impacts on downstream aquatic resources and habitats. Revised Study Plan 9, as supported by stakeholders in 2013 and approved by FERC in its February 21, 2014 Study Plan Determination, provides an overview of the methodology that will be employed during 2014 and 2015 (due to low flow conditions during 2014) to assess the overall relationship between stream flow and resultant habitat of key aquatic species in the project-affected riverine reaches. This document provides habitat suitability criteria (HSC) for key aquatic species and life stages for which flow versus habitat relationships will be developed from 1-dimensional (1D) and 2-dimensional (2D) models as part of the instream flow study.

During initial study scoping and study plan meeting discussion it was agreed that HSC proposed for the Turners Falls Hydroelectric Project (FERC No. 1889) relicensing could be used for this study. Target species identified in the Study 9 Plan common to the two studies are:

- American Shad (*Alosa sapidissima*)
- Walleye (*Sander vitreus*)
- Fallfish (*Semotilus corporalis*)
- Longnose Dace (*Rhinichthys cataractae*)
- White Sucker (*Catostomus commersonii*)
- Tessellated Darter (*Etheostoma olmstedi*)
- Sea Lamprey (*Petromyzon marinus*)
- Macroinvertebrates

Species not shared by the two studies and for which HSC are proposed herein include:

- Smallmouth Bass (*Micropterus dolomieu*)
- Mussels (species found in the study area)

HSC (which can be derived from habitat suitability indexes, habitat criteria curves, species preference curves, and probability-of-use curves), are indices that describe the relative suitability of specific habitat attributes for a specific species and life stage of aquatic organisms. An HSC scale ranges from 0.0, which represents totally unsuitable conditions, to 1.0, which represents optimal conditions (denoted in Figures as “SI”). Curves derived from site-specific field studies are considered ideal, but due to cost and effort these types of studies are rarely performed. In many cases HSC developed from field studies in other locations and those applied to previous instream flow studies are used.

HSC typically include the habitat attributes of water depth, water velocity (most often mean column velocity), substrate composition, and various types of instream or overhead cover. Depth and velocity are interactive with discharge, whereas substrate and cover are typically treated as fixed habitat attributes and are either available or unavailable based on modeled flow, wetted perimeter, and water surface elevation. HSC can take various forms depending on attribute type, such as continuous curve distributions for depth or velocity, stepped functions for categorical attributes such as substrate or cover, or binary criteria (e.g., an attribute is either fully suitable or fully unsuitable).

HSC curves can come from a variety of sources including literature reviews, published papers, state and federal curve libraries and site-specific field studies. Each type of HSC can be developed by collecting new site-specific data from the area being modeled, or by professional judgment, typically through discussions with species and modeling experts. In many applications, HSC developed from a previous study in a different location are applied in the study area, based on similarity of physical habitat conditions between the two sites, or by testing the transferability of the existing HSC using a sample of new data from the project location. Critical factors associated with analysis and development of HSC data include the sampling design, the treatment of habitat availability effects on habitat use, choices related to the pooling of data from various spatial and temporal scales, and data reduction or statistical models used to develop the HSC “curves”.

Often modifications are made to original curves for particular studies based on local knowledge and/or professional judgment. During the course of HSC determination for the Turners Falls project, modifications were made to some species and life stages based on additional information from other sources. Over time, curves can be altered to a degree that the original source or the basis for modifications can be lost or misidentified. Maintaining a trail of revisions and alterations made to original curves, and correct identification of the sources used is important from the standpoint of understanding why modifications were made and by whom. In some cases there is not enough information to determine when or where modifications were made. In this document original source curves are identified where possible.

2. TARGET AQUATIC SPECIES

2.1. Species Life History

American Shad

There are no recent surveys to determine American Shad spawning habitat or spawning sites downstream of Bellows Falls dam or Vernon dam. Shad can currently pass Bellows Falls dam through a fishway at the powerhouse, but there is no evidence that spawning takes place in the Wilder riverine segment upstream. Spawning locations below the Turners Falls project located approximately 20 miles downstream of Vernon identified by Layzer (1974) are located primarily in run habitat. The role of substrate in determining spawning locations is debatable, with research suggesting sizes can range between sand and boulder (Greene et al., 2009). Radio-tagged American Shad tended to remain in localized areas during the spawning season and generally were found in velocities between 0.20 and 0.69 m/s, depths between 1.0 and 2.9 m, and substrates that can vary from sand and gravel to boulder or bedrock (Harris and Hightower, 2011).

Adult shad return to coastal rivers to spawn during the spring when water temperatures are 6.5 – 19.0° C. Eggs are swept downstream and lodge in the substrate. Shad develop quickly from egg to larval stage and it appears that spring river flows and water temperature are determining factors for survival (Savoy et al., 2004). Larvae drift downstream into areas of reduced velocity along shorelines and backwaters. Juvenile shad tend to be distributed throughout the lower Connecticut River in the summer and form large schools before migrating downstream in the fall when river temperatures drop below 16° C (Savoy et al., 2004).

Walleye

Walleye are known to spawn immediately downstream of all dams within the study area (Carrier and Gries, 2010; Sprankle, 1997). Timing of the spawning run is believed to be influenced primarily by water temperature and water velocity and occurs in the spring (April-June). Rocky substrate (gravel, cobble and rubble) is generally preferred and spawning depths are usually <1.0 m (Kerr et al., 1997; Bozek et al., 2011). Water depth, substrate characteristics and water temperature were determined to be the best predictors for walleye spawning sites while water velocity was not a primary determining factor (Kelder and Farrell, 2009). Lowie et al. (2001) found that walleye spawned in conditions at or below the lower end of published optimal ranges for water depth, velocity and temperature and used what was available at the time of spawning, suggesting that these variables and published criteria (McMahon et al., 1984) alone cannot always be used to identify spawning locations of viable populations.

Adults prefer deeper water in the daylight and have an affinity for the bottom (Kerr et al., 1997). Adults tend to select low velocities while juveniles often select slightly higher velocities and shallower depths. Both juveniles and adults are known to move into shallower areas to feed at night.

Fallfish

Fallfish occur throughout the project area in both impounded and riverine reaches. Spawning typically occurs in the spring after water temperatures reach 15° C. Males build a mounded nest of gravels for spawning which generally takes place in shallow areas <0.5 m in depth, slow velocities and usually near instream cover (Trial et al., 1983). Adults prefer pools and deep runs while juveniles can be found in higher velocities in rapid water (e.g. riffles) (Trial et al., 1983; Persinger, 2003). All life stages tend to prefer substrate ranging from sand to cobble.

Longnose Dace

Longnose Dace occur throughout North America and can be found in lakes and streams. They have been found in the Connecticut River just upstream of the upper end of the Wilder impoundment, but have not been documented in any of the projects riverine segments (Yoder et al., 2009; New Hampshire Fish & Game unpublished electrofishing data). Based on literature it is unlikely that they are permanent residents in the project riverine reaches.

The peak of Longnose Dace spawning usually occurs in June to early July in both lakes and streams. In streams, they prefer shallow, fast water with low embeddedness, cobble sized substrate, and nearby cover (Edwards et al., 1983a; Persinger, 2003). Longnose Dace are most abundant in swift flowing, steep gradient, headwater streams of larger river systems (Edwards et al., 1983a). Hubert and Rahel (1989) concluded abundance was correlated with overhead cover, low width-to-depth ratio, and substantial main-channel run habitat; habitat most often located in smaller streams. All age groups occur in very shallow water, usually < 0.3 m deep and rarely > 1 m deep (Edwards et al., 1983a), depths that are scarce in the riverine reaches of the projects.

White Sucker

White Suckers start their spawning migration in spring to early summer, when the daily maximum water temperature reaches 10° C. In the Saint John River in Canada, individuals maintained small home ranges in the river from summer to late winter, averaging 2.6 kilometers or less each year. During the spring spawning season, upstream and downstream movements to three tributaries occurred. Distances traveled were up to 40 km and averaged 9.2 km (Doherty et al., 2010). This suggests that they may migrate into tributaries to spawn if habitat is not available in the stream or river in which they rear. White Sucker spawning habitat is generally considered to be areas in streams and rivers with relatively swift shallow waters running over a gravel bottom.

White Suckers are known to tolerate a broad range of environmental conditions and are considered to be habitat generalists (Twomey and Nelson, 1984). They can be found in both impoundments and riverine reaches in the Connecticut River. Adult

White Suckers (> 150 mm in length) primarily inhabit pools and are common in areas of slow to moderate velocity. Fry prefer moderate currents but generally are not found in riffles or pools. Juveniles can be found in most areas of a stream with relatively shallow depths.

Tessellated Darter

Tessellated Darters prefer areas with moderate to no current, though they can be found in areas with swifter current (Scott and Crossman, 1973). Outside of the breeding season, they show a preference for sandy or mud bottoms. Spawning occurs during the spring and exact timing likely varies with latitude (Schmidt, 1980). Male Tessellated Darters move into rocky spawning habitat in advance of females. They establish and defend a territory and clear off the underside of a rock for use as a spawning site. Following spawning, females depart the area and the male darter remains to guard the eggs. Eggs hatch over a period of five to eight days depending on water temperatures (Schmidt, 1980).

Tessellated Darters play an important role in the life cycle of the Dwarf wedgemussel, a federally endangered freshwater mussel species inhabiting small streams to large rivers with moderate flow. Similar to other freshwater mussel species, the reproductive cycle for the Dwarf wedgemussel requires a host fish onto which the glochidia (larvae) can parasitize and metamorphose into juveniles. Tessellated Darters have been documented in the Wilder and Bellows Falls project-affected areas both upstream and downstream of the dams (Yoder et al., 2009).

Sea Lamprey

Sea Lamprey have been documented in the project-affected area downstream of Wilder dam, but not upstream (New Hampshire Fish & Game, unpublished data; Yoder et al., 2009). In certain years, hundreds to thousands of Sea Lamprey have been counted passing upstream at the Bellows Falls fish ladder, representing a population that may be available to access habitat in the Wilder project-affected area.

Adults return to coastal streams and rivers to spawn during the spring, generally in May and June. They seek out river or stream reaches that contain gravel substrate and swift current velocities, and eggs are deposited in a shallow nest depression constructed on the bottom. Eggs hatch after 10 to 13 days and the small larvae (ammocoetes) move downstream into still water areas of streams and lakes and burrow into muddy or sandy substrate. The larval period generally lasts for up to five years after which the ammocoetes transform into juveniles over a four to six month period before beginning migration downstream to the ocean.

Smallmouth Bass

Smallmouth Bass were introduced to the Connecticut River and into New Hampshire waters some time during the 1860s. They occur throughout the project reaches in riverine and impounded areas. Usually they are found around the protection afforded by the rocks of shoals and talus slopes, or submerged vegetation, and can occupy a wide range of depths (Edwards et al., 1983b). Spawning generally takes place in shallow areas with moderate current and gravel substrate. Juvenile and adult Smallmouth Bass both prefer low velocity water near current, but juveniles are often found in slightly shallower water than adults.

Smallmouth Bass have been documented in all project reaches (Yoder et al., 2009). Information related to the age and growth, timing of seasonal movements and extent of usable habitat for Smallmouth Bass in the project-affected areas has not been collected.

Dwarf wedgemussel and other mussels

Dwarf wedgemussel (*Alasmidonta heterodon*) have been documented (one live individual and one shell) in the free-flowing reaches within the study area in the most recent survey (Study 24, Dwarf wedgemussel and co-occurring mussel survey 2014 preliminary data). In the Connecticut River, the species is generally found in hydrologically stable areas at depths greater than 5 feet, slow velocities and with a preference for substrate comprised of gravel, coarse sand, find sand and clay. Two species that often co-occur with dwarf wedgemussel, the triangle floater (*Alasmidonta undulata*) and creeper (*Strophitus undulatus*), are found in very low numbers in the free-flowing reaches (Biodrawversity LLC and The Louis Berger Group, Inc. 2012).

The triangle floater and creeper prefer habitats in low-gradient river reaches with sand and gravel substrates and with low to moderate water velocities, although they can occur within a broader range of habitat conditions. Although host fish relationships are not fully known, some key fish hosts for the triangle floater include Longnose Dace, Fallfish and White Sucker; and for the creeper may be several species of dace, shiner, bass and sucker (Nedeau, 2008). The triangle floater has been found below all project dams while the creeper has only been found below Bellows Falls and Vernon dams.

Two species found only downstream of Bellows Falls dam and Vernon dam include alewife floater (*Anodonta implicata*), and eastern floater (*Pyganodon cataracta*) (Biodrawversity and The Louis Berger Group, Inc. 2012). Alewife floater may exist in both small streams and large rivers, without clear preference for substrate, depth, or flow conditions. Its habitat use and population density seems to be more strongly tied to where its host fish are likely to spawn or congregate. Host fish for alewife floater include Alewife, Blueback Herring, and American Shad. The eastern floater has the ability to thrive in silt and mud—substrates that most other mussel species seem to avoid. In streams and rivers, it is usually confined to depositional areas with finer substrates and in natural or manmade impoundments. Its hosts likely include species of Sunfish and Bass, and possibly White Sucker (Nedeau, 2008).

Eastern elliptio (*Elliptio complanata*) and eastern lampmussel (*Lampsilis radiata*) are the most common and abundant species and have been documented below all project dams. The eastern elliptio has no clear preference for substrate. It is found in clay, mud, sand, gravel, and cobble bottoms. It is the most abundant of all mussel species in all of the project riverine reaches. It uses a wide range of host fish which may include American Eel, Yellow Perch, Alewife, White Sucker, Sunfish, and Bass. Eastern lampmussel are often found in deeper and more stable areas of large rivers, usually in sand and gravel. Likely host fish include Yellow Perch, Bass, and Sunfish (Nedeau, 2008).

2.2. Seasonal Periodicity of Target Species

Seasonal periodicity of target species and life stages in the Connecticut River within riverine sections of the project area is presented in Table 1. This table may be revised based on information obtained from other aquatic studies (Study 10 – Fish Assemblage; Study 12 – Tessellated Darter; Study 15 – Resident Fish Spawning in Riverine Sections; Study 16 – Sea Lamprey Spawning; Studies 21/22 – American Shad) and input from local biologists.

Table 1. Seasonal periodicity of occurrence of target species and life stages in the Connecticut River. (Primary – blue, Probable - grey) (Inc = incubation of eggs).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
American Shad												
Spawning				blue	blue	grey						
Juvenile							blue	blue	blue	blue	blue	
Adult				grey	blue	blue						
Walleye												
Spawning/Inc			blue	blue								
Fry				blue	blue	blue	blue					
Juvenile						grey	grey	blue	blue	blue	blue	blue
Adult	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Fallfish												
Spawning/Inc				blue	blue							
Fry						blue	blue	blue				
Juvenile	blue	blue	blue						blue	blue	blue	blue
Adult	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Longnose Dace												
Adult/Juvenile	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
White Sucker												
Spawning/Inc				blue	blue	blue						
Fry						blue	blue	blue				
Juvenile	blue	blue							blue	blue	blue	blue
Adult	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue
Smallmouth Bass												
Spawning					blue	blue						
Fry						blue	blue					
Juvenile								blue	blue	blue	blue	blue

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult												
Tessellated Darter												
Adult/Juvenile												
Sea Lamprey												
Spawning												

3. HABITAT SUITABILITY CRITERIA

3.1. Turners Falls Hydroelectric Project

Aquatic species, life stages, and HSC sources agreed upon during the Turners Falls consultation are provided in Table 2.

American Shad (Figures 1, 2 and 3)

HSC for adult and juvenile velocity and adult depth are based on Stier and Crance (1985). Juvenile depth suitability was constructed from information presented in Greene et al. (2009), (Exelon, 2012). The source for adult and juvenile shad substrate suitability is identified as Stier and Crance (1985), though that document only provides substrate suitability for spawning.

Spawning depth, velocity and substrate are based on pooled data from a variety of data sources (Hightower et al., 2012). The spawning depth criteria attributed to Stier and Crance (1985) is actually a modification of the original curve from the Conowingo instream flow study (Exelon 2012). This modification involved extending the end point of depth suitability from 50 feet to 100 feet. The source and justification for this alteration could not be located in documents examined.

Walleye (Figures 4, 5, 6, and 7)

All walleye HSC, except spawning and incubation velocity and depth are based on McMahon et al. (1984). Modifications or alterations to depth and velocity criteria were based on a range of depth and velocity from a compilation of literature reviews from various localities presented in Bozek et al. (2011), originally reported in Kerr et al. (1997). Velocity and depth suitability values were computed by averaging the minimum and maximum values and assigning a value of 1.0 to this range. The result was that all endpoints of the original curves were kept except for the upper end of the velocity range.

Fallfish (Figures 8, 9, 10, and 11)

Fallfish criteria for the Turners Falls project are derived from a combination of brook trout curves (adult and juvenile) developed from a Delphi exercise for the Deerfield River, and modifications of curves of unknown origin for fry and spawning by the New York Department of Environmental Conservation (Gomez and Sullivan, 2007).

Longnose Dace (Figures 12 and 13)

HSC for juvenile and adult Longnose Dace are based on modifications of US Fish and Wildlife Service (FWS) HSC library curves by Vermont Department of Fish and Wildlife (VTDFW) for the Lamoille River hydroelectric project (Gomez and Sullivan, 2000). However, only adult and spawning life stages of Longnose Dace are listed in the FWS library of curves.

White Sucker (Figures 14, 15, and 16)

Depth, velocity and substrate criteria for fry, juvenile and adult White Sucker are taken from Twomey et al. (1984). Spawning depth and velocity criteria are also from Twomey et al. (1984), and the source for spawning substrate is attributed to Gomez and Sullivan (2007); however, Gomez and Sullivan (2007) links the source to Twomey et al. (1984). The actual origin of spawning substrate suitability is unknown.

Tessellated Darter (Figure 17)

HSC for Tessellated Darter adult and juvenile are assumed to be the same. The source identified for HSC was a flow study conducted for the Bell Bend project on the Susquehanna River in Pennsylvania (PPL Bell Bend, 2012). The actual source for depth and velocity curves is Warner et al., 2006 (PPL Bell Bend, 2012). Substrate HSC was based johnny darter criteria (used as a surrogate for Tessellated Darter) developed by Addland and Kuitenen, 2006 (PPL Bell Bend, 2012).

Sea Lamprey (Figure 18)

Sea Lamprey spawning HSC were derived from Kynard and Horgan (2013). Additional information from Yergeau (1983) was incorporated to create the final curves for depth and substrate.

Macroinvertebrates (Figure 19)

The source of the macroinvertebrate HSC chosen for the Turners Falls project is from the Lamoille River instream flow study (Gomez and Sullivan, 2000). The original source for these curves is unknown.

Table 2. Sources and references for proposed habitat suitability criteria for the Turners Falls Hydroelectric Project.

Species	Life Stage	Variable	Original Source	Identified Source[1,2]	Note:
American Shad	Juvenile	Velocity	Stier and Crance, 1985	Stier and Crance, 1985	
		Depth	Stier and Crance, 1985	Exelon, 2012 (Conowingo IFIM)	Based on Greene et al. 2009
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	Not Stier and Crance 1985, source?
	Adult	Velocity	Stier and Crance, 1985	Stier and Crance, 1985	
		Depth	Stier and Crance, 1985	Stier and Crance, 1985	
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	Not Stier and Crance 1985, source?
	Spawning	Velocity	Stier and Crance, 1985	Hightower et al., 2012	Based on data from 6 studies
		Depth	Stier and Crance, 1985	Hightower et al., 2012	Based on data from 7 studies
		Substrate	Stier and Crance, 1985	Hightower et al., 2012	Based on data from 3 studies
Walleye	Fry	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Juvenile	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Adult	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Spawning/ Incubation	Velocity	McMahon et al., 1984	Bozek et al., 2011	Based on literature review
		Depth	McMahon et al., 1984	Bozek et al., 2011	Based on literature review
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
Fallfish	Fry	Velocity	NA	Gomez and Sullivan, 2007	Velocity and depth based on brook trout fry and juvenile HSC curves developed as part of a Delphi Process for the Deerfield River.
		Depth	NA	Gomez and Sullivan, 2007	
		Substrate	NA	Gomez and Sullivan, 2007	
	Juvenile	Velocity	NA	Gomez and Sullivan, 2007	
		Depth	NA	Gomez and Sullivan, 2007	
		Substrate	NA	Gomez and Sullivan, 2007	
	Adult	Velocity	None identified	Gomez and Sullivan, 2007	Developed in consultation with the New York Department of Environmental Conservation
		Depth	None identified	Gomez and Sullivan, 2007	
		Substrate	None identified	Gomez and Sullivan, 2007	
	Spawning/ Incubation	Velocity	None identified	Gomez and Sullivan, 2007	
		Depth	None identified	Gomez and Sullivan, 2007	
		Substrate	None identified	Gomez and Sullivan, 2007	

Table 2 (cont). Sources and references for proposed habitat suitability criteria for the Turners Falls Hydroelectric Project.

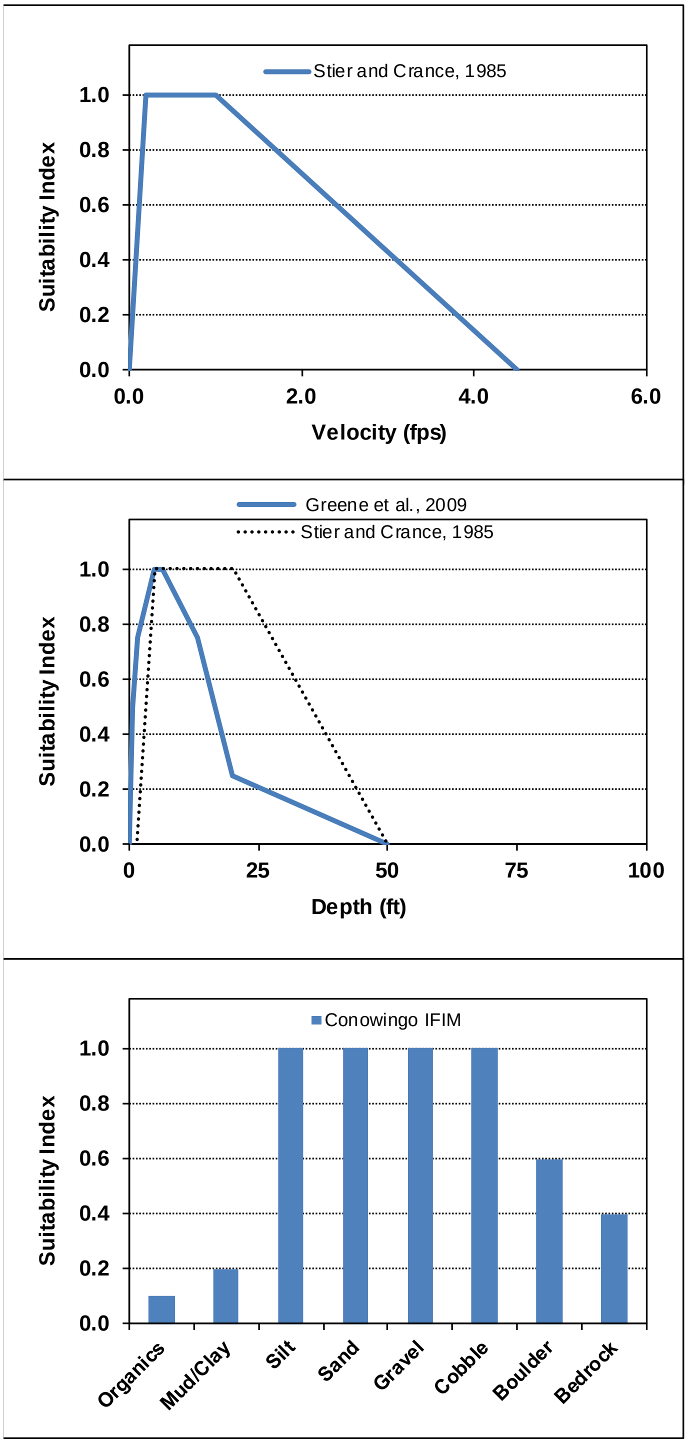
Species	Life Stage	Variable	Original Source	Identified Source[1,2]	Note:
Longnose Dace	Juvenile	Velocity	USGS HSC Library	Gomez and Sullivan, 2000	Modified by Vermont Department of Fish and Wildlife
		Depth	USGS HSC Library	Gomez and Sullivan, 2000	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2000	
	Adult	Velocity	USGS HSC Library	Gomez and Sullivan, 2000	
		Depth	USGS HSC Library	Gomez and Sullivan, 2000	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2000	
White Sucker	Fry	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Twomey et al., 1984	
	Juvenile/Adult	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Twomey et al., 1984	
	Spawning/ Incubation	Velocity	Twomey et al., 1984	Gomez and Sullivan, 2007	Actually Twomey et al. 1984
		Depth	Twomey et al., 1984	Gomez and Sullivan, 2007	Actually Twomey et al. 1984
		Substrate	Twomey et al., 1984	Gomez and Sullivan, 2007	Modified from original source
Tessellated Darter	Adult	Velocity	Warner et al. 2006	PPL, Bell Bend, 2012	Same as original source
		Depth	Warner et al. 2006	PPL, Bell Bend, 2012	Same as original source
		Substrate	Aadland and Kuitunen 2006	PPL, Bell Bend, 2012	Same as original source
SeaLamprey	Spawning	Velocity	Kynard and Horgan, 2013	Kynard and Horgan, 2013	Modified by FWS based on Yergeau, 1983 (depth and substrate)[3]
		Depth	Kynard and Horgan, 2013	Kynard and Horgan, 2013	
		Substrate	Kynard and Horgan, 2013	Kynard and Horgan, 2013	
Macro-invetebrates	nymphs	Velocity	Unknown	Gomez and Sullivan, 2000	VTDFW modified
		Depth	Unknown	Gomez and Sullivan, 2000	NMPC curve
		Substrate	Unknown	Gomez and Sullivan, 2000	

1 Memorandum. May 30, 2013. To Turners Falls Instream Flow Study Team from Bandon Kulik. RE: Instream Flow Study: Habitat Suitability Criteria.

2 First Light Power Resources. August 14, 2013. Revised Study Plan for the Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485). Section 3.3.1.

3 Letter from FWS to Jason George, Gomez and Sullivan dated July 3, 2014.

American Shad Juvenile



Modification Source: Conowingo IFIM Depth and Substrate

Source: Stier and Crance, 1985

Velocity (ft/s)	SI	Velocity (ft/s)	SI
0.00	0.00	0.00	0.00
0.20	1.00	0.20	1.00
1.00	1.00	1.00	1.00
4.50	0.00	4.50	0.00

Greene et al., 2009

Depth (ft)	SI	Depth (ft)	SI
0.00	0.00	0.00	0.00
0.66	0.50	1.50	0.00
1.50	0.75	5.00	1.00
4.90	1.00	20.00	1.00
6.60	1.00	50.00	0.00
13.20	0.75		
20.00	0.25		
50.00	0.00		

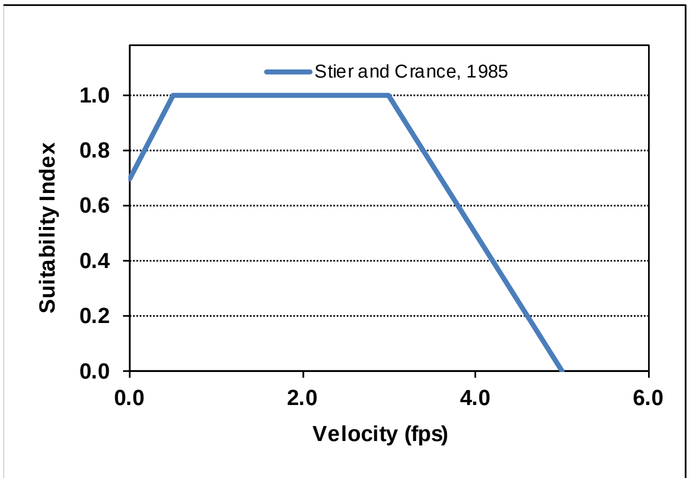
Substrate	SI
Organics	0.10
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

Stier and Crance, 1985- No substrate suitability for juvenile shad provided

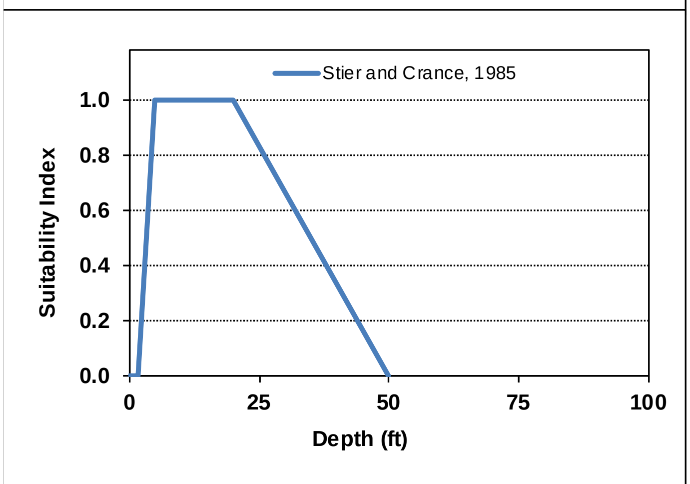
Figure 1. American Shad juvenile HSC, Turners Falls Hydroelectric Project.

American Shad Adult

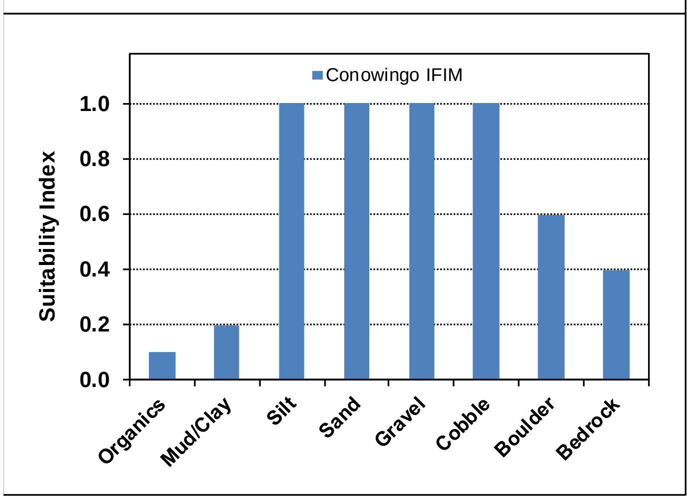
Source:
Stier and Crance, 1985



Velocity (ft/s)	SI
0.00	0.70
0.50	1.00
3.00	1.00
5.00	0.00



Depth (ft)	SI
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00



Source:
Conowingo IFIM
Substrate

Substrate	SI
Organics	0.10
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

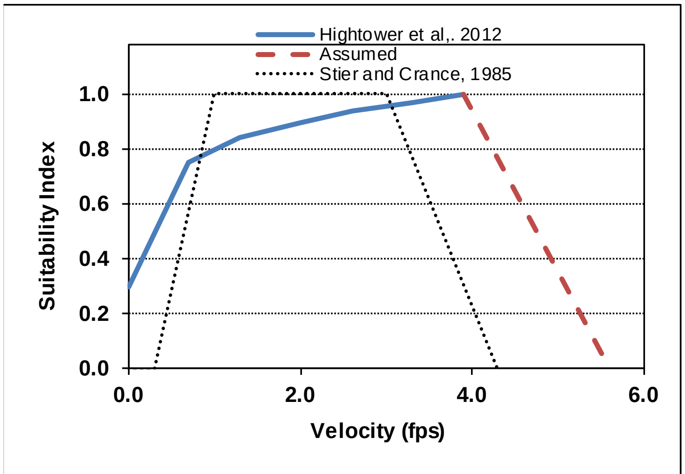
Stier and Crance, 1985-
No substrate suitability
for juvenile shad
provided

Figure 2. American Shad adult HSC, Turners Falls Hydroelectric Project.

American Shad Spawning

Source: Hightower et al,. 2012

Source: Stier and Crance, 1985

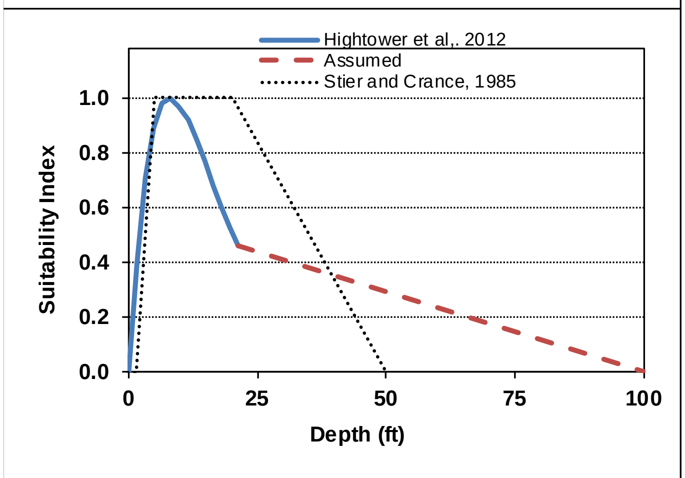


Hightower et al,. 2012:

Velocity (ft/s)	SI
0.00	0.30
0.70	0.75
1.30	0.84
2.00	0.90
2.60	0.94
3.30	0.97
3.90	1.00
5.60	0.00

Stier and Crance, 1985:

Velocity (ft/s)	SI
0.00	0.00
0.30	0.00
1.00	1.00
3.00	1.00
4.30	0.00

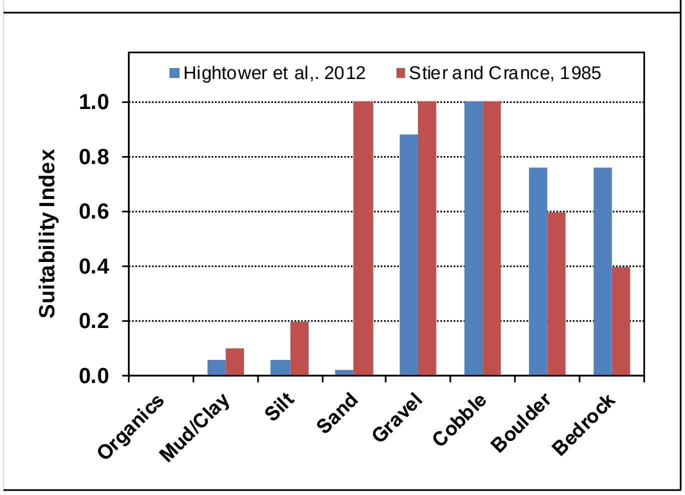


Hightower et al,. 2012:

Depth (ft)	SI
0.00	0.00
1.60	0.40
3.30	0.71
4.90	0.89
6.60	0.98
8.20	1.00
9.80	0.97
11.50	0.92
13.10	0.85
14.80	0.77
16.40	0.68
18.00	0.60
19.70	0.53
21.30	0.46
100.00	0.00

Stier and Crance, 1985:

Depth (ft)	SI
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00



Hightower et al,. 2012:

Substrate	SI
Organics	0.00
Mud/Clay	0.06
Silt	0.06
Sand	0.02
Gravel	0.88
Cobble	1.00
Boulder	0.76
Bedrock	0.76

Stier and Crance, 1985:

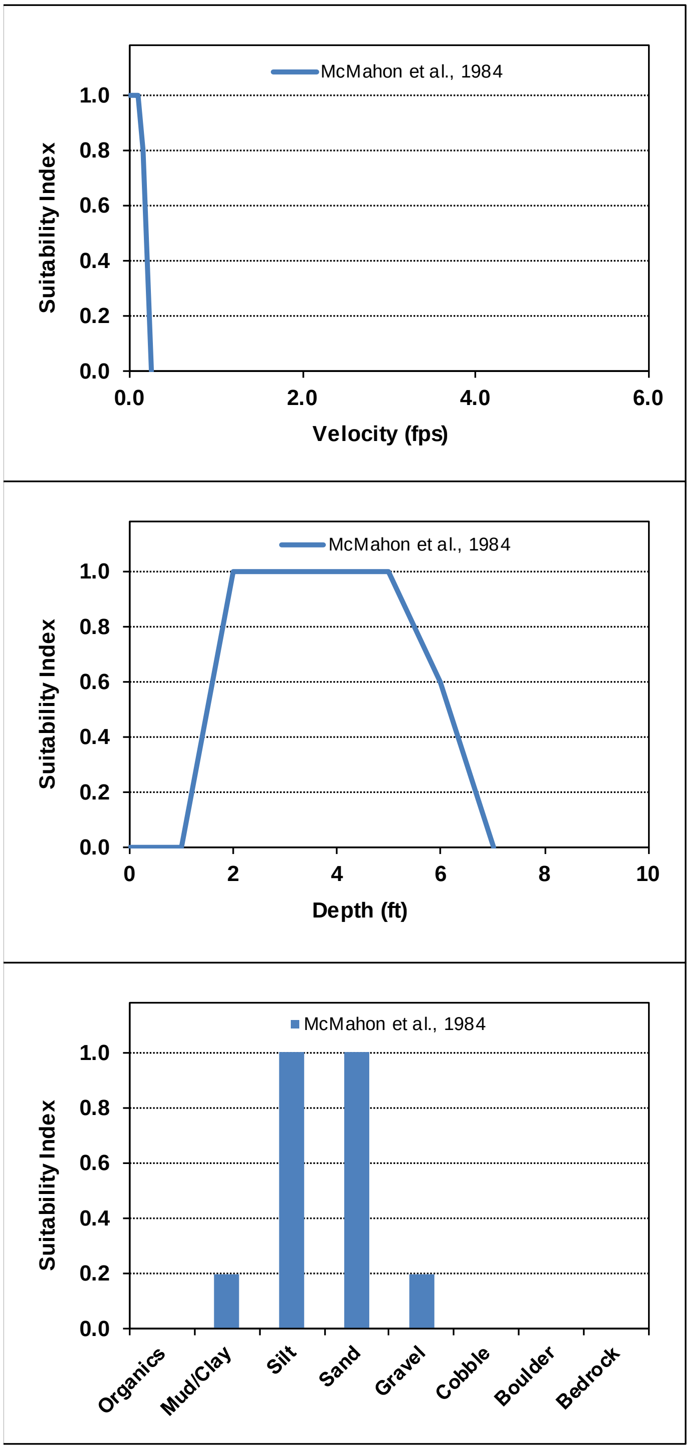
Substrate	SI
Organics	0.00
Mud/Clay	0.10
Silt	0.20
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

Figure 3. American Shad spawning HSC, Turners Falls Hydroelectric Project.

Walleye Fry

Source:

McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.10	1.00
0.15	0.80
0.25	0.00
2.00	0.00

Depth (ft)	SI
0.00	0.00
1.00	0.00
2.00	1.00
5.00	1.00
6.00	0.60
7.00	0.00

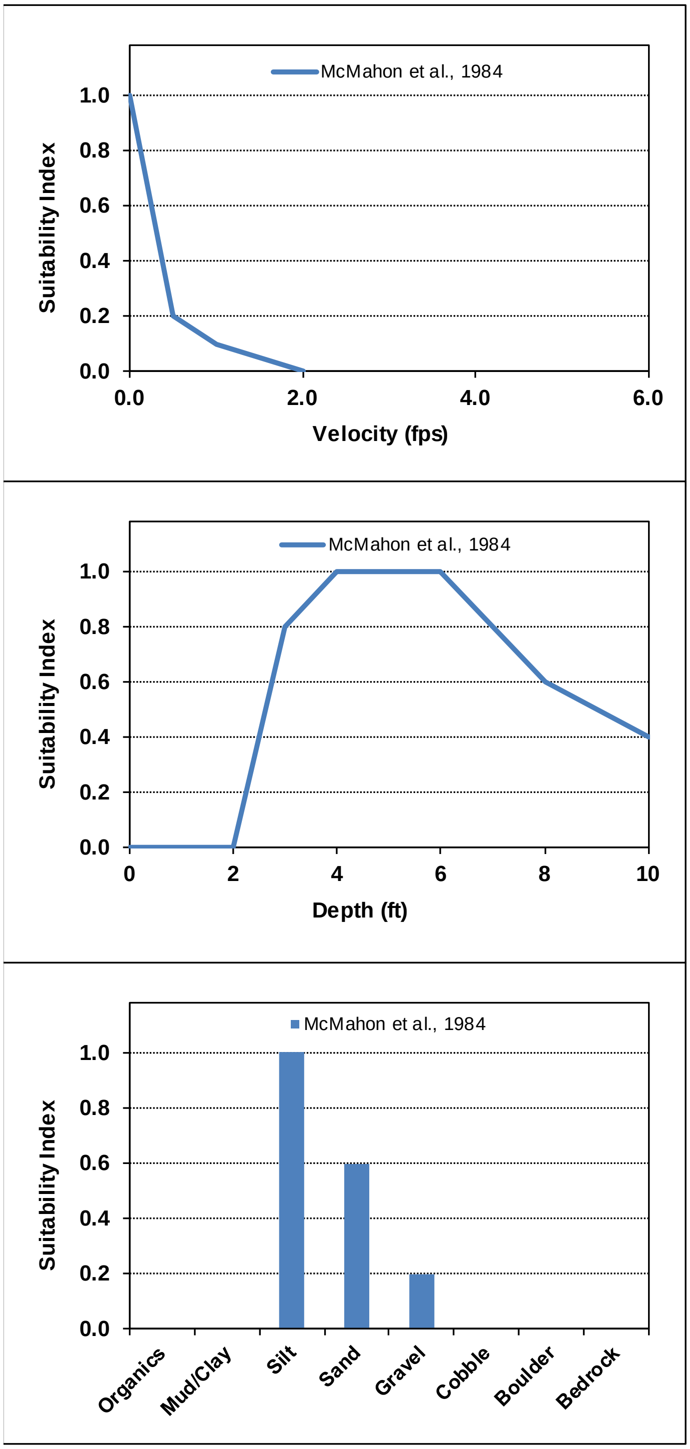
Substrate	SI
Organics	0.00
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	0.20
Cobble	0.00
Boulder	0.00
Bedrock	0.00

Figure 4. Walleye fry HSC, Turners Falls Hydroelectric Project.

Walleye Juvenile

Source:

McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.50	0.20
1.00	0.10
2.00	0.00

Depth (ft)	SI
0.00	0.00
2.00	0.00
3.00	0.80
4.00	1.00
6.00	1.00
8.00	0.60
10.00	0.40
50.00	0.40

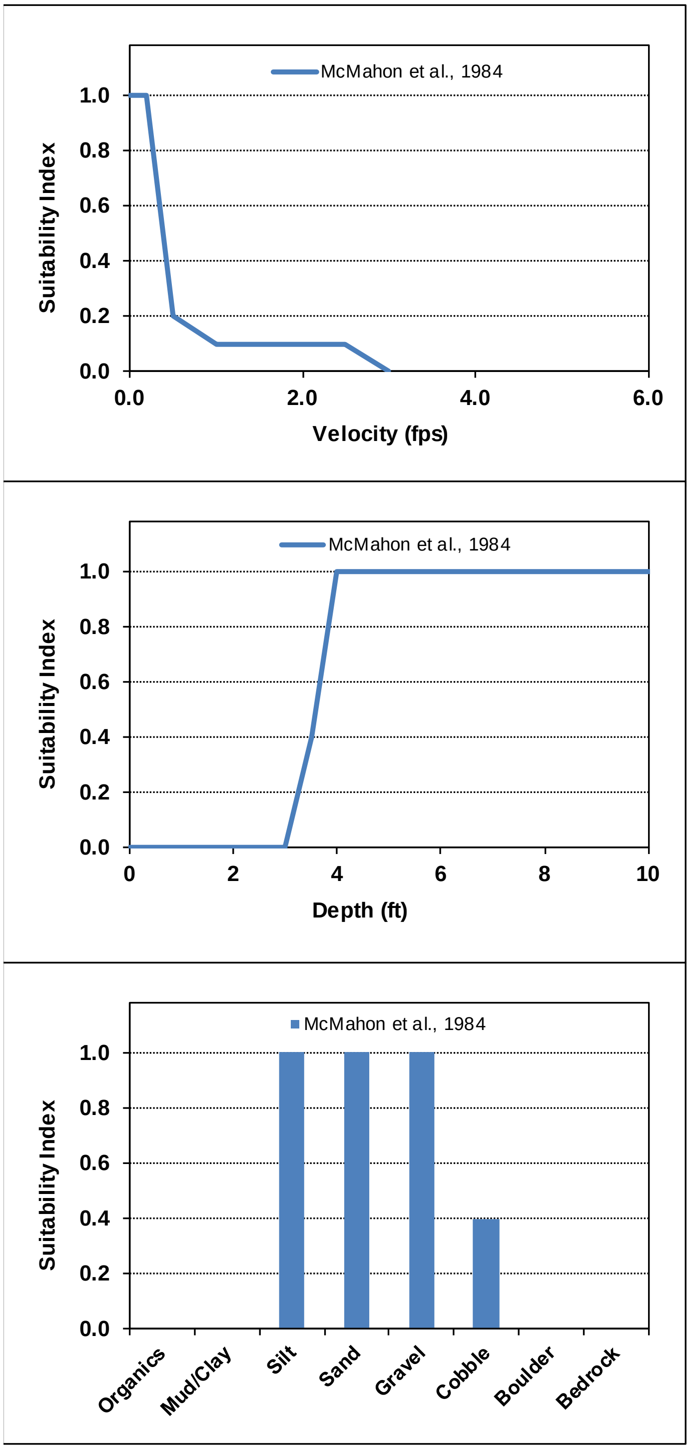
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	1.00
Sand	0.60
Gravel	0.20
Cobble	0.00
Boulder	0.00
Bedrock	0.00

Figure 5. Walleye juvenile HSC, Turners Falls Hydroelectric Project.

Walleye Adult

Source:

McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.20	1.00
0.50	0.20
1.00	0.10
2.50	0.10
3.00	0.00

Depth (ft)	SI
0.00	0.00
3.00	0.00
3.50	0.40
4.00	1.00
50.00	1.00

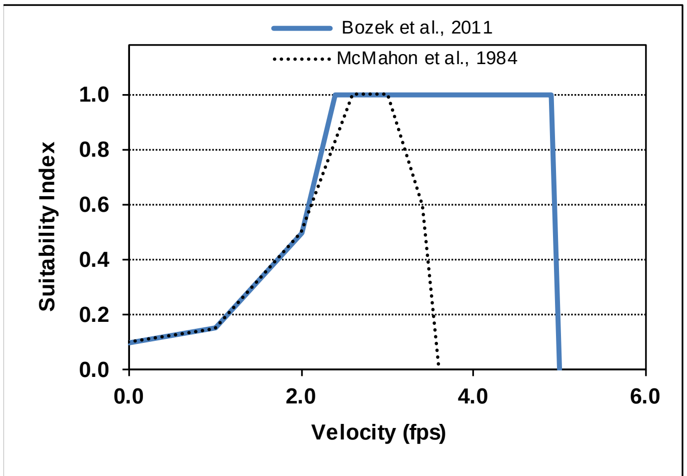
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	0.40
Boulder	0.00
Bedrock	0.00

Figure 6. Walleye adult HSC, Turners Falls Hydroelectric Project.

Walleye Spawning & Incubation

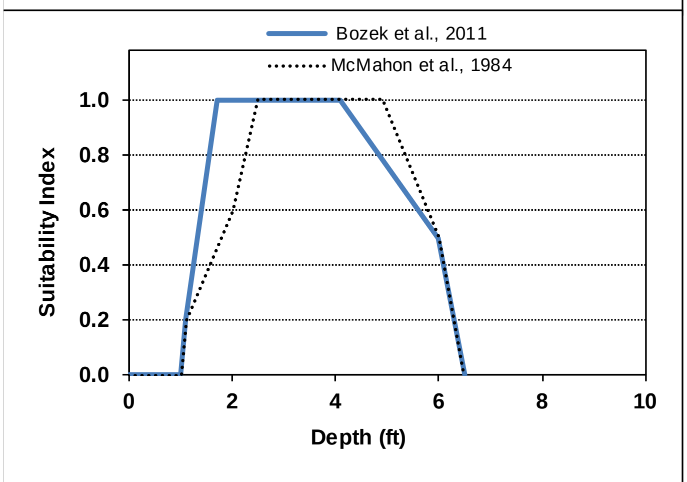
Modification Source: Bozek et al., 2011

Source: McMahon et al., 1984



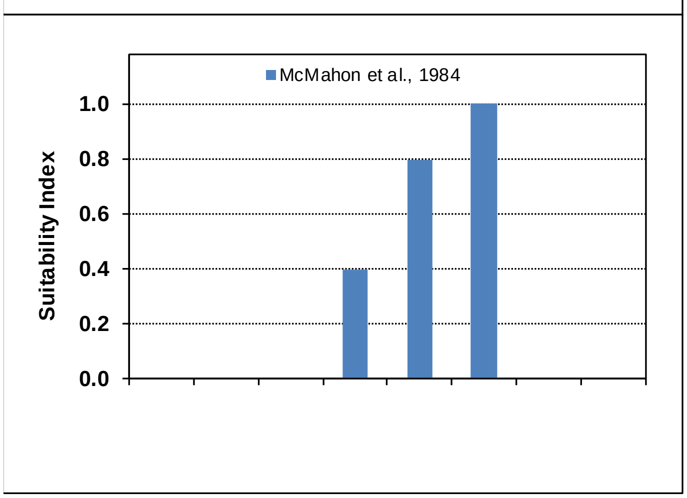
Velocity (ft/s)	SI
0.00	0.10
1.00	0.15
2.00	0.50
2.40	1.00
4.90	1.00
5.00	0.00
endpoint hypothetical	

Velocity (ft/s)	SI
0.00	0.10
1.00	0.15
2.00	0.50
2.60	1.00
3.00	1.00
3.40	0.60
3.60	0.00



Depth (ft)	SI
0.00	0.00
1.00	0.00
1.10	0.20
1.70	1.00
4.10	1.00
6.00	0.50
6.50	0.00

Depth (ft)	SI
0.00	0.00
1.00	0.00
1.10	0.20
2.00	0.60
2.50	1.00
4.90	1.00
6.00	0.50
6.50	0.00



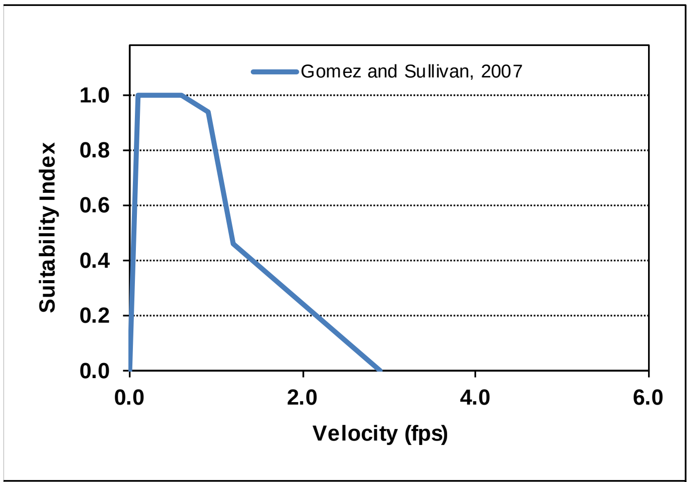
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.40
Gravel	0.80
Cobble	1.00
Boulder	0.00
Bedrock	0.00

Figure 7. Walleye spawning HSC, Turners Falls Hydroelectric Project.

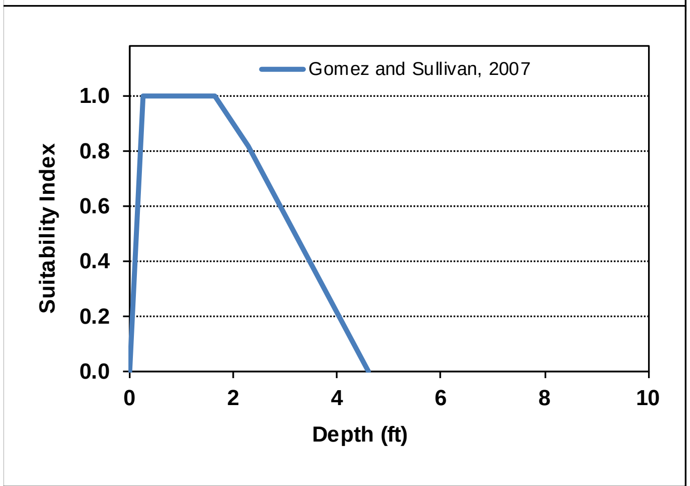
Fallfish Fry

Velocity and depth from brook trout fry curves (Deerfield River)
Substrate developed by Charles Ritzi

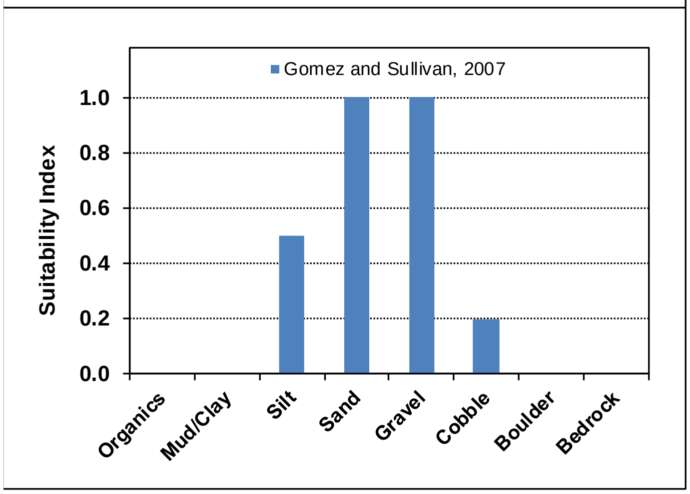
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	1.00
0.60	1.00
0.90	0.94
1.20	0.46
2.90	0.00



Depth (ft)	SI
0.00	0.00
0.25	1.00
1.65	1.00
2.30	0.82
4.60	0.00
100.00	0.00



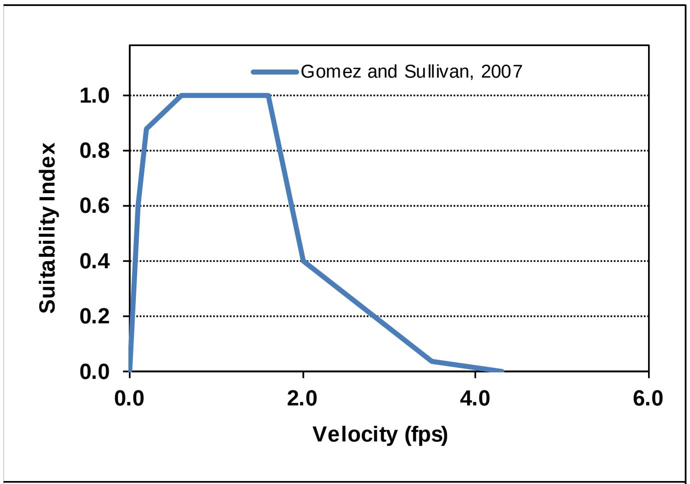
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.50
Sand	1.00
Gravel	1.00
Cobble	0.20
Boulder	0.00
Bedrock	0.00

Figure 8. Fallfish fry HSC, Turners Falls Hydroelectric Project.

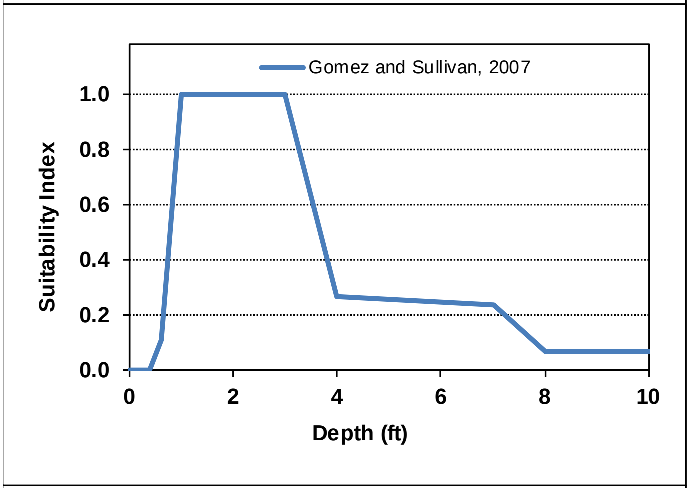
Fallfish Juvenile

Velocity and depth from brook trout fry curves (Deerfield River)
Substrate developed by Charles Ritzi

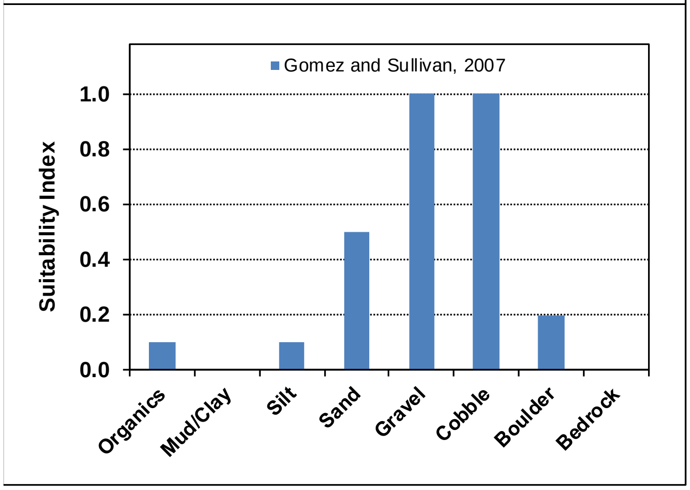
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	0.60
0.20	0.88
0.60	1.00
1.60	1.00
2.00	0.40
3.50	0.04
4.30	0.00



Depth (ft)	SI
0.00	0.00
0.40	0.00
0.60	0.11
1.00	1.00
3.00	1.00
4.00	0.27
7.00	0.24
8.00	0.07
20.00	0.07
100.00	0.07



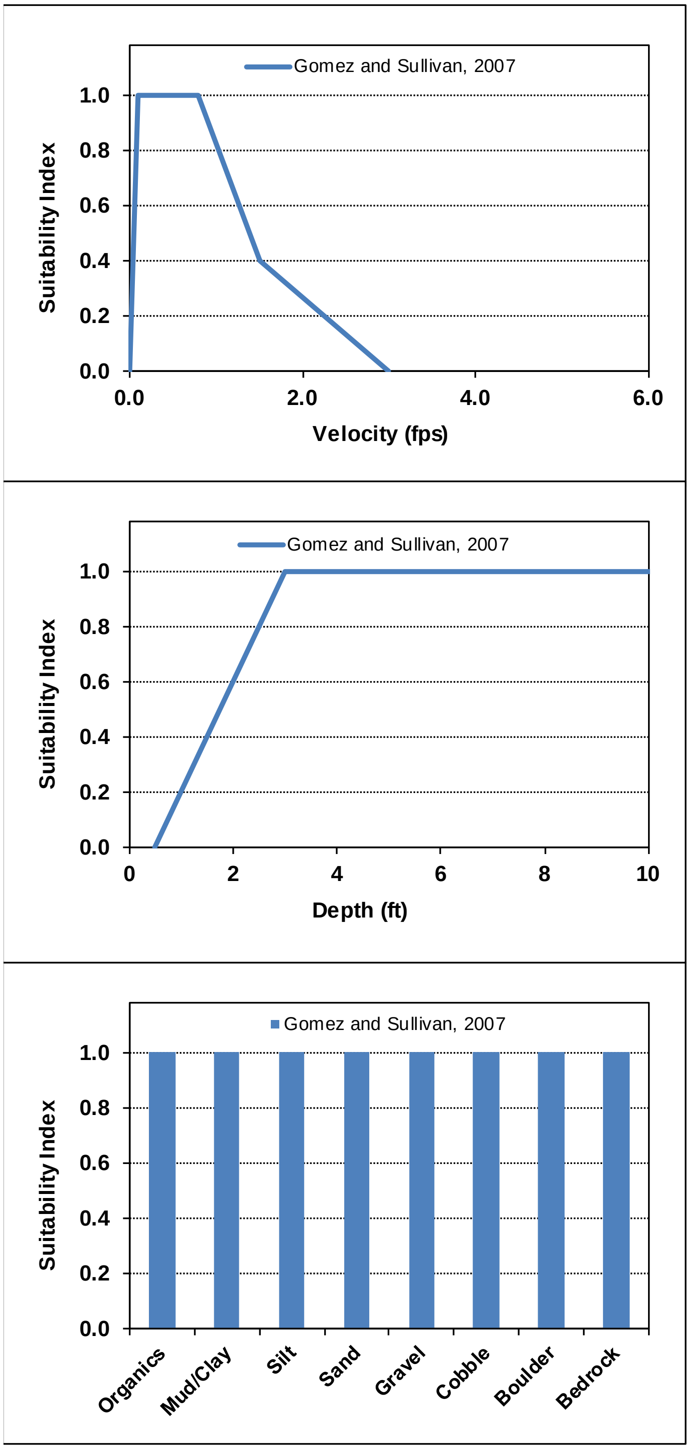
Substrate	SI
Organics	0.10
Mud/Clay	0.00
Silt	0.10
Sand	0.50
Gravel	1.00
Cobble	1.00
Boulder	0.20
Bedrock	0.00

Figure 9. Fallfish juvenile HSC, Turners Falls Hydroelectric Project.

Fallfish Adult

Developed from consultation with NYSDEC
(New York Dept. of Environmental Conservation)

Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	1.00
0.80	1.00
1.50	0.40
3.00	0.00

Depth (ft)	SI
0.00	0.00
0.50	0.00
3.00	1.00
100.00	1.00

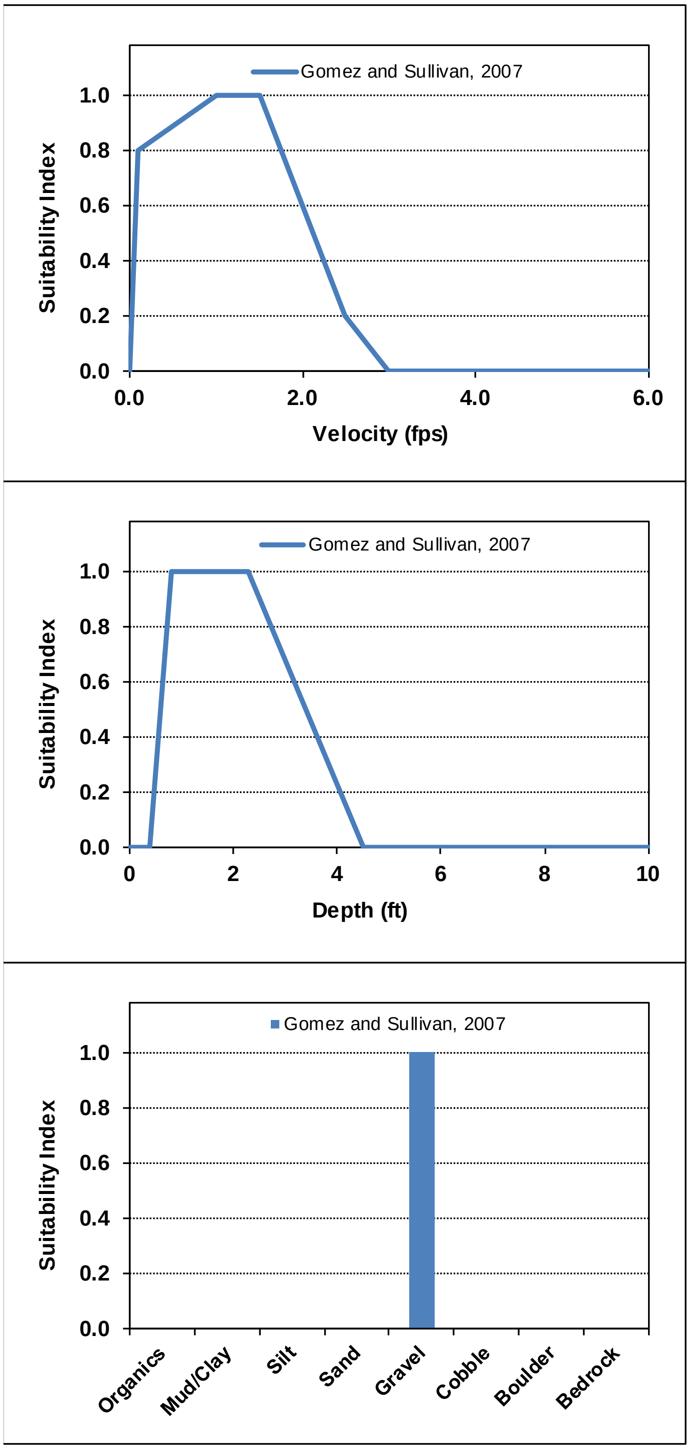
Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

Figure 10. Fallfish adult HSC, Turners Falls Hydroelectric Project.

Fallfish Spawning & Incubation

Developed from consultation with NYSDEC
(New York Dept. of Environmental Conservation)

Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	0.80
1.00	1.00
1.50	1.00
2.50	0.20
3.00	0.00
100.00	0.00

Depth (ft)	SI
0.00	0.00
0.40	0.00
0.80	1.00
2.30	1.00
4.50	0.00
100.00	0.00

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.00
Gravel	1.00
Cobble	0.00
Boulder	0.00
Bedrock	0.00

Figure 11. Fallfish spawning & incubation HSC, Turners Falls Hydroelectric Project.

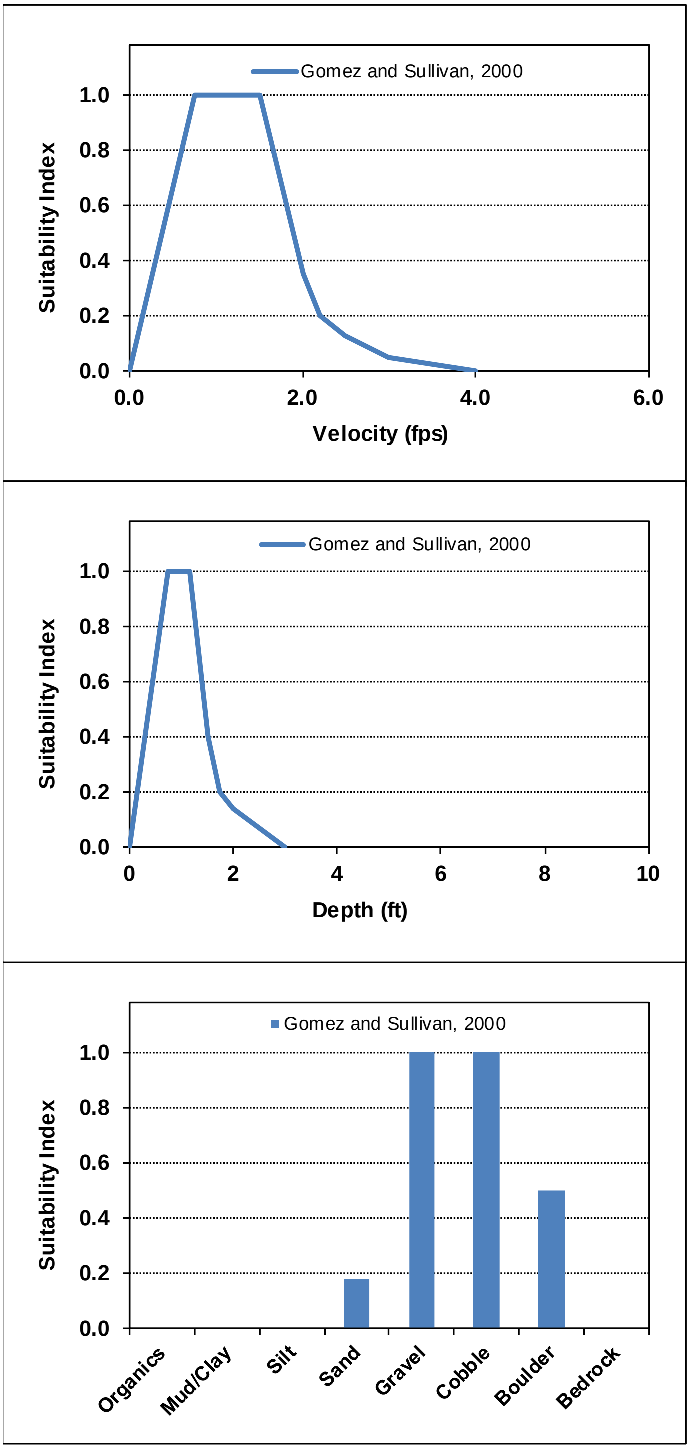
Longnose Dace Juvenile

Original curve identified as from USFWS HSC library

Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

Source:

Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.75	1.00
1.50	1.00
2.00	0.35
2.20	0.20
2.50	0.13
3.00	0.05
4.00	0.00

Depth (ft)	SI
0.00	0.00
0.75	1.00
1.15	1.00
1.50	0.40
1.75	0.20
2.00	0.14
3.00	0.00

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.18
Gravel	1.00
Cobble	1.00
Boulder	0.50
Bedrock	0.00

Figure 12. Longnose Dace juvenile HSC, Turners Falls Hydroelectric Project.

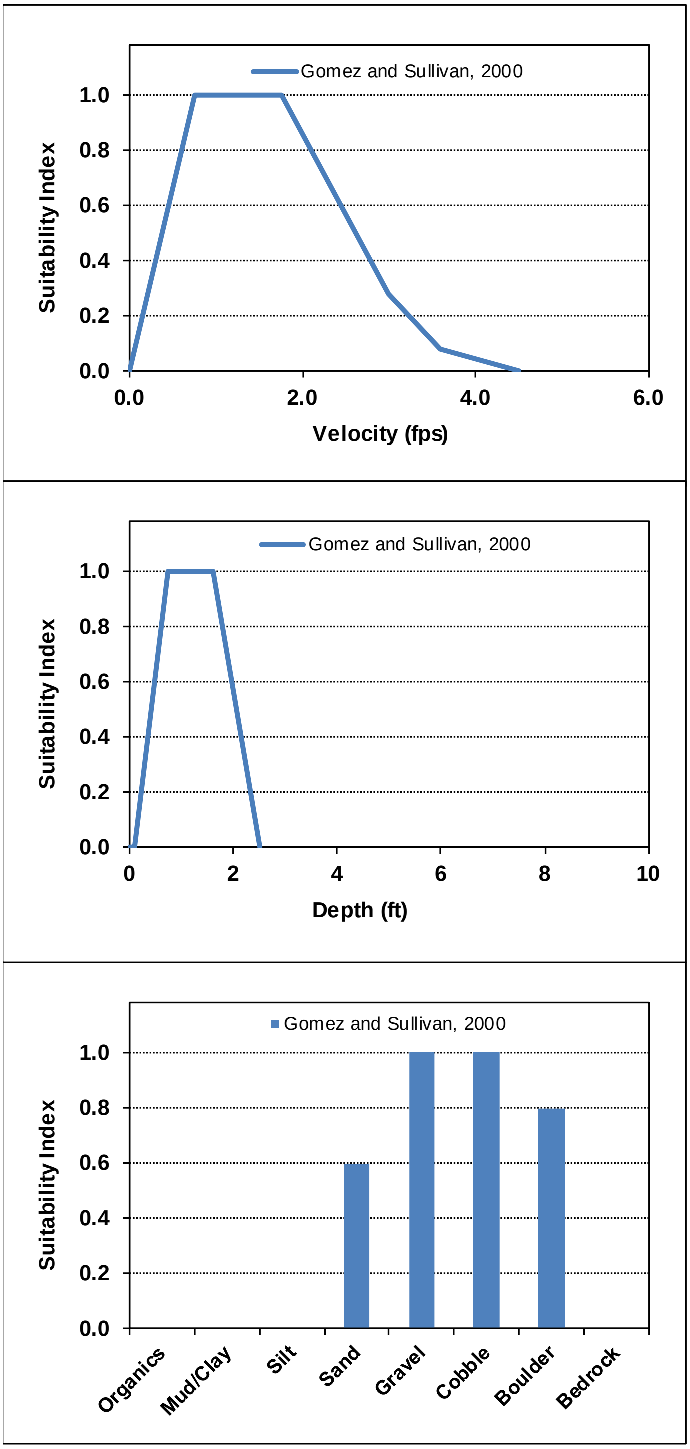
Longnose Dace Adult

Original curve identified as from USGS HSC library

Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

Source:

Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.75	1.00
1.75	1.00
3.00	0.28
3.60	0.08
4.50	0.00

Depth (ft)	SI
0.00	0.00
0.10	0.00
0.75	1.00
1.60	1.00
2.50	0.00

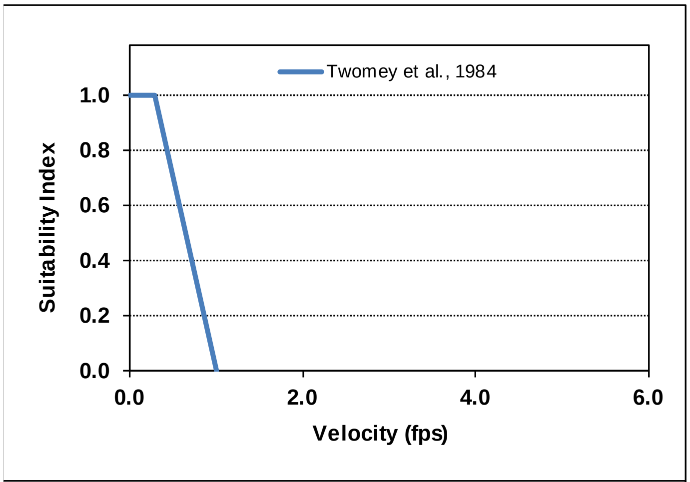
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.60
Gravel	1.00
Cobble	1.00
Boulder	0.80
Bedrock	0.00

Figure 13. Longnose Dace adult HSC, Turners Falls Hydroelectric Project.

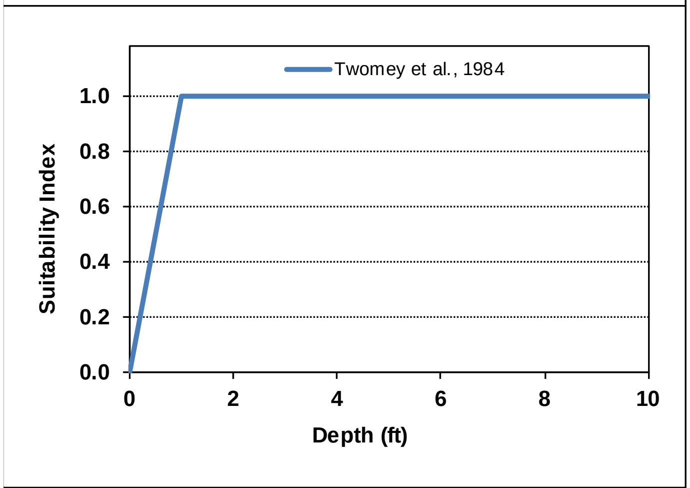
White Sucker Fry

Source:

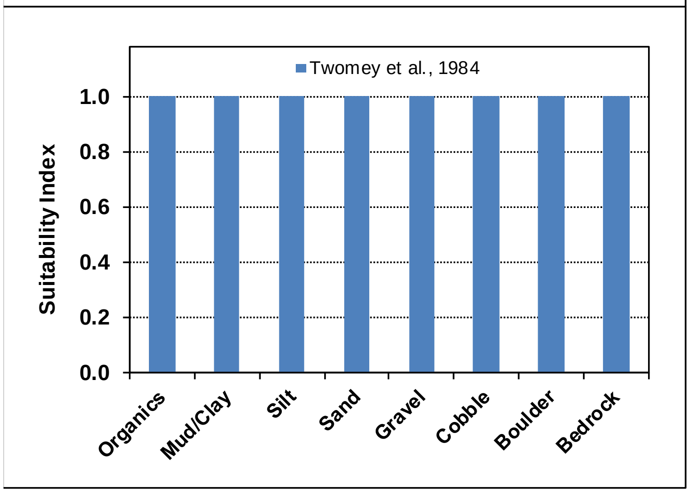
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.30	1.00
1.00	0.00



Depth (ft)	SI
0.00	0.00
1.00	1.00
100.00	1.00



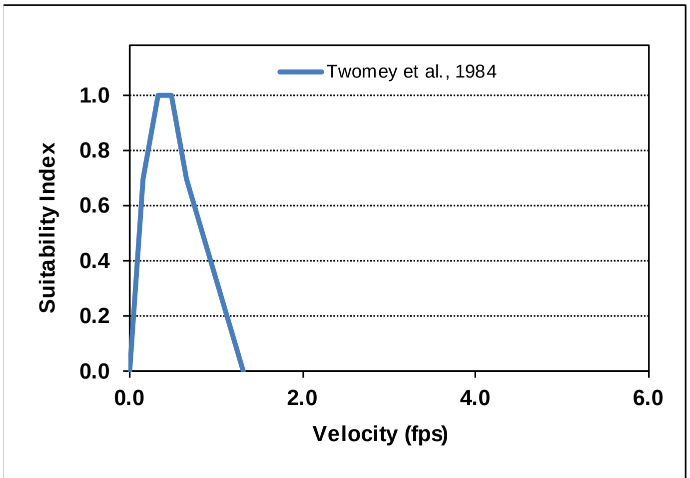
Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

Figure 14. White Sucker fry HSC, Turners Falls Hydroelectric Project.

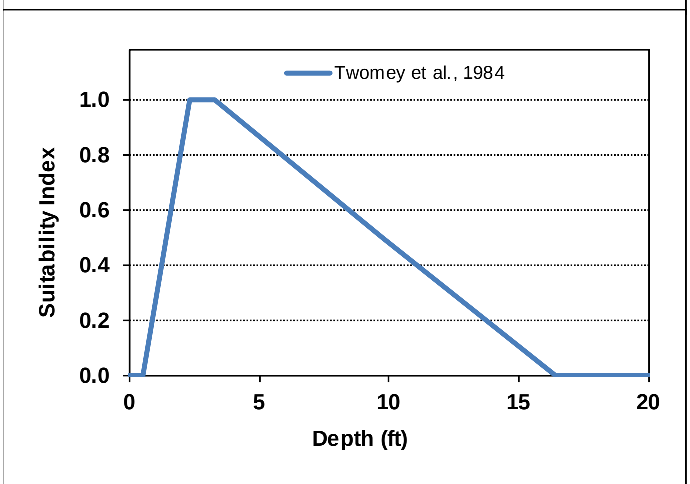
White Sucker Adult/Juvenile

Source:

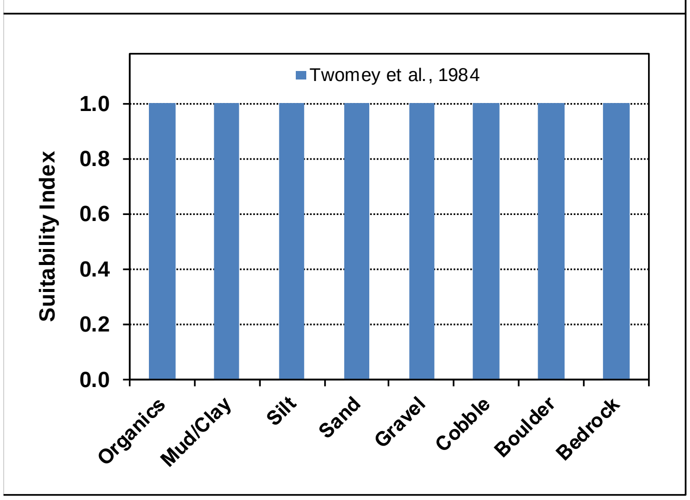
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	0.00
0.16	0.70
0.33	1.00
0.49	1.00
0.66	0.70
1.31	0.00



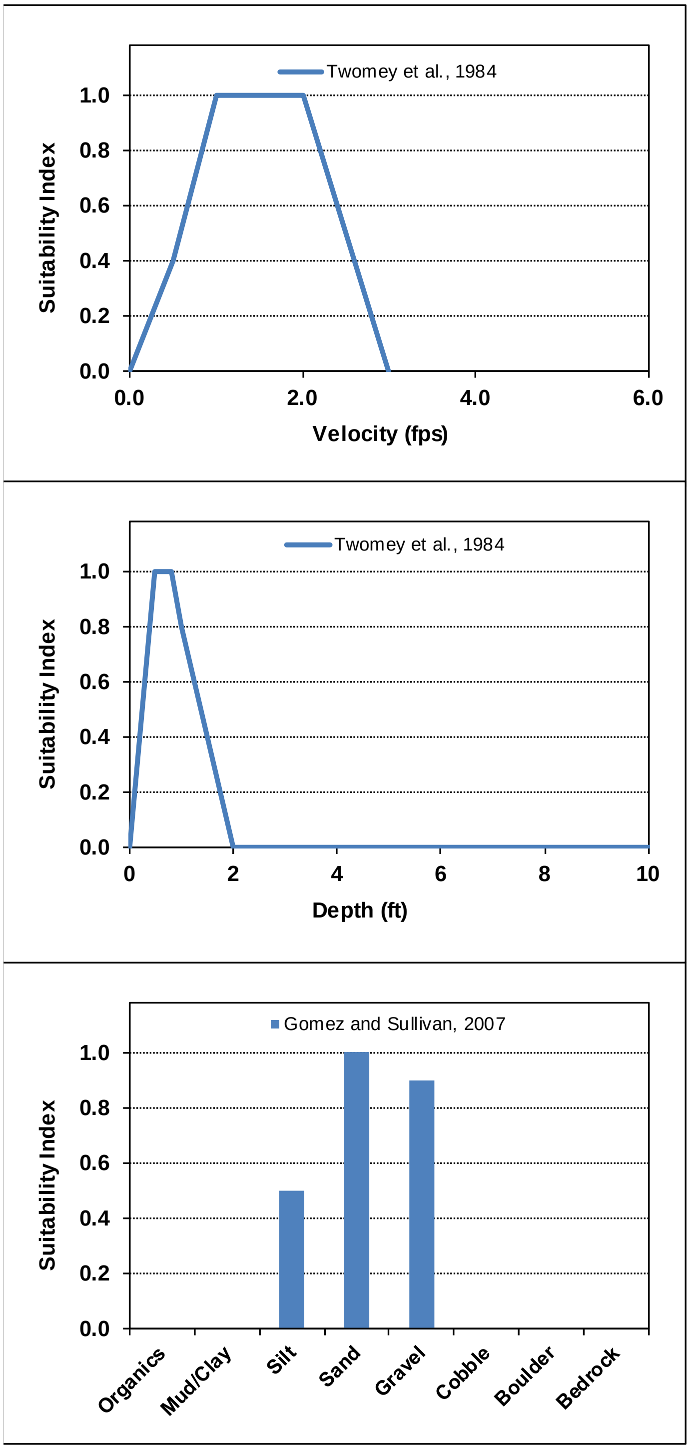
Depth (ft)	SI
0.00	0.00
0.50	0.00
2.30	1.00
3.30	1.00
9.80	0.50
16.40	0.00
100.00	0.00



Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

Figure 15. White Sucker juvenile/adult HSC, Turners Falls Hydroelectric Project.

White Sucker Spawning & Incubation



Source:

Twomey et al., 1984

Velocity (ft/s)	SI
0.00	0.00
0.50	0.40
1.00	1.00
2.00	1.00
3.00	0.00

Depth (ft)	SI
0.00	0.00
0.50	1.00
0.80	1.00
1.00	0.80
2.00	0.00
100.00	0.00

Substrate Source:
Gomez and Sullivan, 2007

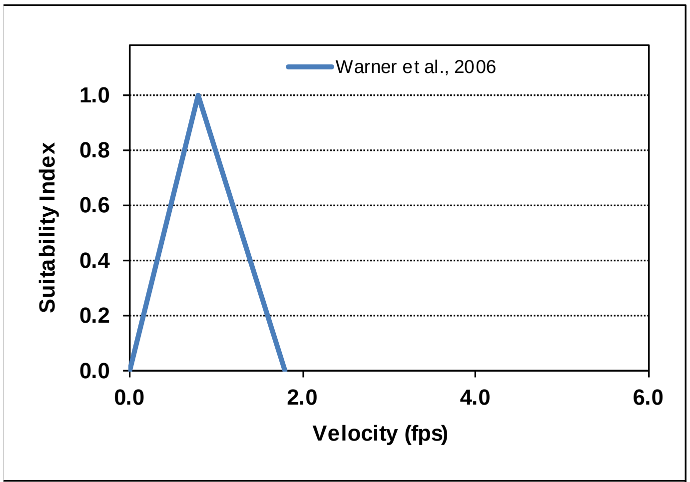
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.50
Sand	1.00
Gravel	0.90
Cobble	0.00
Boulder	0.00
Bedrock	0.00

Figure 16. White Sucker spawning HSC, Turners Falls Hydroelectric Project.

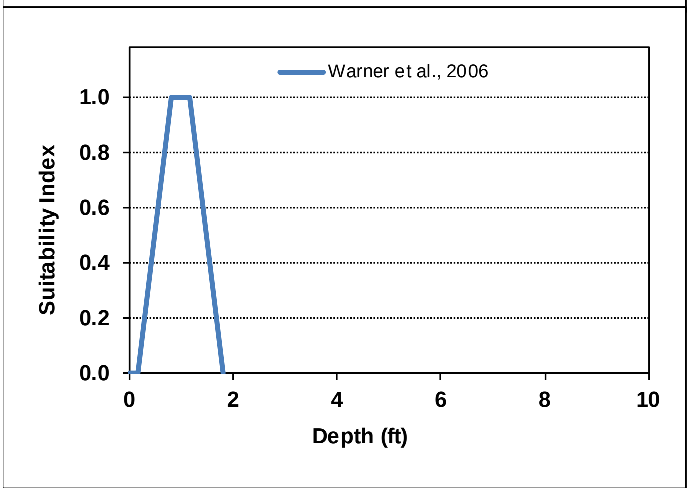
Tessellated Darter Adult

Source:

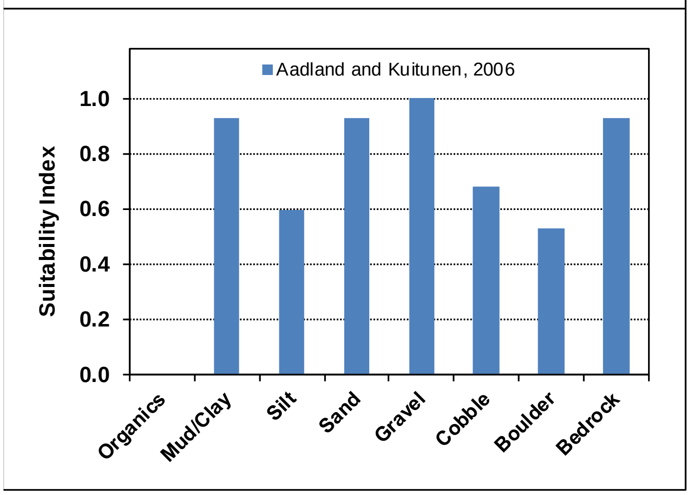
Warner et al., 2006



Velocity (ft/s)	SI
0.00	0.00
0.80	1.00
1.80	0.00



Depth (ft)	SI
0.00	0.00
0.16	0.00
0.80	1.00
1.15	1.00
1.80	0.00



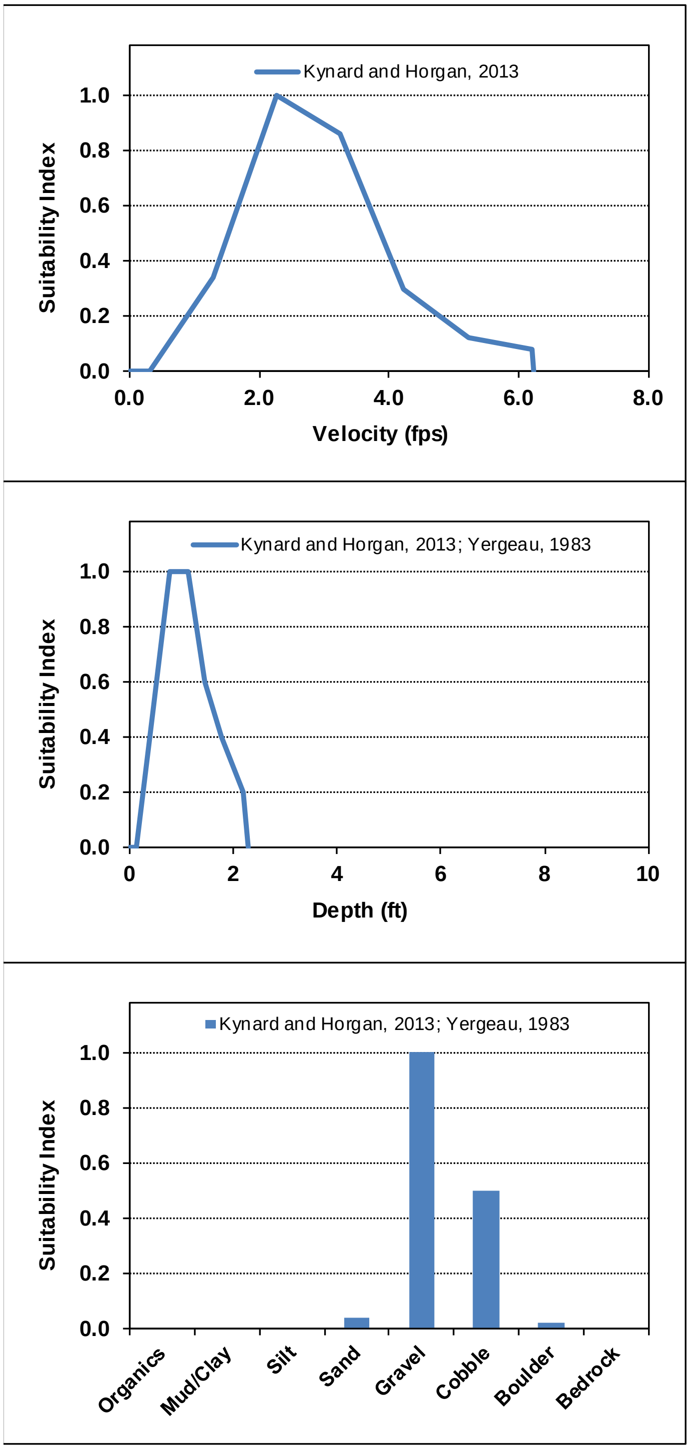
Substrate Source: Aadland and Kuitunen, 2006
Johnny Darter- Surrogate for Tessellated Darter
(PPL Bell Bend 2012)

Substrate	SI
Organics	0.00
Mud/Clay	0.93
Silt	0.60
Sand	0.93
Gravel	1.00
Cobble	0.68
Boulder	0.53
Bedrock	0.93

Figure 17. Tessellated Darter adult HSC, Turners Falls Hydroelectric Project.

Sea Lamprey Spawning & Incubation

Modified by USFWS (2014) based on Yergeau 1983 (depth and substrate)



Source:

Kynard and Horgan, 2013

Yergeau, 1983

Velocity (ft/s)	SI
0.00	0.00
0.30	0.00
1.28	0.34
2.26	1.00
3.25	0.86
4.23	0.30
5.22	0.12
6.20	0.08
6.23	0.00

Depth (ft)	SI
0.00	0.00
0.13	0.00
0.46	0.50
0.79	1.00
1.12	1.00
1.44	0.60
1.77	0.40
2.20	0.20
2.30	0.00

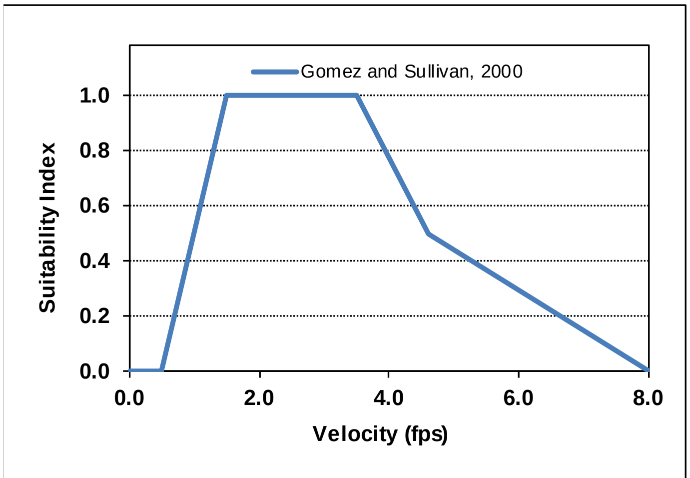
Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.04
Gravel	1.00
Cobble	0.50
Boulder	0.02
Bedrock	0.00

Figure 18. Sea Lamprey spawning HSC, Turners Falls Hydroelectric Project.

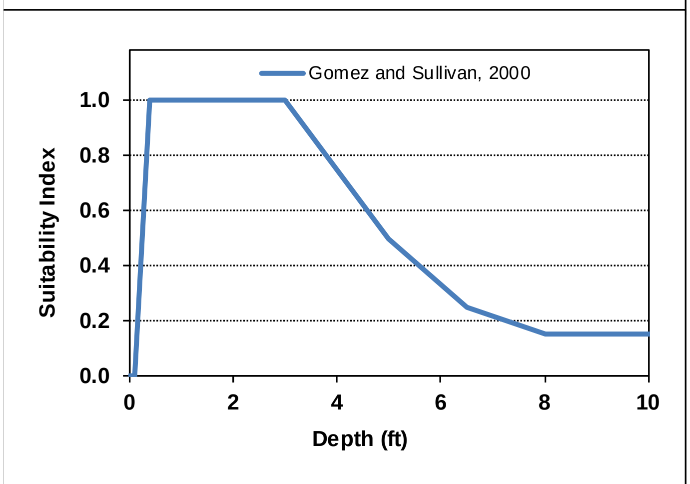
Macroinvertebrates

Source:

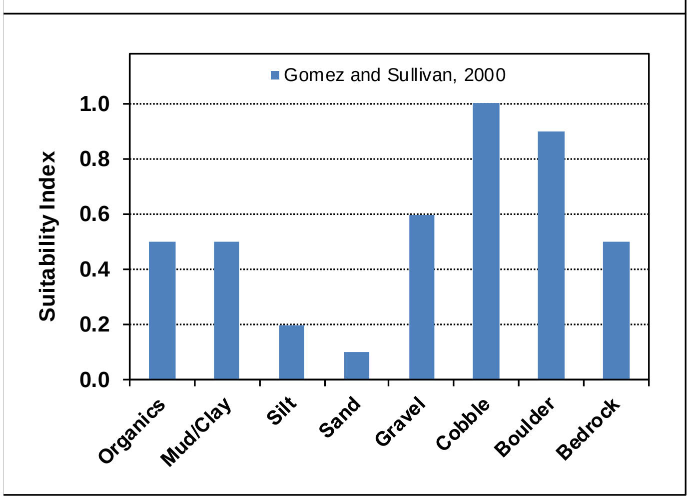
Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.50	0.00
1.50	1.00
3.50	1.00
4.60	0.50
8.00	0.00



Depth (ft)	SI
0.00	0.00
0.10	0.00
0.40	1.00
3.00	1.00
5.00	0.50
6.50	0.25
8.00	0.15
10.00	0.15
100.00	0.00



Substrate	SI
Organics	0.50
Mud/Clay	0.50
Silt	0.20
Sand	0.10
Gravel	0.60
Cobble	1.00
Boulder	0.90
Bedrock	0.50

Figure 19. Macroinvertebrate HSC, Turners Falls Hydroelectric Project.

3.2. Wilder, Bellows Falls and Vernon Projects

Smallmouth Bass

Smallmouth Bass were not included as a target species in the Turners Falls study. The compilation of smallmouth HSC presented here come from a variety of sources, ranging from literature reviews to site-specific studies. In some cases criteria from a prior source, primarily depth or substrate suitability, were adopted by a later study or review. Transferability testing is often recommended for choosing HSC that best defines optimal and suitable ranges for smallmouth bass in the region under study (Groshens and Orth, 1993; Newcomb et al., 1994). Without extensive habitat use and availability data, transferability testing is not practical for this study. We recommended HSC that encompass the central range of suitability values for depth and velocity from a number of sources and primary substrate characteristic found in the Connecticut River.

Table 3 provides HSC sources for Smallmouth Bass fry velocity, depth and substrate. Fry velocity curves show high suitability for velocities less than 1.0 ft/s (Figure 20). This corresponds well with a velocity range of less than 0.5 ft/s most frequented by young-of-year and fry (Simonson and Swenson, 1990). Direct observation studies of fry show optimum depths from 1 to 4 feet (Allen, 1996; Leonard et al. 1986). Unlimited depth criteria for fry (Bovee, 1978; Edwards et al. 1983) are partly based on data from lakes, and Edwards et al. (1983) notes that in streams and rivers it is reasonable to assume utilization of shallower depths by fry. Substrate suitability is quite variable and is likely a product of substrate availability between studies. Allen (1996) notes that sand and gravel substrate was dominant in the Susquehanna River and as a result, most observations of fry were over these substrates. We recommend curves from Leonard et al., 1986 be used for velocity, depth and substrate.

Juvenile and adult Smallmouth Bass sources for HSC are shown in Table 4. Velocity and depth curves for juveniles and adults are similar and in most cases juvenile velocity criteria show slightly greater suitability for higher velocities (Figures 21 and 22). The curves for velocity and depth from Groshens and Orth (1994) are composites of curves from the two streams evaluated in that study and HSC are from Leonard et al. (1986), Addland et al. (1991) and Monohan (1991). Depth suitability is unlimited in most cases except for those reported by Groshens and Orth (1994), a consequence of maximum depth availability of 7.0 feet in that study and limited depth criteria for two of the curves used to create the composite HSC. Substrate suitability is variable, though all curves show high suitability for large substrate that often serves as cover. For adult and juvenile smallmouth bass we recommend using velocity criteria from Groshens and Orth (1994) and depth criteria from Leonard et al. (1986) on the assumption that depth should not be a limiting factor in the Connecticut River. Based on the premise that substrate suitability is related to instream cover, we suggest using criteria from Leonard et al. (1986) which give higher suitability to larger substrate, including bedrock.

Table 3. Smallmouth Bass fry HSC sources.

Variable	Source	Location	Method	Note:
Fry				
Velocity	Addland and Kuitunen, 2006	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	Direct Observation	HSC curve derived from frequency histograms
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Edwards et al., 1983	NA	Literature	
	Leonard et al., 1986	Virginia	Direct Observation	Curve derived from use/availability data and professional judgment
Depth	Addland and Kuitunen, 2006	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	Direct Observation	HSC curve derived from frequency histograms
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Edwards et al., 1983	NA	NA	Same as Bovee, 1978
	Leonard et al., 1986	Virginia	Direct Observation	Curve derived from use/availability data and professional judgment
Substrate	Addland and Kuitunen, 2006	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	Direct Observation	HSC curve derived from frequency histograms
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Edwards et al., 1983	NA	NA	Same as Bovee, 1978
	Leonard et al., 1986	Virginia	Direct Observation	Curve derived from use/availability data and professional judgment

Smallmouth bass fry

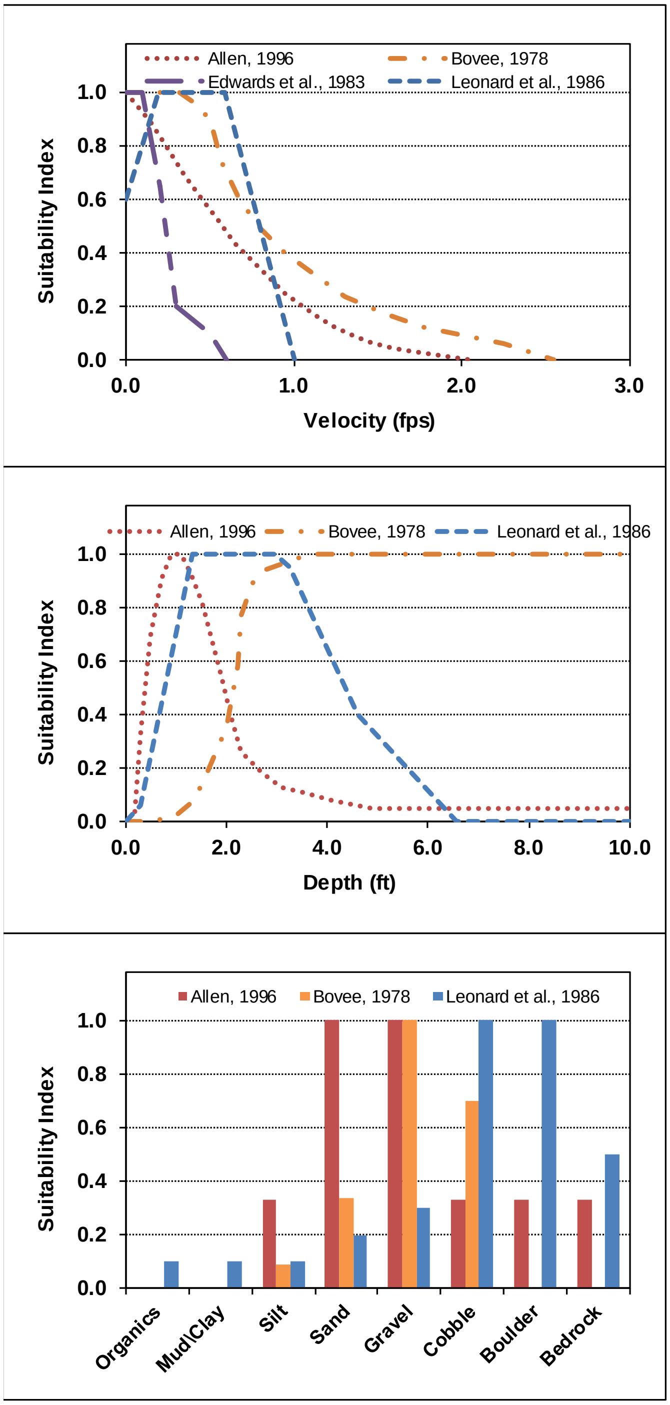


Figure 20. Smallmouth Bass fry HSC from various sources.

Table 4. Smallmouth Bass juvenile and adult HSC sources.

Variable	Source	Location	Method	Note:
Juvenile / Adult				
Velocity	Addland et al., 1991	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	Direct Observation	HSC curves derived from frequency histograms (juv and adult combined)
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Edwards et al., 1983	Oklahoma	Literature	Based on data from Orth, 1980
	Groshens and Orth, 1994	Virginia	Direct Observation	Composite curve (includes Leonard et al., 1986; Monohan, 1991; Addland et al., 1989; plus data from this study)
	Leonard et al., 1986	Virginia	Direct Observation	Curves derived from use/availability data and professional judgment
	Monohan, 1991	Michigan	Direct Observation	Curves derived from non-parametric use/availability
Depth	Addland et al., 1991	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	NA	NA	No depth curves developed
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Edwards et al., 1983	Oklahoma	Literature	Based on data from Orth, 1980
	Groshens and Orth, 1994	North Anna R., Virginia	Direct Observation	Composite curve (includes Leonard et al., 1986; Monohan, 1991; Addland et al., 1989; plus data from this study)
	Leonard et al., 1986	Virginia	Direct Observation	Curves derived from use/availability data and professional judgment
	Monohan, 1991	Michigan	Direct Observation	Curves derived from non-parametric use/availability
Substrate	Addland et al., 1991	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	NA	NA	No substrate curves developed
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Edwards et al., 1983	Oklahoma	Literature	Based on data from Orth, 1980
	Groshens and Orth, 1994	North Anna R., Virginia	NA	No substrate curves developed
	Leonard et al., 1986	Virginia	Direct Observation	Curves derived from use/availability data and professional judgment
	Monohan, 1991	Michigan	NA	No substrate curves developed

Smallmouth bass juvenile

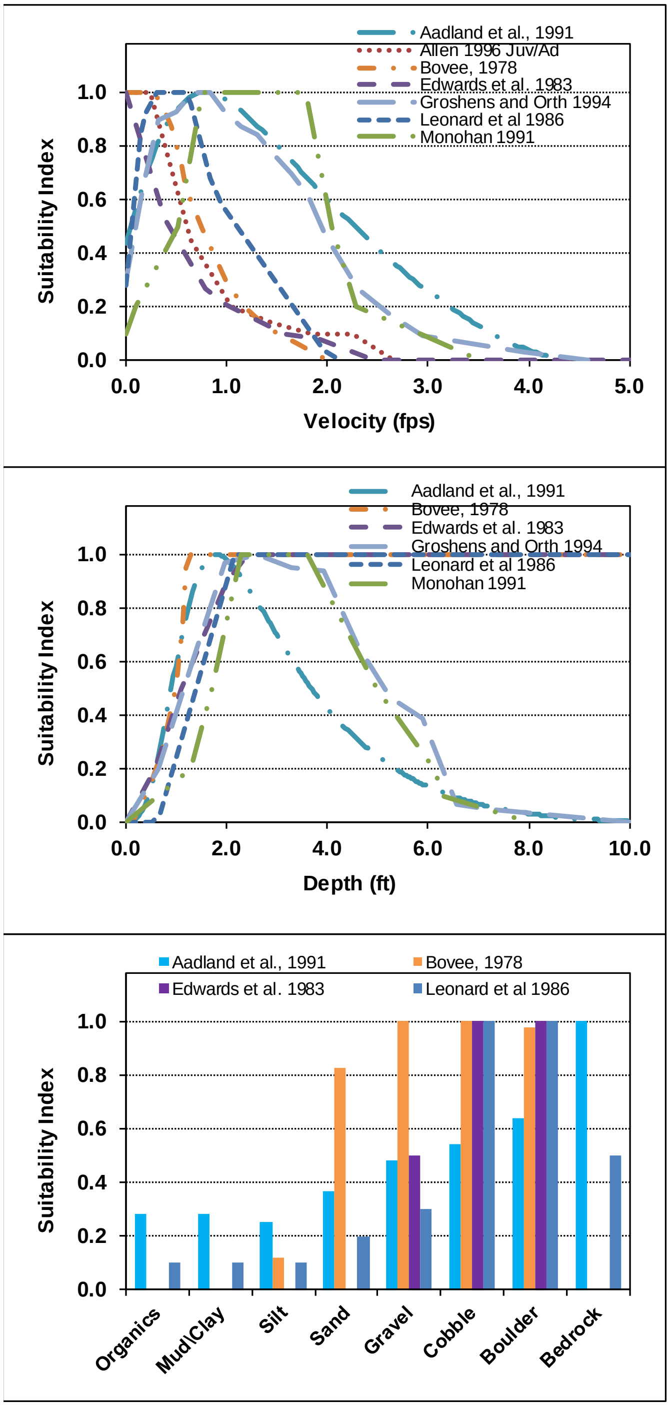


Figure 21. Smallmouth Bass juvenile HSC from various sources.

Smallmouth bass adult

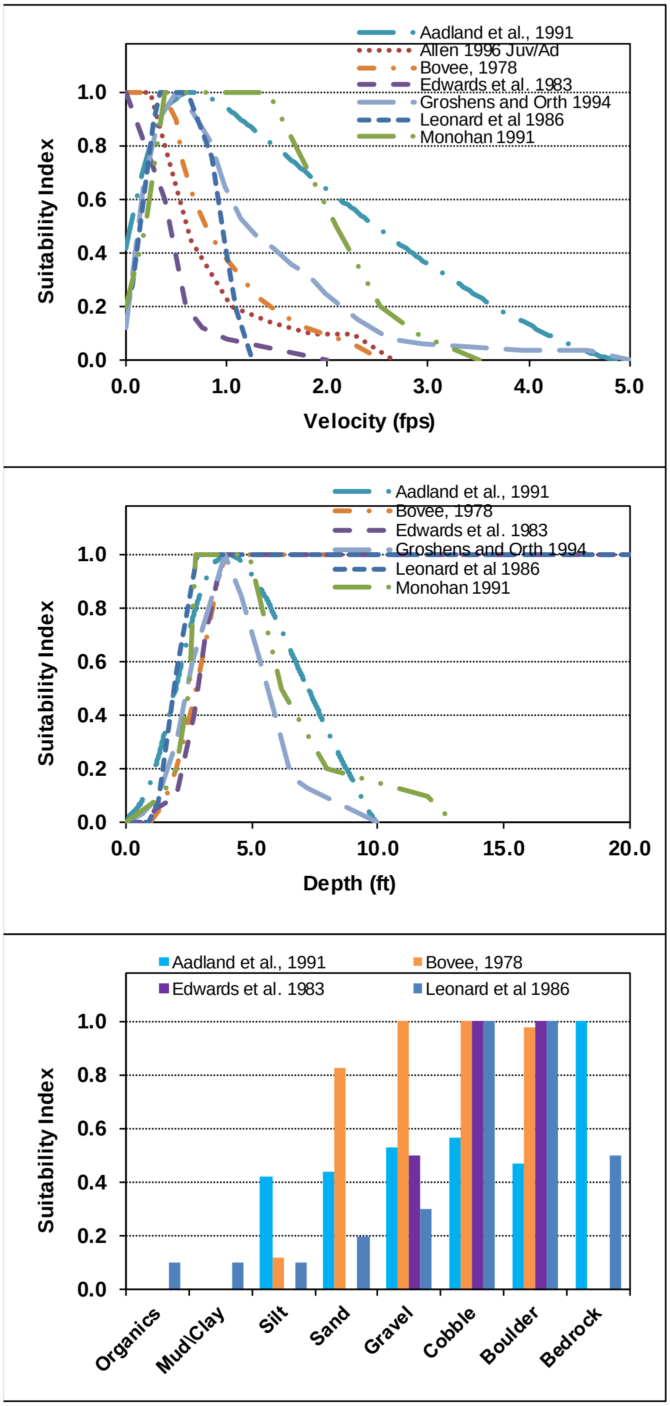


Figure 22. Smallmouth Bass adult HSC from various sources.

Smallmouth Bass spawning HSC sources are presented in Table 5. Smallmouth spawning HSC show a propensity for low velocities, generally less than 1.0 ft/s (Figure 23). The velocity curve from Bovee (1978) maintains markedly higher suitability than those from other sources, though the source is empirical and not derived from field data. Depth suitability is quite variable with two sources (Bovee, 1978 and Leonard et al., 1986) indicating unlimited depth and others with narrower ranges of depth. Substrate suitability is also variable with Addland and Kuitunen (2006) showing relatively high values for silt and sand. As noted previously, substrate suitability can be highly dependent on availability.

We recommend using the velocity curve developed by Allen (1996). This encompasses all but the Bovee (1978) HSC and corresponds with most literature suggesting that smallmouth prefer low velocities for spawning. The depth curve from Edwards et al. (1983), which limits spawning depth, and substrate from Allen (1996) which assigns gravel, sand and cobble (the dominant substrates found in the Connecticut River) highest suitability are also proposed.

Table 5. Smallmouth Bass spawning HSC sources.

Variable	Source	Location	Method	Note:
Spawning				
Velocity	Addland and Kuitunen, 2006	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	Direct Observation	HSC curve derived from frequency histograms
	Bovee, 1978	NA	Literature	Estimated from hydraulic formulae
	Bovee et al, 1994	Huron River	Direct Observation	
	Edwards et al., 1983	NA	Literature	Same as Bovee, 1978
	Leonard et al., 1986	Virginia	Direct Observation	Curve derived from use/availability data and professional judgment
Depth	Addland and Kuitunen, 2006	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	NA	Used Bovee, 1978
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Bovee et al, 1994	Huron River	Direct Observation	
	Edwards et al., 1983	NA	Literature	
	Leonard et al., 1986	Virginia	Direct Observation	Curve derived from use/availability data and professional judgment
Substrate	Addland and Kuitunen, 2006	Minnesota	Various	HSC curves derived from frequency histograms and non-linear regression
	Allen, 1996	Susquehanna R.	Direct Observation	HSC curve derived from frequency histograms
	Bovee, 1978	NA	Literature	FWS HSC Library Curves
	Bovee et al, 1994	Huron River	Direct Observation	No curves developed
	Edwards et al., 1983	NA	NA	Same as Bovee, 1978
	Leonard et al., 1986	Virginia	Direct Observation	Curve derived from use/availability data and professional judgment

Smallmouth bass spawning

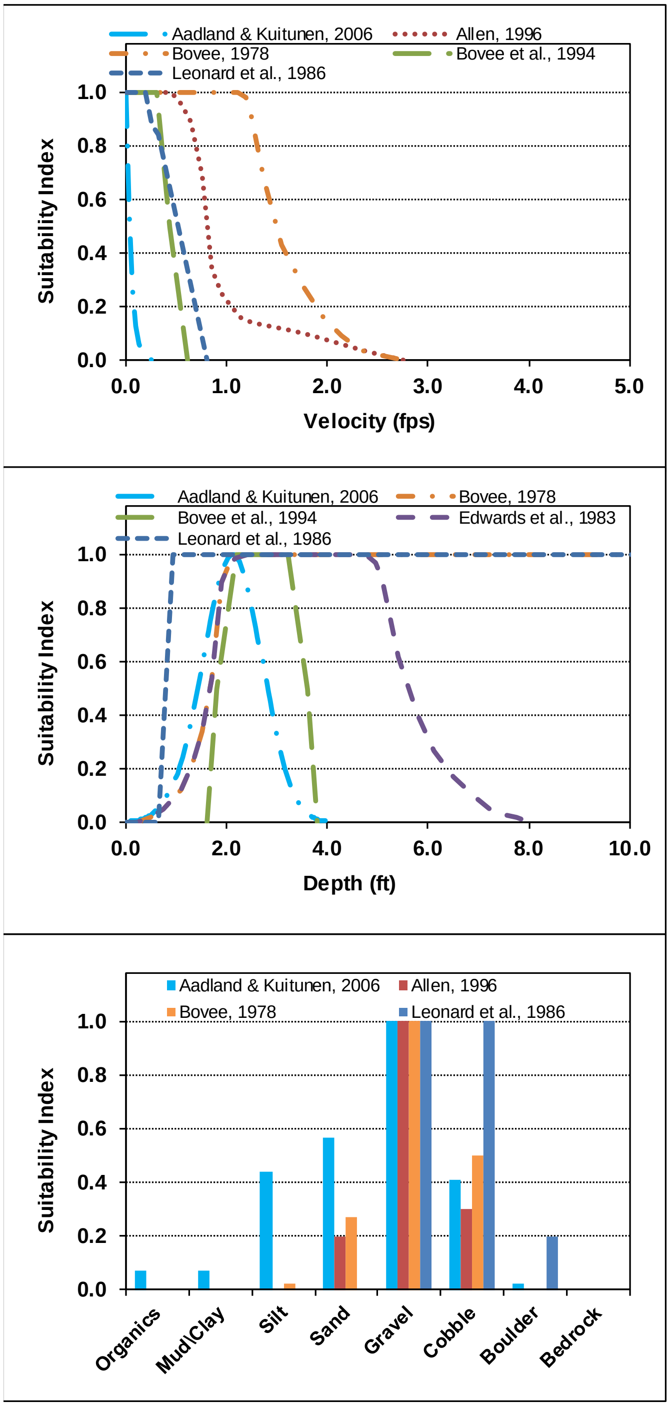


Figure 23. Smallmouth Bass spawning HSC from various sources

Mussels

Suitability information derived from the Dwarf wedgemussel and co-occurring mussel quantitative sampling conducted in 2014 (Study 24, Phase 2) will be used to construct HSC. Data collected includes water velocity, depth, substrate composition, shear stress and Froude number. Regression analyses and other statistical methods will help select, prioritize/weight, and scale the most important predictive parameters. These data will be supplemented with existing information (other publications, case studies, unpublished data, and expert review). The development of these habitat suitability criteria will be a transparent process and the aquatics working group will have an opportunity to review data sources, rationale for inclusion/exclusion of certain parameters, and weighting and scaling of each parameter. Results will be applied to 2D modeling in the lower portion of the Wilder reach 3, and can be applied to 1D transects in all reaches and the 2D study site in Wilder reach 2.

3.3. Proposed HSC for Wilder, Bellows Falls and Vernon Projects

Changes and revisions are recommended for some HSC proposed for the Turners Falls project based on additional information or reexamination of data sources. The rationale for revisions or changes to the Turners Falls HSC for American Shad spawning and Walleye spawning is described below. An alternative Tessellated Darter HSC is also proposed. Sources for proposed HSC for use in the evaluation of habitat and flow relationships for the Wilder, Bellows Falls, and Vernon projects are presented in Table 7. Proposed HSC of all target species and life stages to be used for the Wilder, Bellows Falls, and Vernon projects instream flow studies are presented in Appendix A.

American Shad spawning

Hightower et al. (2012) used ichthyoplankton collections as a basis for their analysis of velocity suitability. They acknowledge that velocity could differ between sites where eggs were collected in plankton samples and sites where spawning occurred. The primary disadvantage of ichthyoplankton sampling is that eggs travel an unknown distance between a spawning site and a collection site. In addition, eggs are more liable to be collected in areas of high velocity because they are less likely to settle to the bottom.

A review of data used by Hightower et al. (2012) to construct velocity HSC shows that the majority of samples and proportion of eggs present are very similar (Table 6), suggesting there is no selection for any particular velocity. However, the statistical method chosen to evaluate this data is based on a process that will result in a single point of maximum suitability, in this case at velocities (1.2+ m/s) that were rarely encountered and contained only 2% of samples with eggs present.

Table 6. Data from Hightower et al., 2012 used to construct velocity suitability criteria. (ft/s column added)

Velocity		Data Summary				
m/s	ft/s	Samples	Prop. Samples	Present	Prop. Present	Suitability
0.0	0	140	0.13	22	0.06	0.300
0.2	0.66	306	0.27	96	0.25	0.752
0.4	1.31	356	0.32	118	0.30	0.843
0.6	1.97	203	0.18	104	0.27	0.899
0.8	2.62	73	0.07	31	0.08	0.941
1.0	3.28	21	0.02	12	0.03	0.973
1.2+	3.94	14	0.01	6	0.02	1.000
Total		1113		389		

Source: (http://www.fwspubs.org/doi/suppl/10.3996/082011-JFWM-047)

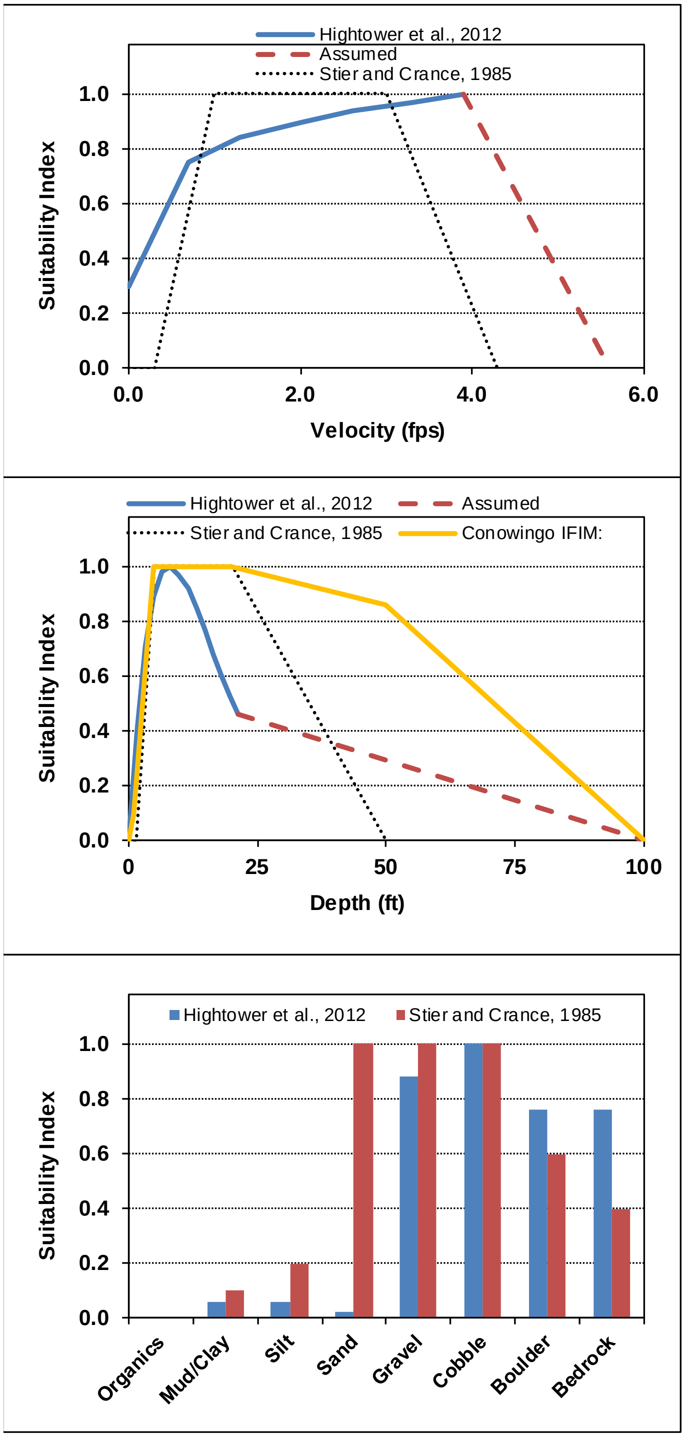
Harris and Hightower (2011) looked at a range of discharges between 1,300 cfs and 13,000 cfs (similar to project flows on the Connecticut River), concluding that spawners used higher velocities as flows increased, though the mean velocity use differed little. In the Harris and Hightower study radio-tagged American Shad tended to remain in localized areas during the spawning season and generally were found in velocities between 0.20 and 0.69 m/s (0.66 to 2.3 ft/s) at depths between 1.0 and 2.9 m. In addition, they note that regardless of discharge and available water velocities, spawning American shad generally avoided velocities greater than 1.0 m/s (3.3 ft/s). A study by Ross et al. (1993a) on the Delaware River reported spawning velocities in the range of 0.0-0.7 m/s and suggested there should not be a lower limit for velocity.

The spawning depth curve end point assigned to Stier and Crance (1985) is actually a modification of the original depth curve made for the Conowingo instream flow study (Exelon, 2012) (Figure 24). The original depth curve went to zero at 50 ft.

We propose to modify HSC for American Shad velocity and depth to reflect results of this review and reexamination of the data (Figure 25). For velocity we used the lower tail of the curve from Hightower et al. (2012) based on literature that suggests there should not be a lower limit to spawning velocity. All velocities from 1.0 ft/s (the original Stier and Crance, 1985 suitability of 1.0) to the upper limit of the Hightower curve are given a suitability of 1.0. For depth, we propose to use the curve developed by Hightower et al. (2012) and use the original endpoint of 50 feet from Stier and Crance (1985).

The data used by Hightower et al. (2012) to determine substrate suitability indicated the use of sand substrate for spawning, though in lower proportions than was available compared to other substrates. However, the model results gave sand a suitability of 0.02, less than that of silt and mud. The role of substrate in determining spawning locations is debatable, with research suggesting sizes can range between sand and boulder (Greene et al., 2009). As such, we propose to use the original Stier and Crance (1984) substrate criteria.

American Shad Spawning



Source:
Hightower et al., 2012

Velocity (ft/s)	SI
0.00	0.30
0.70	0.75
1.30	0.84
2.00	0.90
2.60	0.94
3.30	0.97
3.90	1.00
5.60	0.00

Source:
Stier and Crance, 1985

Velocity (ft/s)	SI
0.00	0.00
0.30	0.00
1.00	1.00
3.00	1.00
4.30	0.00

Depth (ft)	SI
0.00	0.00
1.60	0.40
3.30	0.71
4.90	0.89
6.60	0.98
8.20	1.00
9.80	0.97
11.50	0.92
13.10	0.85
14.80	0.77
16.40	0.68
18.00	0.60
19.70	0.53
21.30	0.46
100.00	0.00

Stier and Crance 1985

Depth (ft)	SI
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00

Conowingo IFIM:
Cited as Stier and Crance, 1985

Depth (ft)	SI
0.00	0.00
1.00	0.10
5.00	1.00
20.00	1.00
50.00	0.86
100.00	0.00

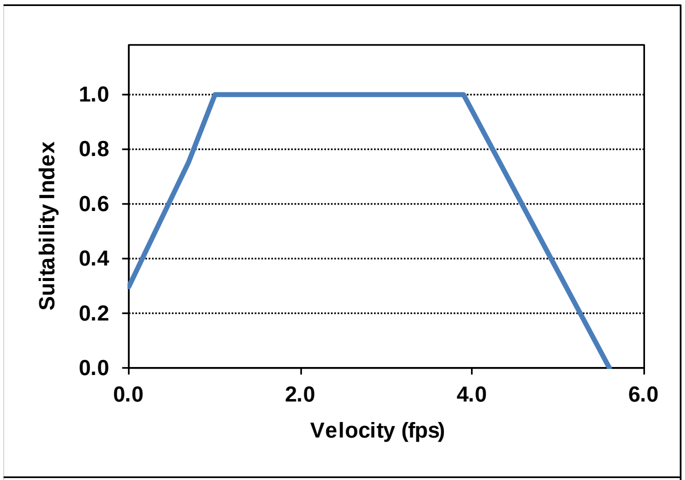
Substrate	SI
Organics	0.00
Mud/Clay	0.06
Silt	0.06
Sand	0.02
Gravel	0.88
Cobble	1.00
Boulder	0.76
Bedrock	0.76

Substrate	SI
Organics	0.00
Mud/Clay	0.10
Silt	0.20
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

Figure 24. American Shad spawning HSC from various sources

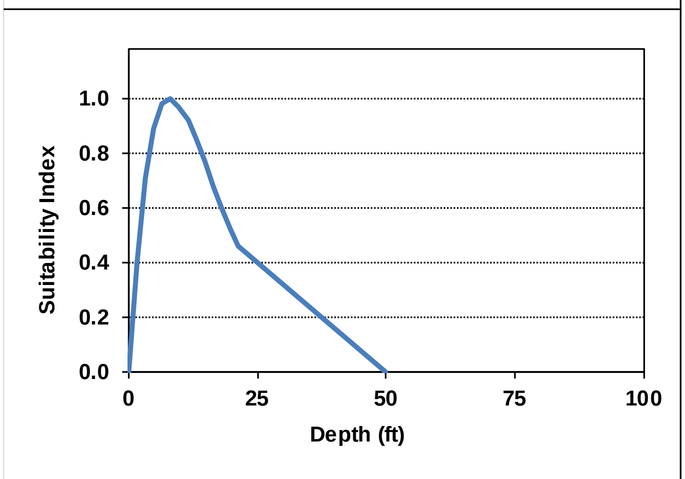
American Shad Spawning

Source:



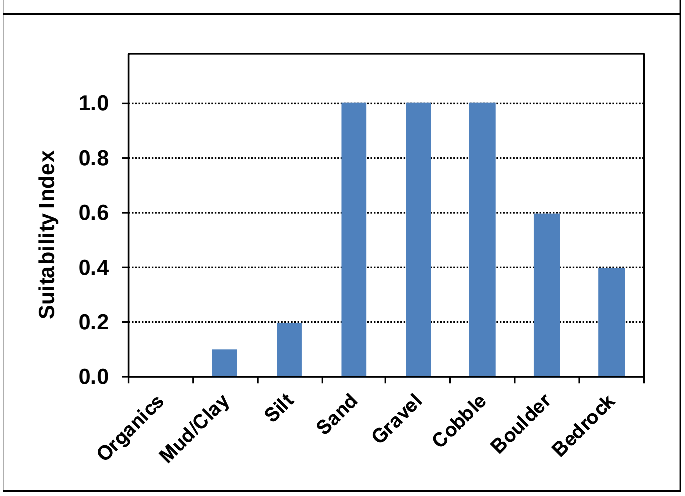
Based on Hightower et al., 2012 and Stier and Crance, 1985

Velocity (ft/s)	SI
0.00	0.30
0.70	0.75
1.00	1.00
3.00	1.00
3.90	1.00
5.60	0.00



Based on Hightower et al., 2012 and Stier and Crance, 1985

Depth (ft)	SI
0.00	0.00
1.60	0.40
3.30	0.71
4.90	0.89
6.60	0.98
8.20	1.00
9.80	0.97
11.50	0.92
13.10	0.85
14.80	0.77
16.40	0.68
18.00	0.60
19.70	0.53
21.30	0.46
50.00	0.00



Stier and Crance, 1985

Substrate	SI
Organics	0.00
Mud/Clay	0.10
Silt	0.20
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

Figure 25. Proposed American Shad spawning HSC.

Walleye

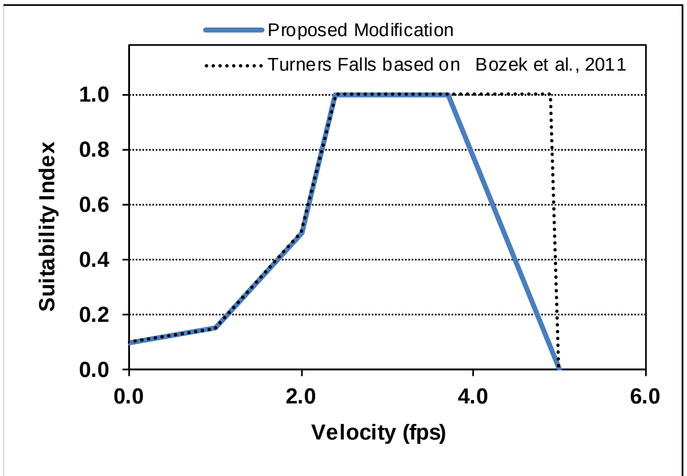
The modified walleye spawning and incubation velocity curve developed for the Turners Falls project is based on averaging minimum and maximum values of velocity ranges reported in Bozek et al. (2011) (Figure 26). Minimums of reported ranges are between 0.05 and 1.70 m/s (0.16 to 5.6 ft/s) while maximum values fall between 0.7 and 3.5 m/s (0.7 to 11.5 ft/s). Bozek et al. (2011) indicates that high velocities in the ranges reported (e.g., 9.5 and 11.5 ft/s) seem rather improbable and may be an artifact of coarse sampling techniques employed in difficult sampling environments, or instrumentation of insufficient resolution to measure microhabitats. As noted by Kerr et al. (1997) velocities exceeding 2.0 m/s (6.5 ft/s) may be avoided by spawning walleye and fatigue studies by Jones et al. (1974) indicate a 50 cm walleye -would be fatigued after 10 min in water velocities of 0.8 m/s (2.6 ft/s). Another study of walleye swimming performance found the highest maintainable speed for 10 minutes was between 1.4 and 3.75 ft/s, and the burst speed of walleye ranged from 5.2 to 8.5 ft/s (Peake et al., 2000).

Based on this information we believe the high end velocity ranges above 6.5 ft/s reported in Bozek et al. (2011) should not be included in calculating average maximum velocities, as was done for the Turners Falls curves. Using this criterion the average maximum velocity would be 3.7 ft/s and not 4.9 ft/s. We propose to change the Walleye spawning velocity suitability to reflect this (Figure 26).

Tesselated Darter

An alternative Tessellated Darter HSC for velocity and depth from Persinger (2003) is proposed (Figure 27) which “envelope” the HSC from Warner et al. (2006).

Walleye Spawning & Incubation



Proposed Modification

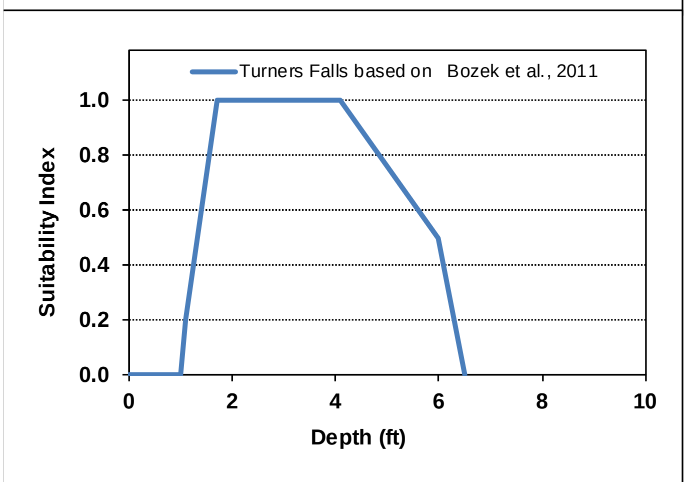
Velocity (ft/s)	SI
0.00	0.10
1.00	0.15
2.00	0.50
2.40	1.00
3.70	1.00
5.00	0.00

endpoint hypothetical

Turners Falls based on Bozek et al., 2011

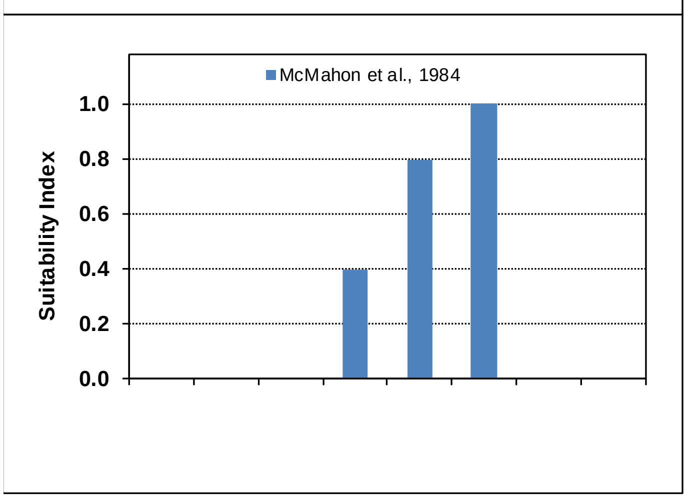
Velocity (ft/s)	SI
0.00	0.10
1.00	0.15
2.00	0.50
2.40	1.00
4.90	1.00
5.00	0.00

endpoint hypothetical



Turners Falls based on Bozek et al., 2011

Depth (ft)	SI
0.00	0.00
1.00	0.00
1.10	0.20
1.70	1.00
4.10	1.00
6.00	0.50
6.50	0.00

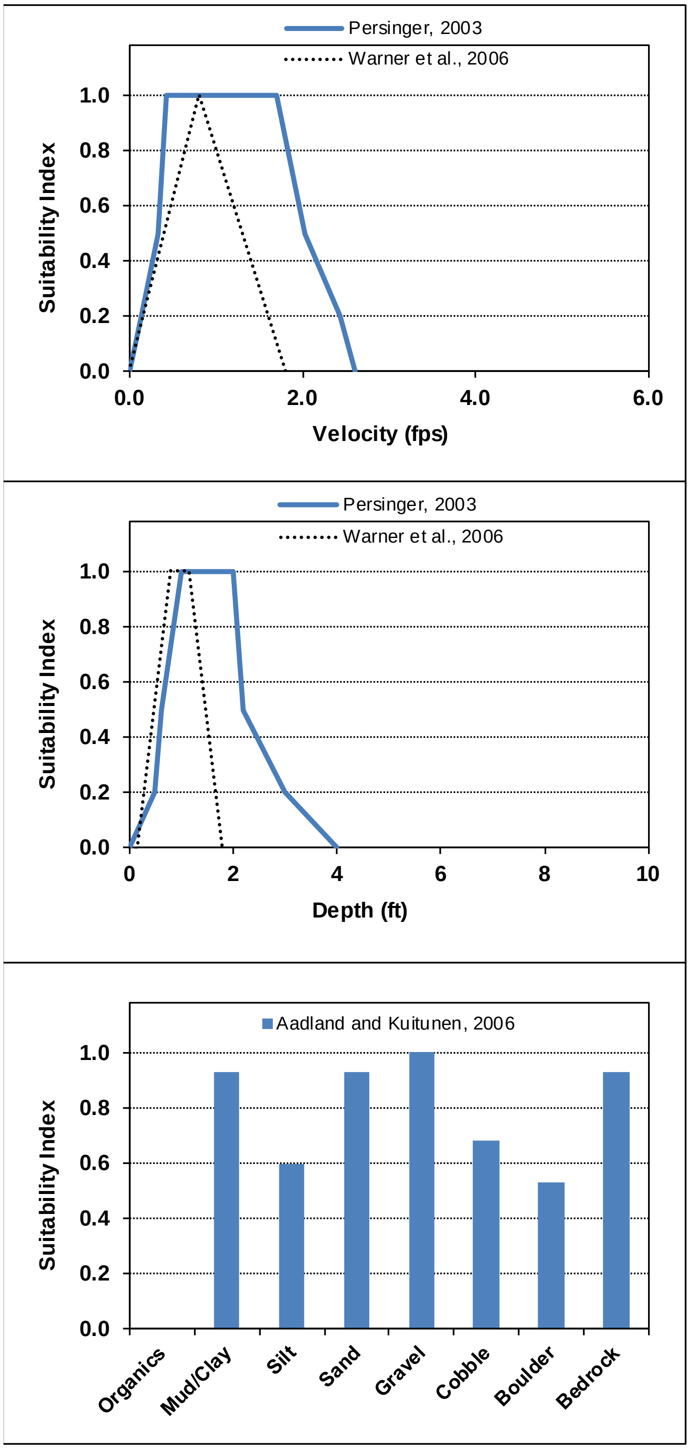


McMahon et al., 1984

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.40
Gravel	0.80
Cobble	1.00
Boulder	0.00
Bedrock	0.00

Figure 26. Proposed walleye spawning HSC.

Tessellated Darter Adult



Proposed
Persinger, 2003

Source:
Warner et al., 2006

Velocity (ft/s)	SI
0.00	0.00
0.13	0.20
0.33	0.50
0.43	1.00
1.70	1.00
2.03	0.50
2.43	0.20
2.60	0.00

end point assumed

Velocity (ft/s)	SI
0.00	0.00
0.80	1.00
1.80	0.00

Depth (ft)	SI
0.00	0.00
0.50	0.20
0.60	0.50
1.00	1.00
2.00	1.00
2.20	0.50
3.00	0.20
4.00	0.00

end point assumed

Depth (ft)	SI
0.00	0.00
0.16	0.00
0.80	1.00
1.15	1.00
1.80	0.00

Substrate Source: Aadland and Kuitunen, 2006
Johnny Darter- Surrogate for Tessellated Darter
(PPL Bell Bend 2012)

Substrate	SI
Organics	0.00
Mud/Clay	0.93
Silt	0.60
Sand	0.93
Gravel	1.00
Cobble	0.68
Boulder	0.53
Bedrock	0.93

Figure 27. Tessellated Darter proposed HSC.

Table 7. Proposed HSC sources and references for the Wilder, Bellows Falls and Vernon projects.

Species	Life Stage	Variable	Original Source	Identified Source	Note:
American Shad	Juvenile	Velocity	Stier and Crance, 1985	Stier and Crance, 1985	
		Depth	Stier and Crance, 1985	Excelon, 2012 (Conowingo IFIM)	Based on Greene et al. 2009
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	Not Stier and Crance 1985, source?
	Adult	Velocity	Stier and Crance, 1985	Stier and Crance, 1985	
		Depth	Stier and Crance, 1985	Stier and Crance, 1985	
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	Not Stier and Crance 1985, source?
	Spawning	Velocity	Stier and Crance, 1985	Hightower et al., 2012	Modified based on review of data
		Depth	Stier and Crance, 1985	Hightower et al., 2012	Used original Stier and Crance, 1985 endpoint of 50 feet.
		Substrate	Stier and Crance, 1985	Stier and Crance, 1985	
Walleye	Fry	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Juvenile	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Adult	Velocity	McMahon et al., 1984	McMahon et al., 1984	
		Depth	McMahon et al., 1984	McMahon et al., 1984	
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
	Spawning/ Incubation	Velocity	McMahon et al., 1984	Revised in this document	Based on reanalysis of Bozek et al., 2011
		Depth	McMahon et al., 1984	Bozek et al., 2011	From Turners Falls project
		Substrate	McMahon et al., 1984	McMahon et al., 1984	
Fallfish	Fry	Velocity	NA	Gomez and Sullivan, 2007	Velocity and depth based on brook trout fry and juvenile HSC curves developed as part of a Delphi Process for the Deerfield River.
		Depth	NA	Gomez and Sullivan, 2007	
		Substrate	NA	Gomez and Sullivan, 2007	
	Juvenile	Velocity	NA	Gomez and Sullivan, 2007	
		Depth	NA	Gomez and Sullivan, 2007	
		Substrate	NA	Gomez and Sullivan, 2007	
	Adult	Velocity	None identified	Gomez and Sullivan, 2007	Developed in consultation with the New York Department of Environmental Conservation
		Depth	None identified	Gomez and Sullivan, 2007	
		Substrate	None identified	Gomez and Sullivan, 2007	
	Spawning/ Incubation	Velocity	None identified	Gomez and Sullivan, 2007	
		Depth	None identified	Gomez and Sullivan, 2007	
		Substrate	None identified	Gomez and Sullivan, 2007	

Table 7 (cont). Proposed HSC sources and references for the Wilder, Bellows Falls and Vernon projects.

Species	Life Stage	Variable	Original Source	Identified Source	Note:
Longnose Dace	Juvenile	Velocity	USGS HSC Library	Gomez and Sullivan, 2000	Modified by Vermont Department of Fish and Wildlife
		Depth	USGS HSC Library	Gomez and Sullivan, 2000	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2000	
	Adult	Velocity	USGS HSC Library	Gomez and Sullivan, 2000	
		Depth	USGS HSC Library	Gomez and Sullivan, 2000	
		Substrate	USGS HSC Library	Gomez and Sullivan, 2000	
White Sucker	Fry	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Twomey et al., 1984	
	Juvenile/Adult	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Twomey et al., 1984	
	Spawning/ Incubation	Velocity	Twomey et al., 1984	Twomey et al., 1984	
		Depth	Twomey et al., 1984	Twomey et al., 1984	
		Substrate	Twomey et al., 1984	Gomez and Sullivan, 2007	Modified from original source
Tessellated Darter	Adult	Velocity	Warner et al. 2006	Persinger, 2003	
		Depth	Warner et al. 2006	Persinger, 2003	
		Substrate	Aadland and Kuitunen 2006	Aadland and Kuitunen 2006	Jhonny darter as surrogate
Sea lamprey	Spawning	Velocity	Kynard and Horgan, 2013	Kynard and Horgan, 2013	Modified by FWS based on Yergeau, 1983 (depth and substrate)[3]
		Depth	Kynard and Horgan, 2013	Kynard and Horgan, 2013	
		Substrate	Kynard and Horgan, 2013	Kynard and Horgan, 2013	
Smallmouth Bass	Fry	Velocity	Multiple	Leonard et al., 1986	
		Depth	Multiple	Leonard et al., 1986	
		Substrate	Multiple	Leonard et al., 1986	
	Juvenile	Velocity	Multiple	Groshens and Orth, 1994	
		Depth	Multiple	Leonard et al., 1986	
		Substrate	Multiple	Leonard et al., 1986	
	Adult	Velocity	Multiple	Groshens and Orth, 1994	
		Depth	Multiple	Leonard et al., 1986	
		Substrate	Multiple	Leonard et al., 1986	
	Spawning	Velocity	Multiple	Allen, 1996	
		Depth	Multiple	Edwards et al., 1983e	
		Substrate	Multiple	Allen, 1996	
Macro-invetebrates	nymphs	Velocity	Unknown	Gomez and Sullivan, 2000	VTDFW modified
		Depth	Unknown	Gomez and Sullivan, 2000	NMPC curve
		Substrate	Unknown	Gomez and Sullivan, 2000	

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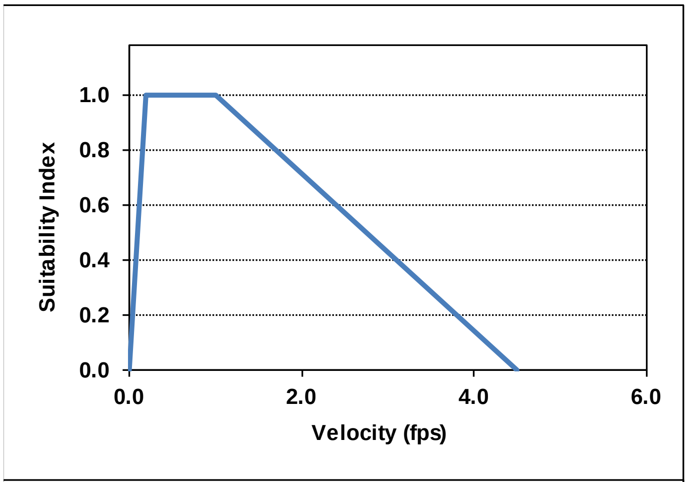
Appendix A

Final Habitat Suitability Criteria for the Wilder, Bellows Falls, and Vernon Projects

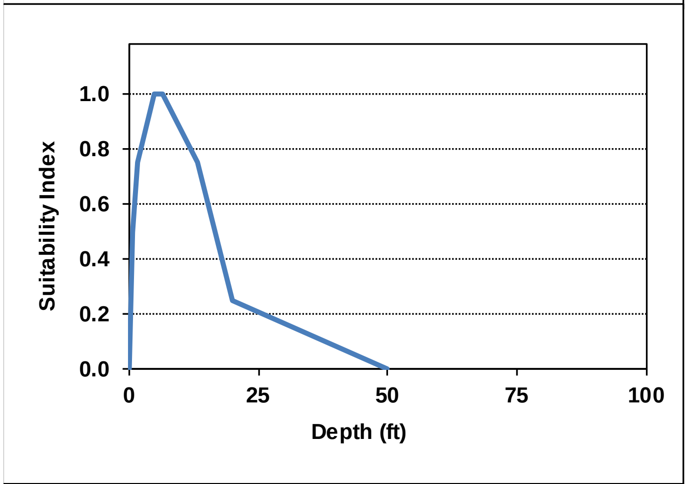
American Shad Juvenile

Source:



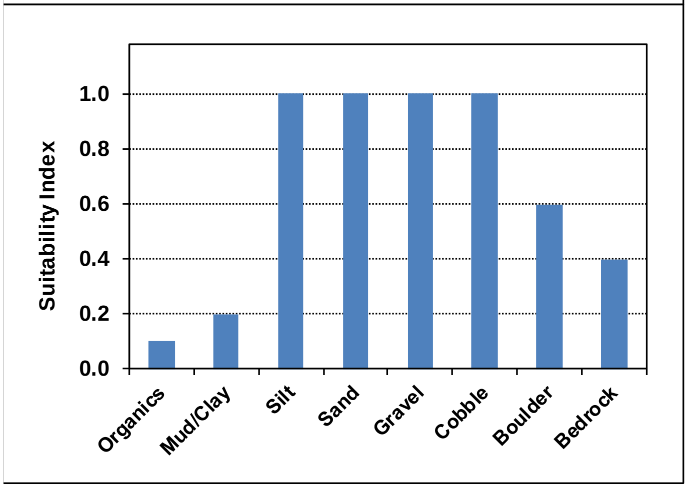
Stier and Crance, 1985

Velocity (ft/s)	SI
0.00	0.00
0.20	1.00
1.00	1.00
4.50	0.00



Greene et al., 2009

Depth (ft)	SI
0.00	0.00
0.66	0.50
1.50	0.75
4.90	1.00
6.60	1.00
13.20	0.75
20.00	0.25
50.00	0.00

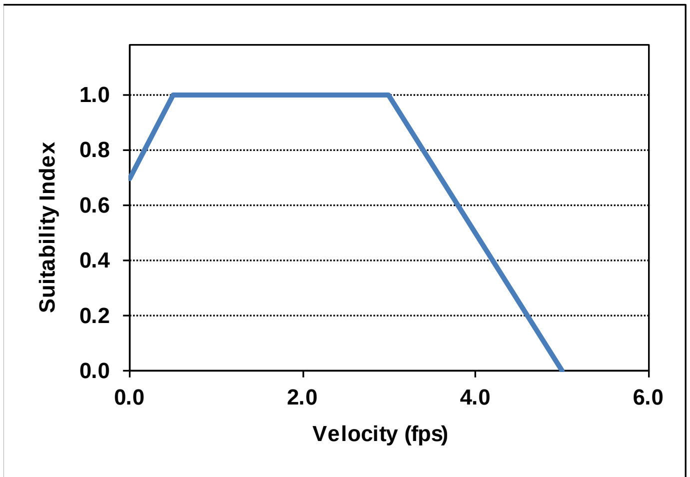


Conowingo IFIM

Substrate	SI
Organics	0.10
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

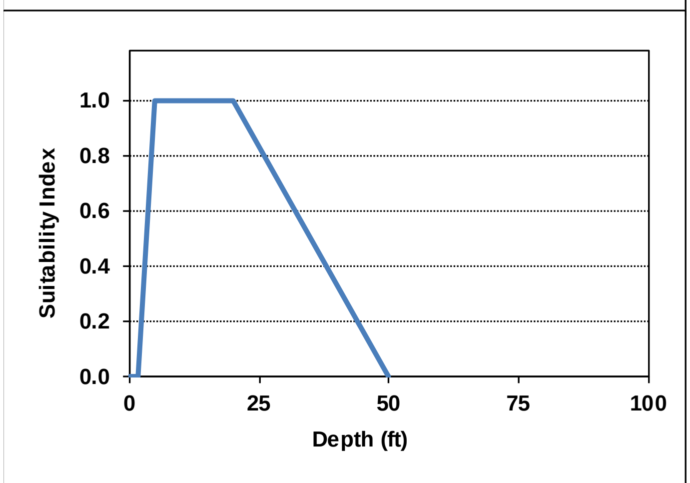
American Shad Adult

Source:



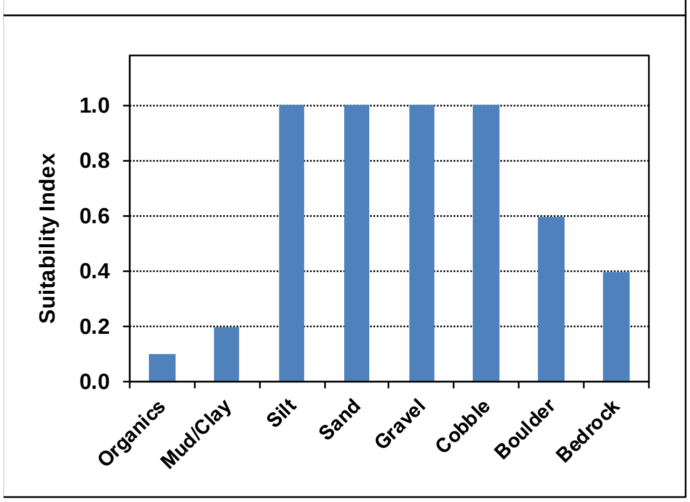
Stier and Crance, 1985

Velocity (ft/s)	SI
0.00	0.70
0.50	1.00
3.00	1.00
5.00	0.00



Stier and Crance, 1985

Depth (ft)	SI
0.00	0.00
1.50	0.00
5.00	1.00
20.00	1.00
50.00	0.00

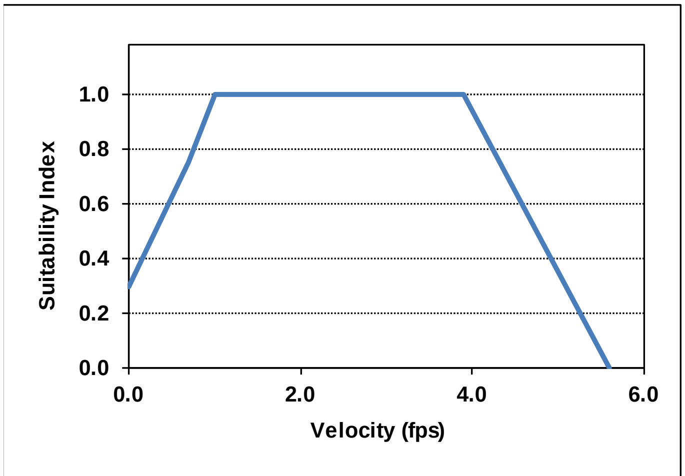


Conowingo IFIM

Substrate	SI
Organics	0.10
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

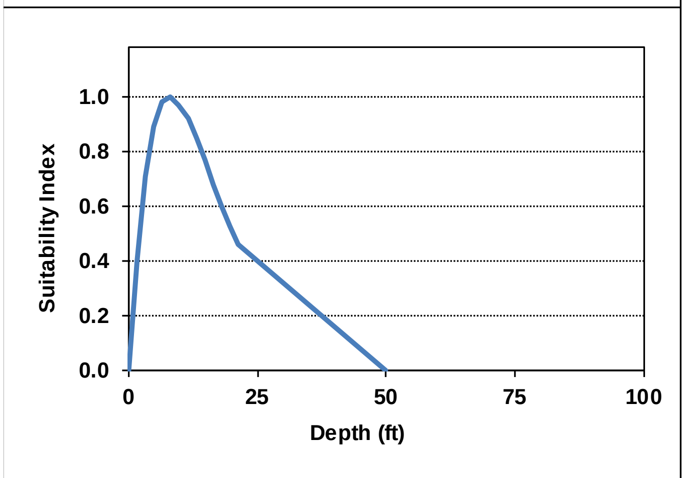
American Shad Spawning

Source:



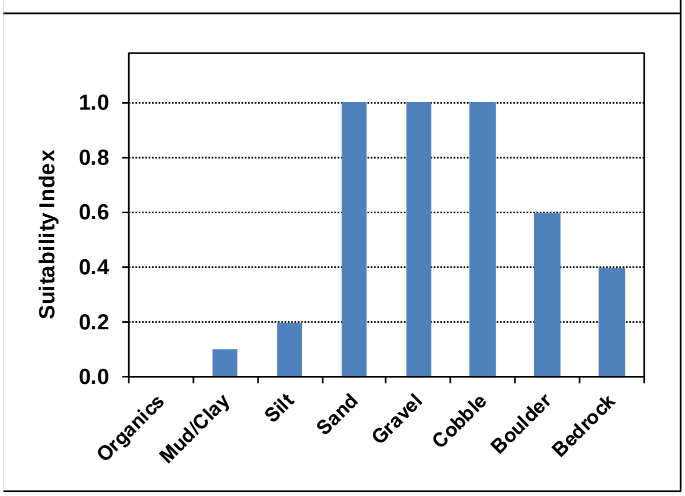
Velocity based on data from Hightower et al., 2012

Velocity (ft/s)	SI
0.00	0.30
0.70	0.75
1.00	1.00
3.00	1.00
3.90	1.00
5.60	0.00



Hightower et al., 2012 and Stier and Crance, 1985

Depth (ft)	SI
0.00	0.00
1.60	0.40
3.30	0.71
4.90	0.89
6.60	0.98
8.20	1.00
9.80	0.97
11.50	0.92
13.10	0.85
14.80	0.77
16.40	0.68
18.00	0.60
19.70	0.53
21.30	0.46
50.00	0.00



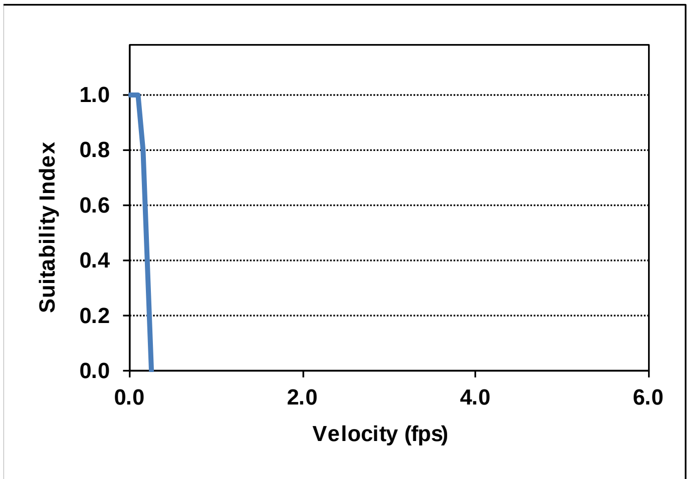
Stier and Crance, 1985

Substrate	SI
Organics	0.00
Mud/Clay	0.10
Silt	0.20
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	0.60
Bedrock	0.40

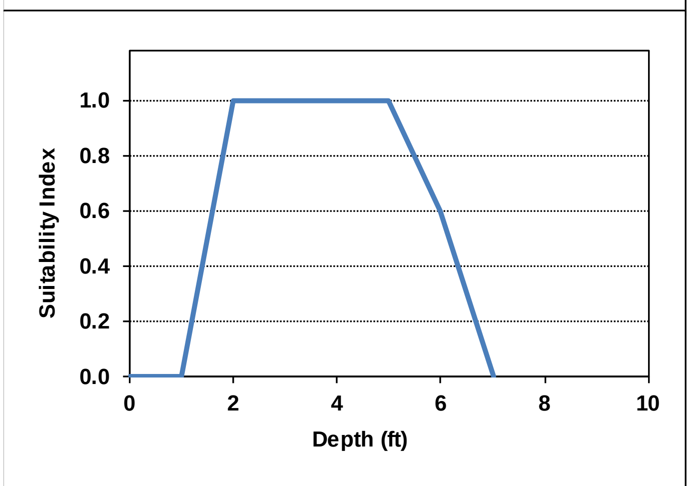
Walleye Fry

Source:

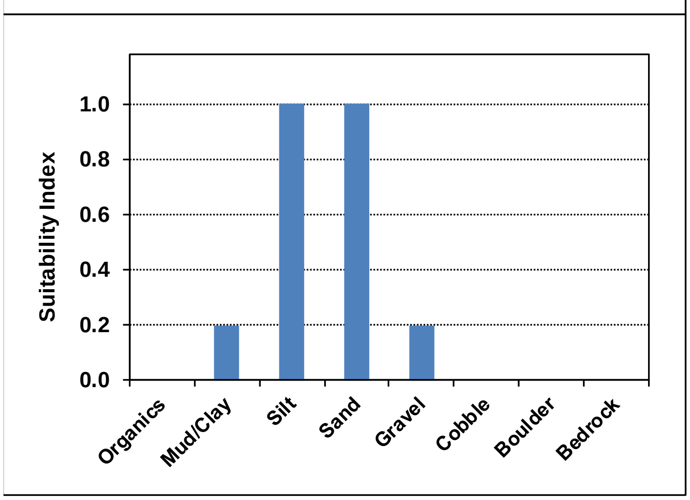
McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.10	1.00
0.15	0.80
0.25	0.00
2.00	0.00



Depth (ft)	SI
0.00	0.00
1.00	0.00
2.00	1.00
5.00	1.00
6.00	0.60
7.00	0.00

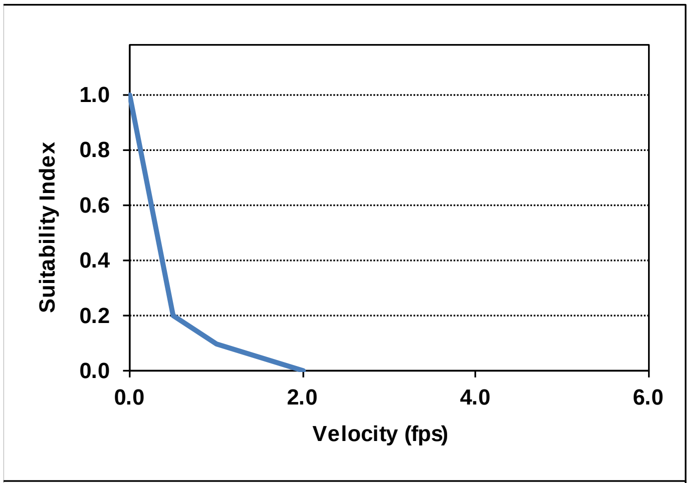


Substrate	SI
Organics	0.00
Mud/Clay	0.20
Silt	1.00
Sand	1.00
Gravel	0.20
Cobble	0.00
Boulder	0.00
Bedrock	0.00

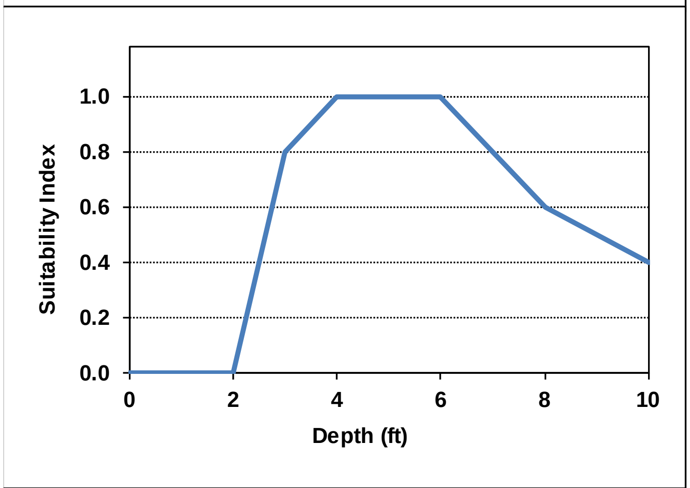
Walleye Juvenile

Source:

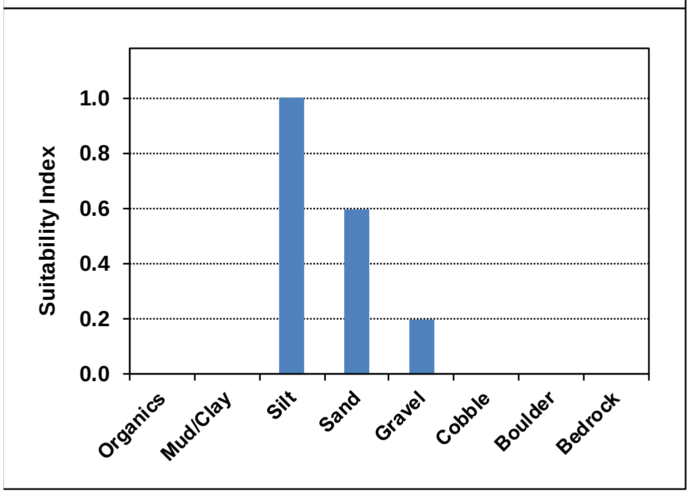
McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.50	0.20
1.00	0.10
2.00	0.00



Depth (ft)	SI
0.00	0.00
2.00	0.00
3.00	0.80
4.00	1.00
6.00	1.00
8.00	0.60
10.00	0.40
50.00	0.40

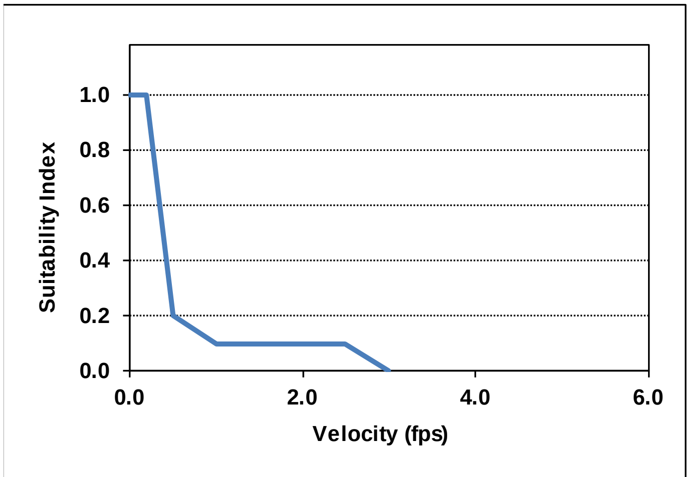


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	1.00
Sand	0.60
Gravel	0.20
Cobble	0.00
Boulder	0.00
Bedrock	0.00

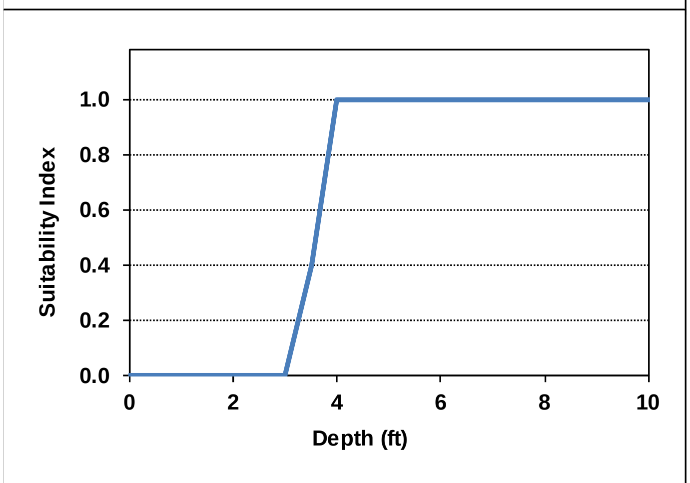
Walleye Adult

Source:

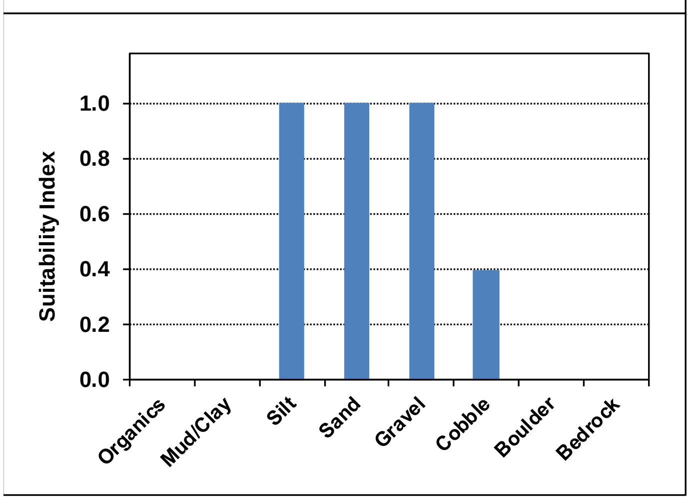
McMahon et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.20	1.00
0.50	0.20
1.00	0.10
2.50	0.10
3.00	0.00



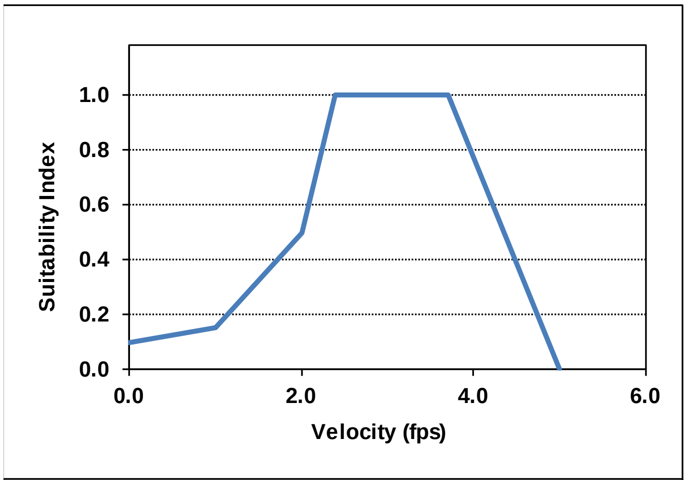
Depth (ft)	SI
0.00	0.00
3.00	0.00
3.50	0.40
4.00	1.00
50.00	1.00



Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	0.40
Boulder	0.00
Bedrock	0.00

Walleye Spawning & Incubation

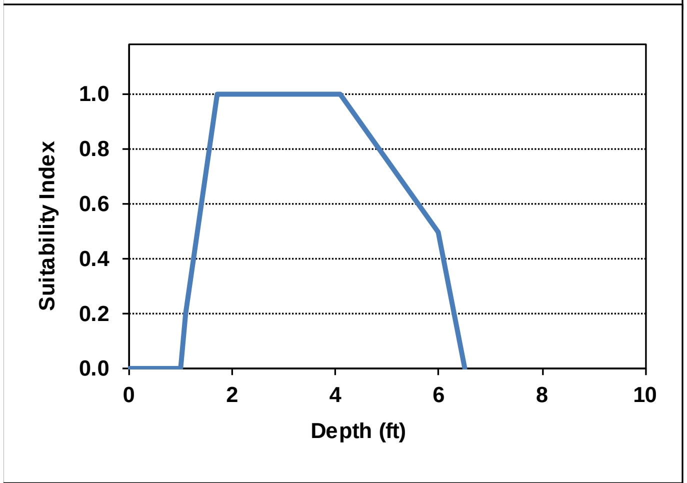
Source:



Based on Bozek et al., 2011

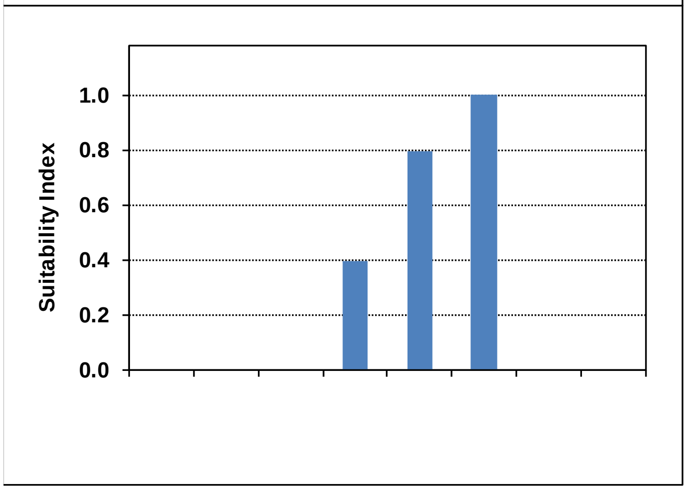
Velocity (ft/s)	SI
0.00	0.10
1.00	0.15
2.00	0.50
2.40	1.00
3.70	1.00
5.00	0.00

endpoint hypothetical



Turners Falls based on Bozek et al., 2011

Depth (ft)	SI
0.00	0.00
1.00	0.00
1.10	0.20
1.70	1.00
4.10	1.00
6.00	0.50
6.50	0.00



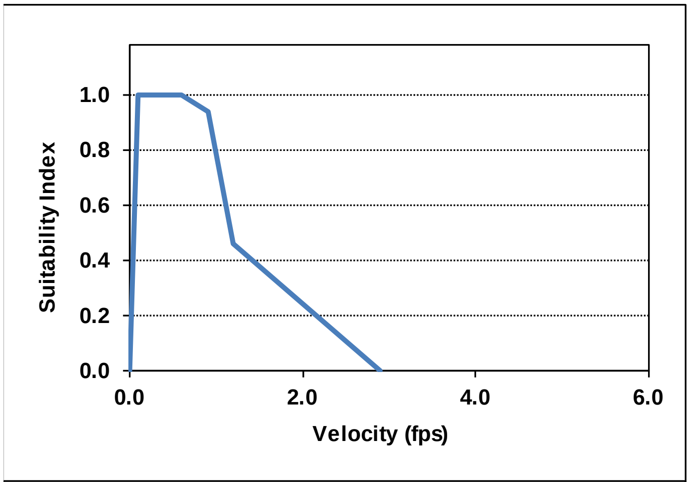
McMahon et al., 1984

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.40
Gravel	0.80
Cobble	1.00
Boulder	0.00
Bedrock	0.00

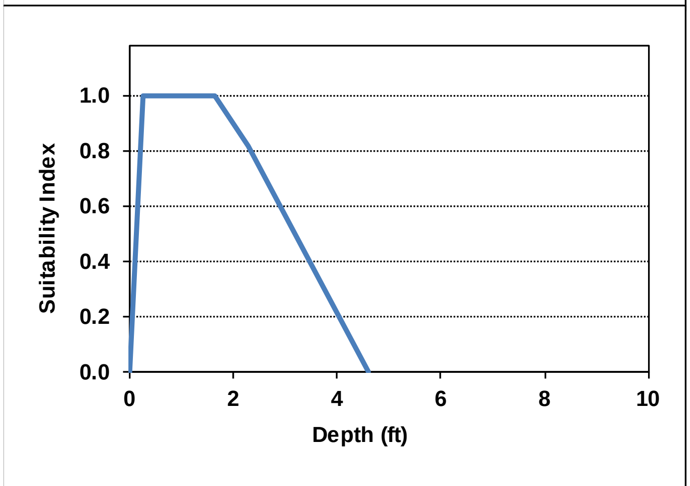
Fallfish Fry

Velocity and depth from brook trout fry curves (Deerfield River)
Substrate developed by Charles Ritzi

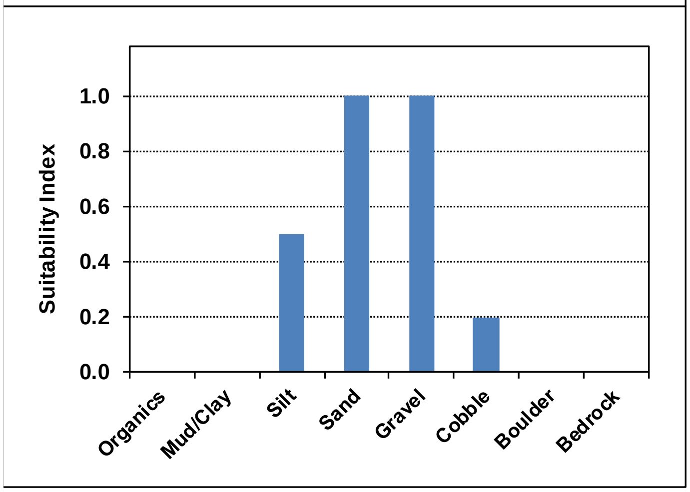
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	1.00
0.60	1.00
0.90	0.94
1.20	0.46
2.90	0.00



Depth (ft)	SI
0.00	0.00
0.25	1.00
1.65	1.00
2.30	0.82
4.60	0.00
100.00	0.00

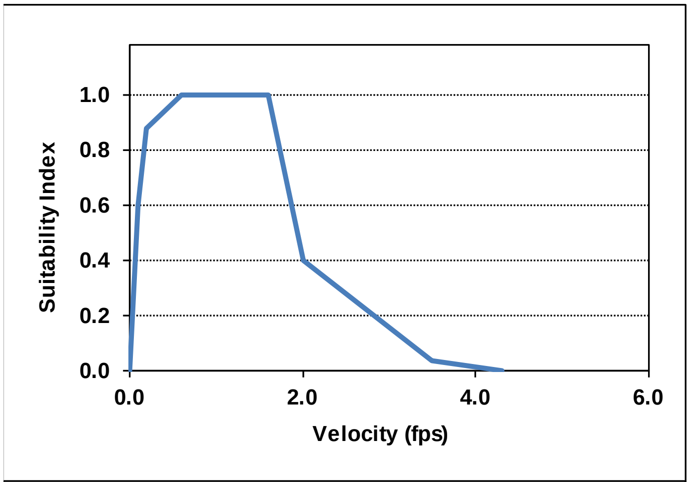


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.50
Sand	1.00
Gravel	1.00
Cobble	0.20
Boulder	0.00
Bedrock	0.00

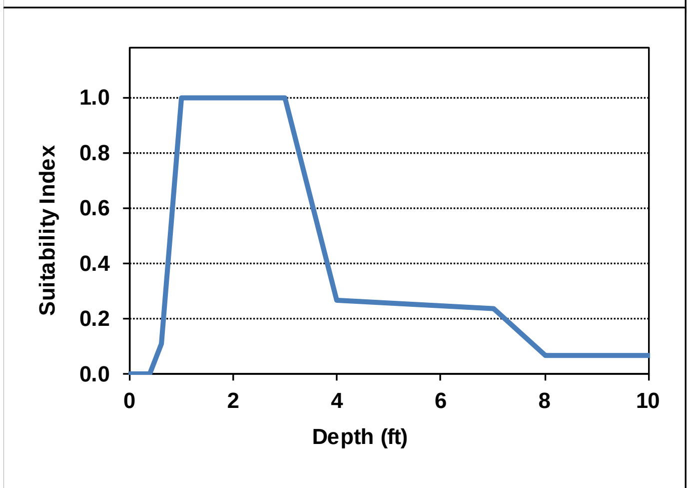
Fallfish Juvenile

Velocity and depth from brook trout fry curves (Deerfield River)
Substrate developed by Charles Ritzi

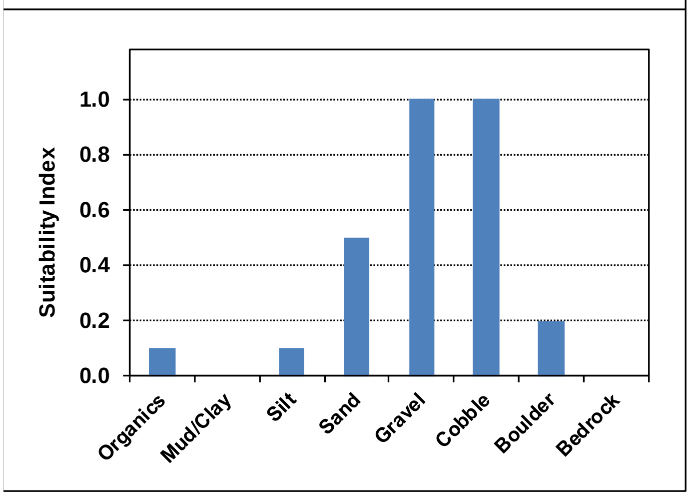
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	0.60
0.20	0.88
0.60	1.00
1.60	1.00
2.00	0.40
3.50	0.04
4.30	0.00



Depth (ft)	SI
0.00	0.00
0.40	0.00
0.60	0.11
1.00	1.00
3.00	1.00
4.00	0.27
7.00	0.24
8.00	0.07
20.00	0.07
100.00	0.07

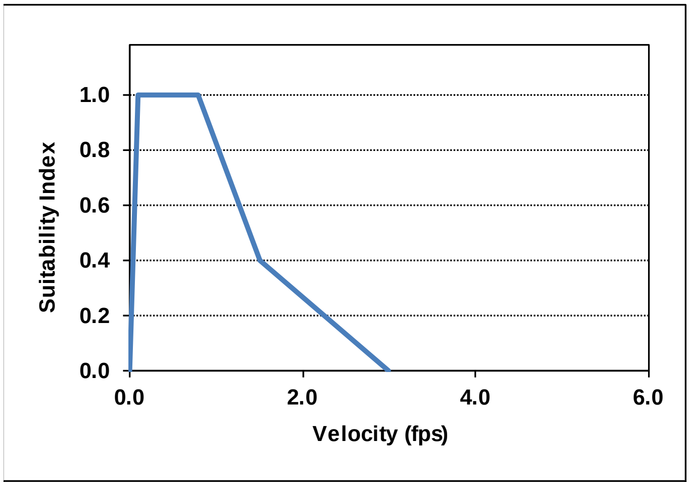


Substrate	SI
Organics	0.10
Mud/Clay	0.00
Silt	0.10
Sand	0.50
Gravel	1.00
Cobble	1.00
Boulder	0.20
Bedrock	0.00

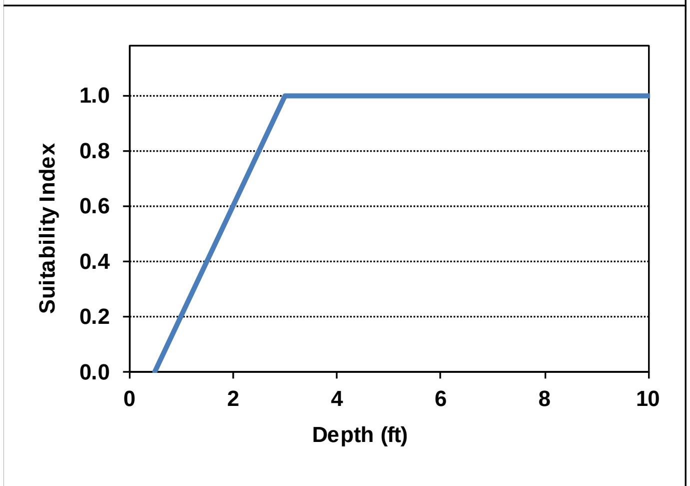
Fallfish Adult

Developed from consultation with NYSDEC
(New York Dept. of Environmental Conservation)

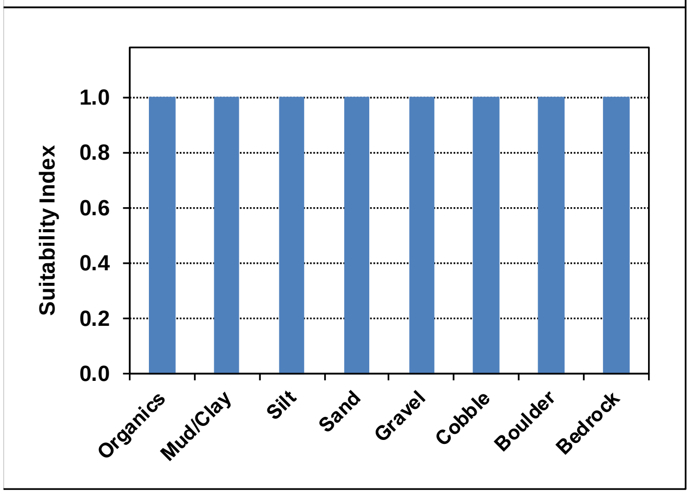
Source:
Gomez and Sullivan, 2007



Velocity (ft/s)	SI
0.00	0.00
0.10	1.00
0.80	1.00
1.50	0.40
3.00	0.00



Depth (ft)	SI
0.00	0.00
0.50	0.00
3.00	1.00
100.00	1.00

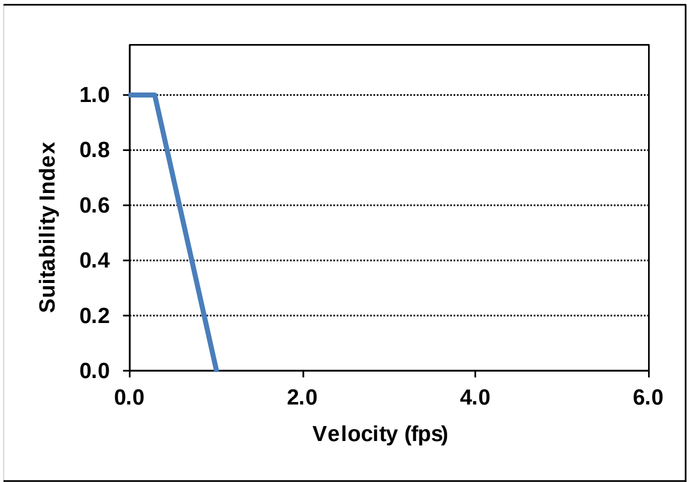


Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

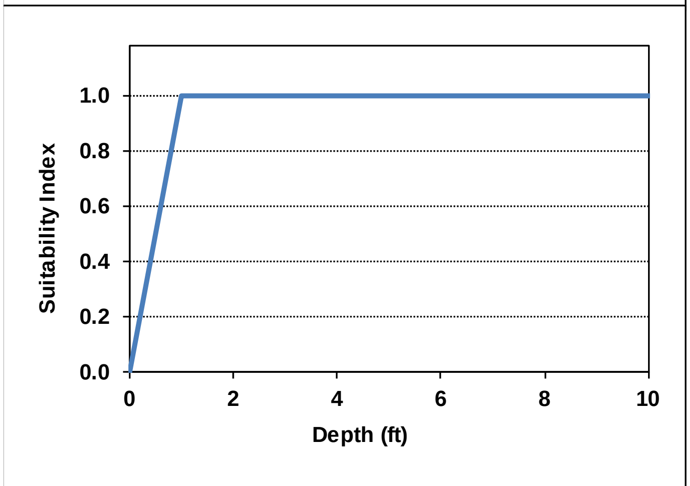
White Sucker Fry

Source:

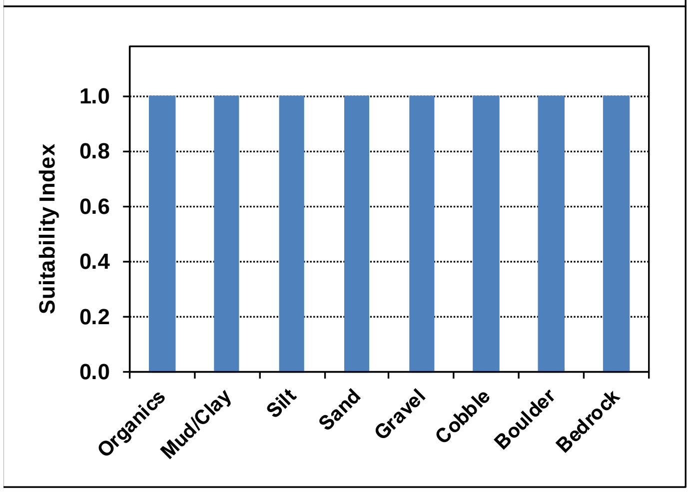
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	1.00
0.30	1.00
1.00	0.00



Depth (ft)	SI
0.00	0.00
1.00	1.00
100.00	1.00

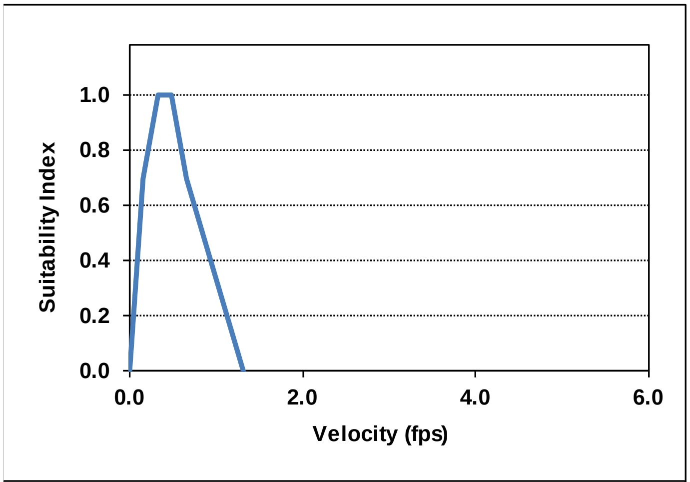


Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

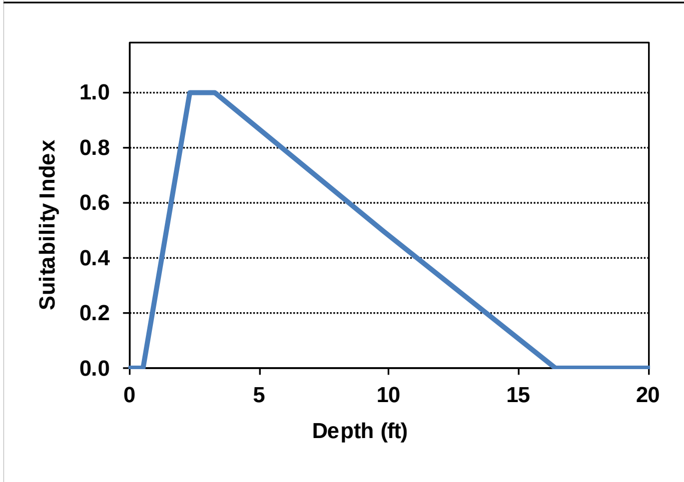
White Sucker Adult/Juvenile

Source:

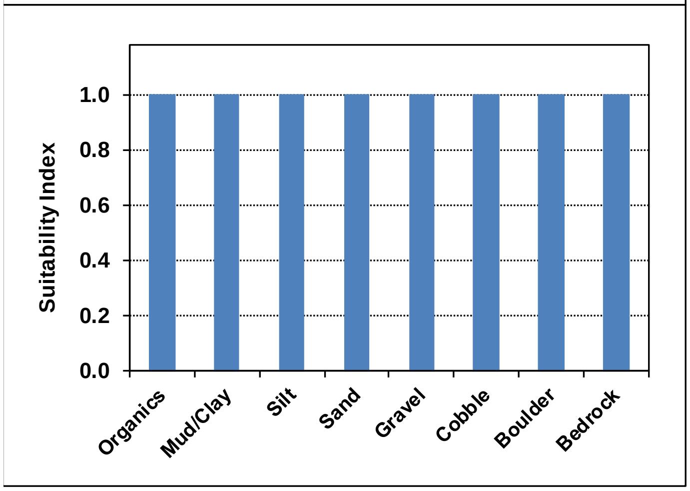
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	0.00
0.16	0.70
0.33	1.00
0.49	1.00
0.66	0.70
1.31	0.00



Depth (ft)	SI
0.00	0.00
0.50	0.00
2.30	1.00
3.30	1.00
9.80	0.50
16.40	0.00
100.00	0.00

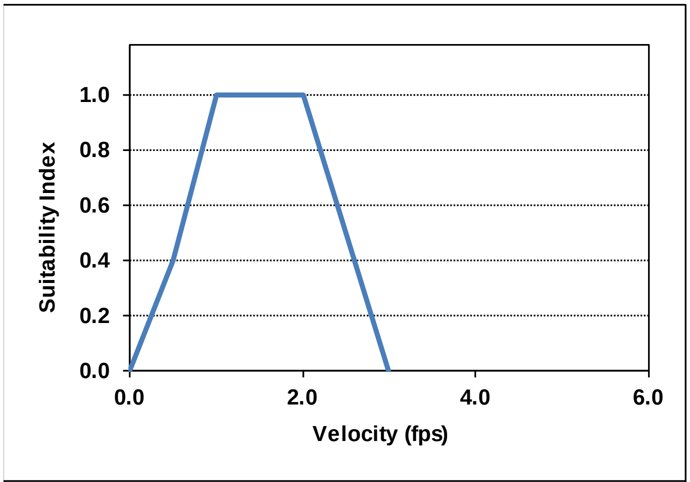


Substrate	SI
Organics	1.00
Mud/Clay	1.00
Silt	1.00
Sand	1.00
Gravel	1.00
Cobble	1.00
Boulder	1.00
Bedrock	1.00

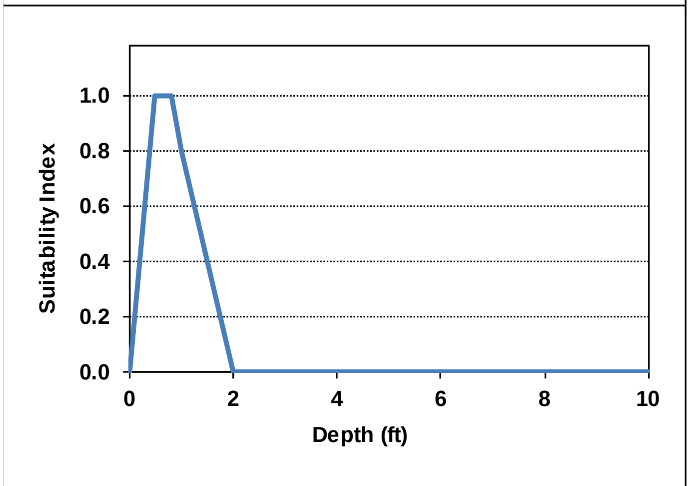
White Sucker Spawning & Incubation

Source:

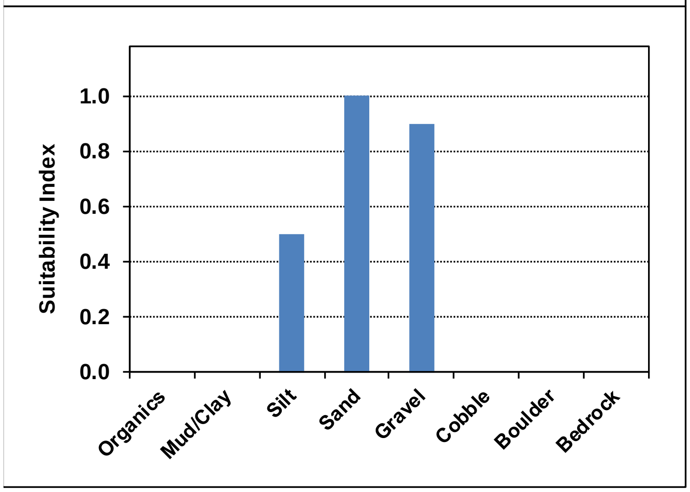
Twomey et al., 1984



Velocity (ft/s)	SI
0.00	0.00
0.50	0.40
1.00	1.00
2.00	1.00
3.00	0.00



Depth (ft)	SI
0.00	0.00
0.50	1.00
0.80	1.00
1.00	0.80
2.00	0.00
100.00	0.00



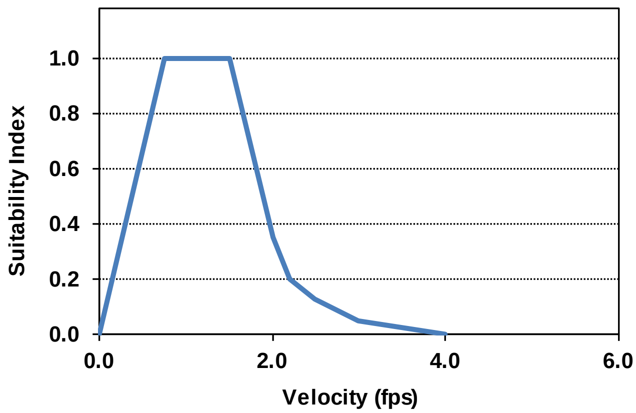
Substrate Source:
Gomez and Sullivan, 2007

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.50
Sand	1.00
Gravel	0.90
Cobble	0.00
Boulder	0.00
Bedrock	0.00

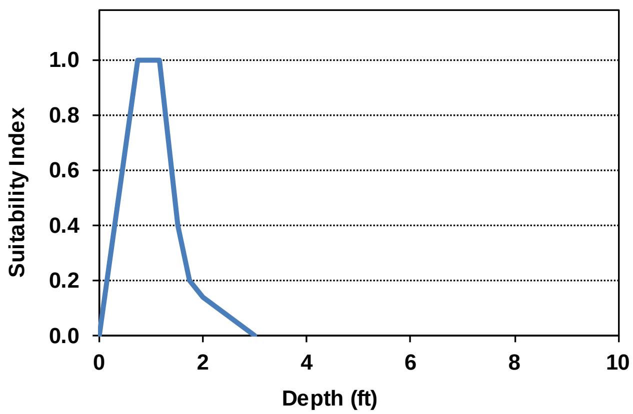
Longnose Dace Juvenile

Original curve identified as from USFWS HSC library
Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

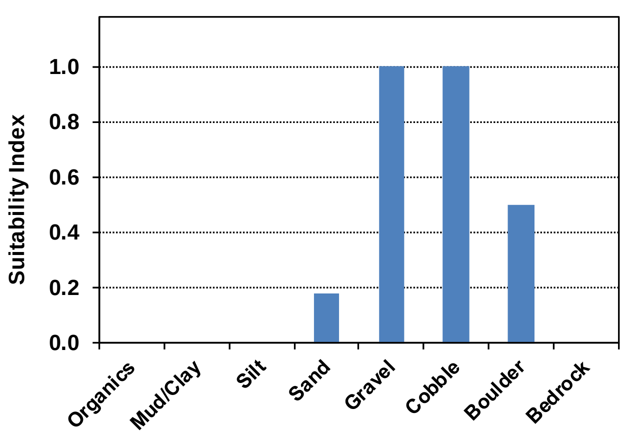
Source:
Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.75	1.00
1.50	1.00
2.00	0.35
2.20	0.20
2.50	0.13
3.00	0.05
4.00	0.00



Depth (ft)	SI
0.00	0.00
0.75	1.00
1.15	1.00
1.50	0.40
1.75	0.20
2.00	0.14
3.00	0.00

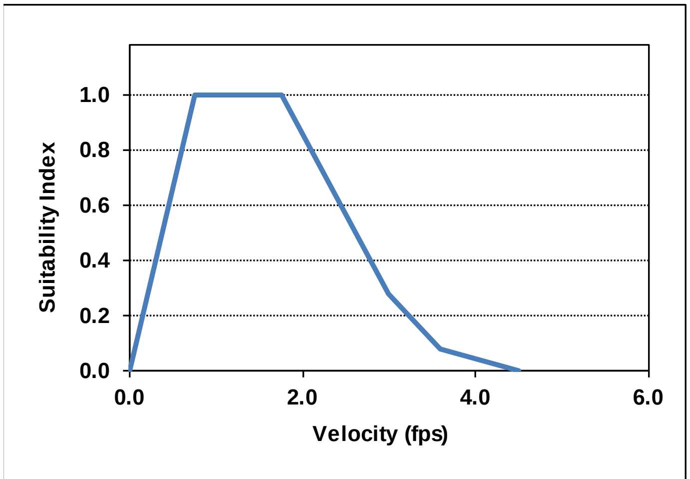


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.18
Gravel	1.00
Cobble	1.00
Boulder	0.50
Bedrock	0.00

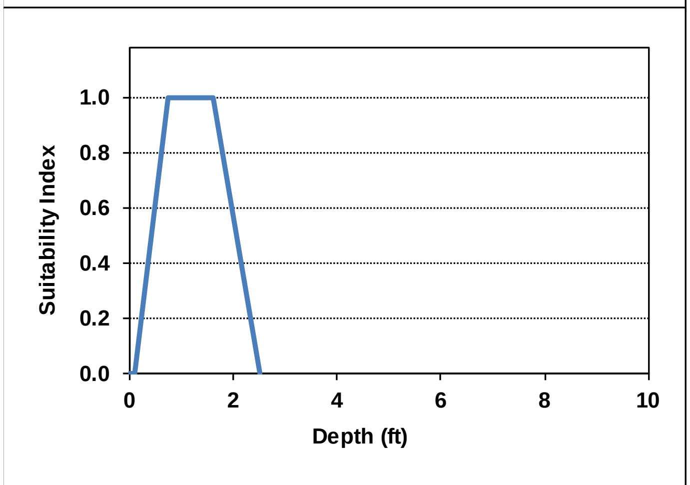
Longnose Dace Adult

Original curve identified as from USGS HSC library
Modified by VDFW for the Lamoille River IFS (Gomez and Sullivan, 2000)

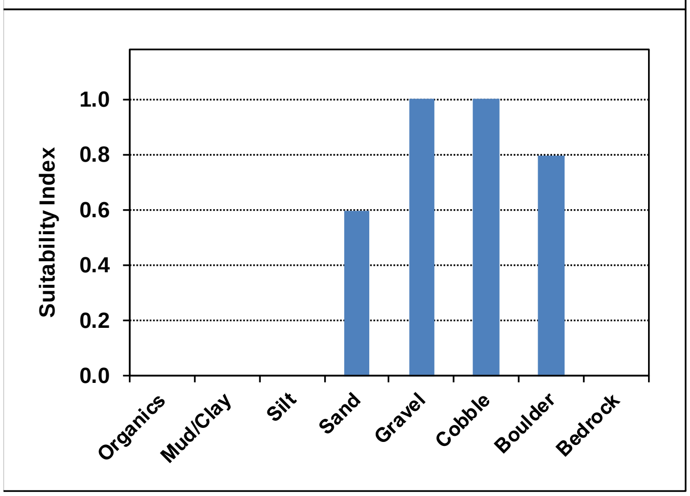
Source:
Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.75	1.00
1.75	1.00
3.00	0.28
3.60	0.08
4.50	0.00

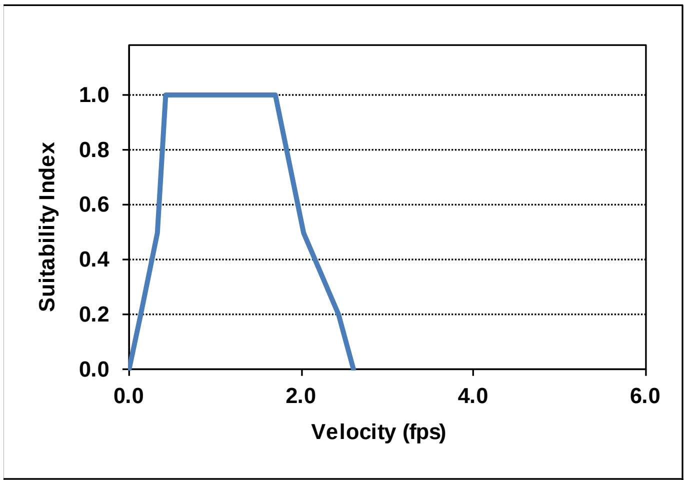


Depth (ft)	SI
0.00	0.00
0.10	0.00
0.75	1.00
1.60	1.00
2.50	0.00



Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.60
Gravel	1.00
Cobble	1.00
Boulder	0.80
Bedrock	0.00

Tessellated Darter Adult



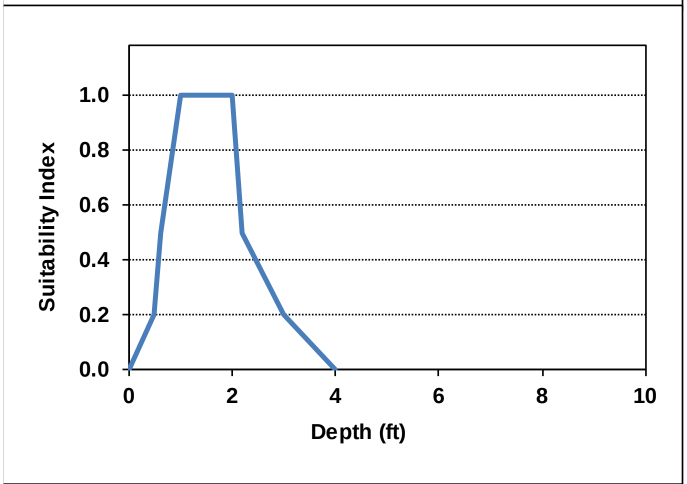
Source:

Persinger, 2003

Velocity and Depth

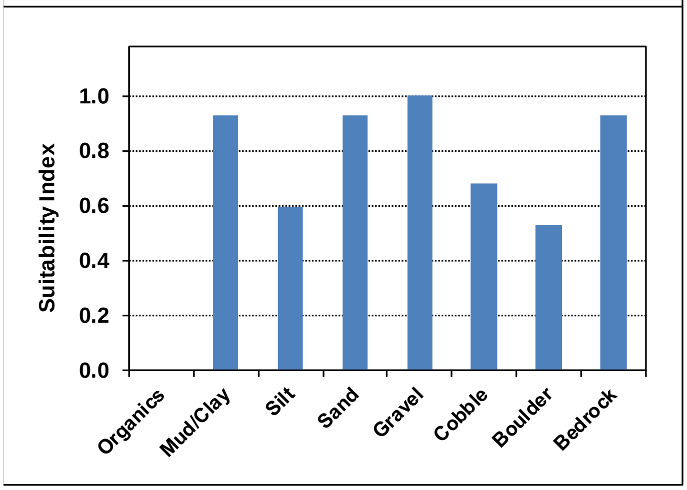
Velocity (ft/s)	SI
0.00	0.00
0.13	0.20
0.33	0.50
0.43	1.00
1.70	1.00
2.03	0.50
2.43	0.20
2.60	0.00

end point assumed



Depth (ft)	SI
0.00	0.00
0.50	0.20
0.60	0.50
1.00	1.00
2.00	1.00
2.20	0.50
3.00	0.20
4.00	0.00

end point assumed



Substrate Source: Aadland and Kuitunen, 2006

Johnny Darter- Surrogate for Tessellated Darter

(PPL Bell Bend 2012)

Substrate	SI
Organics	0.00
Mud/Clay	0.93
Silt	0.60
Sand	0.93
Gravel	1.00
Cobble	0.68
Boulder	0.53
Bedrock	0.93

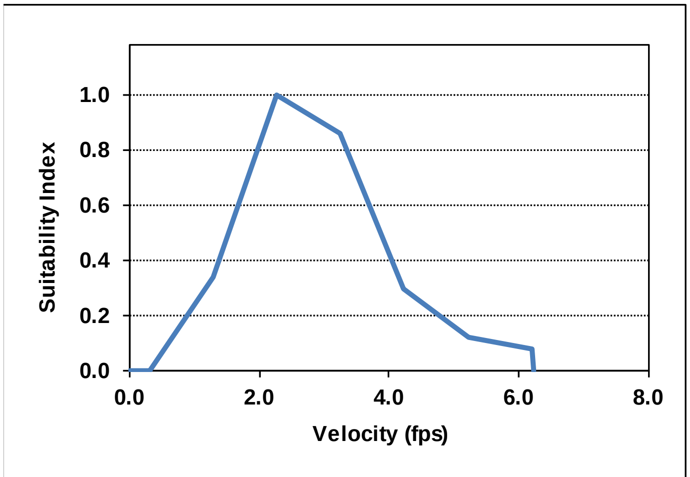
Sea Lamprey Spawning & Incubation

Modified by USFWS (2014) based on Yergeau 1983 (depth and substrate)

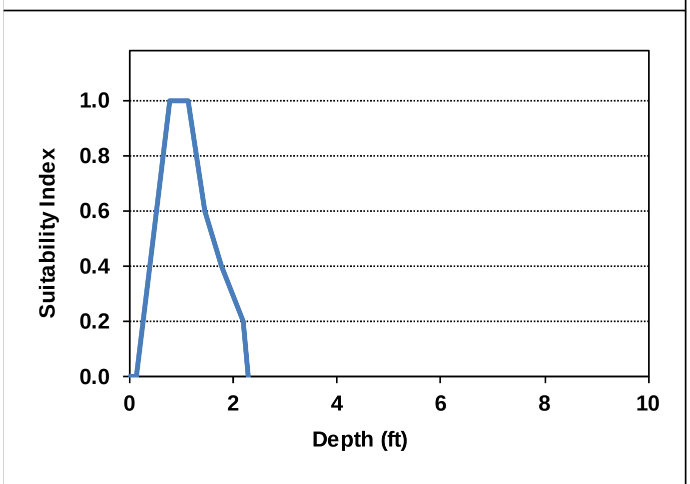
Source:

Kynard and Horgan, 2013

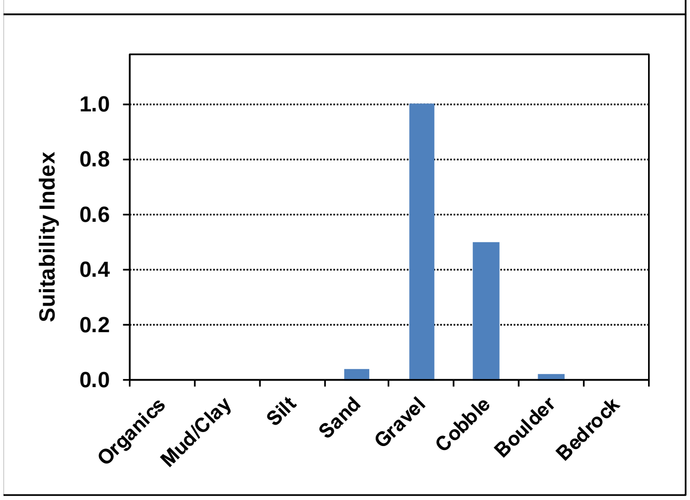
Yergeau, 1983



Velocity (ft/s)	SI
0.00	0.00
0.30	0.00
1.28	0.34
2.26	1.00
3.25	0.86
4.23	0.30
5.22	0.12
6.20	0.08
6.23	0.00



Depth (ft)	SI
0.00	0.00
0.13	0.00
0.46	0.50
0.79	1.00
1.12	1.00
1.44	0.60
1.77	0.40
2.20	0.20
2.30	0.00

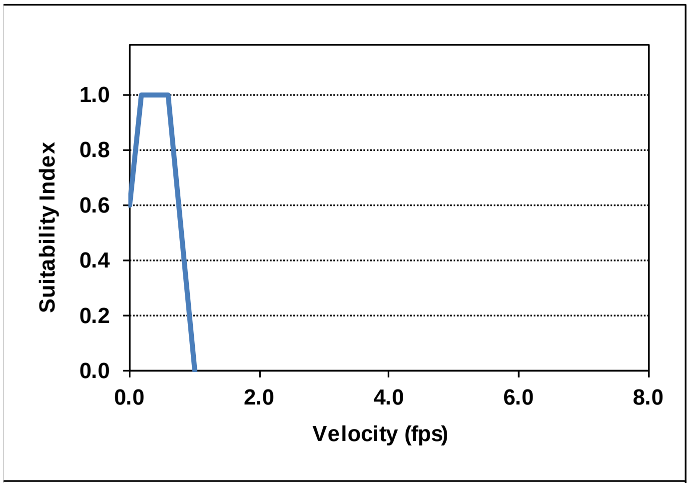


Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.04
Gravel	1.00
Cobble	0.50
Boulder	0.02
Bedrock	0.00

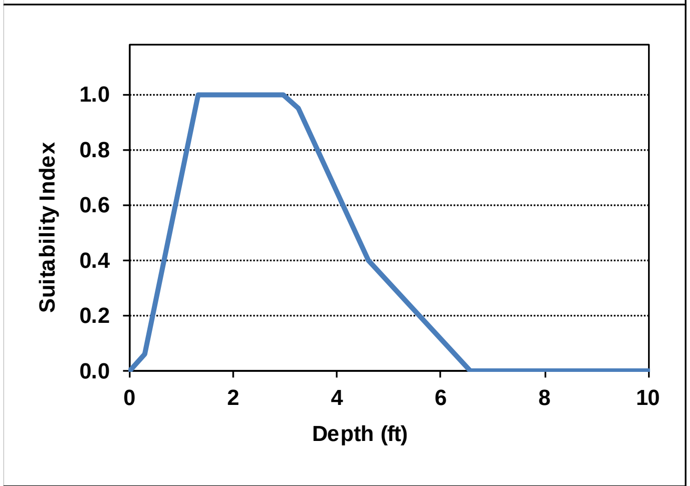
Smallmouth Bass Fry

Source:

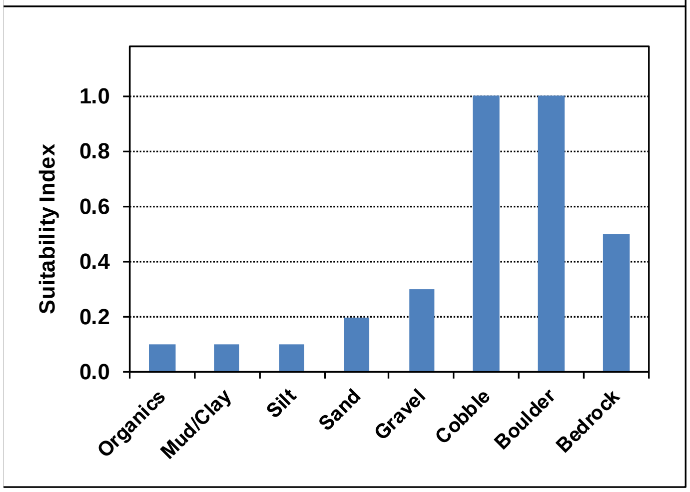
Leonard et al, 1986



Velocity (ft/s)	SI
0.00	0.60
0.19	1.00
0.59	1.00
1.00	0.00

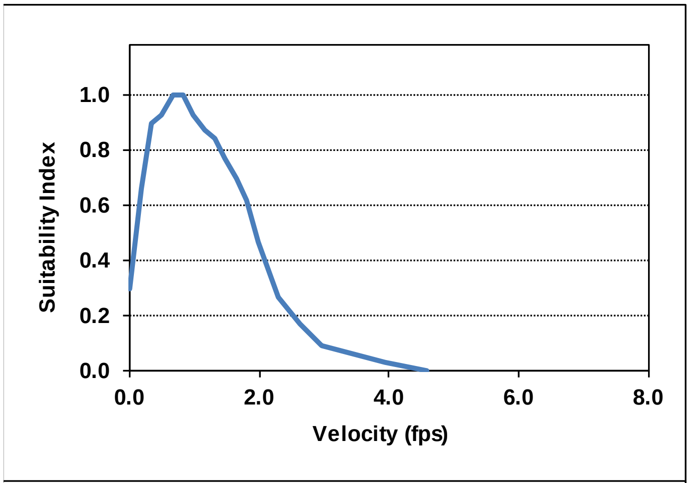


Depth (ft)	SI
0.00	0.00
0.28	0.06
1.31	1.00
2.95	1.00
3.25	0.95
4.59	0.40
6.56	0.00
10.00	0.00



Substrate	SI
Organics	0.10
Mud/Clay	0.10
Silt	0.10
Sand	0.20
Gravel	0.30
Cobble	1.00
Boulder	1.00
Bedrock	0.50

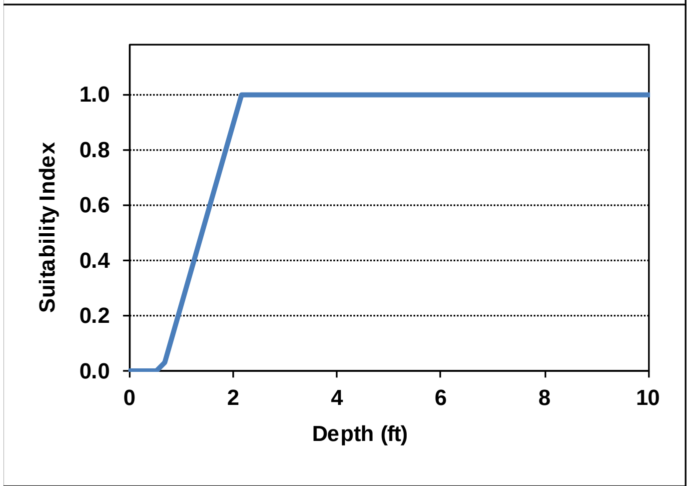
Smallmouth Bass Juvenile



Source:

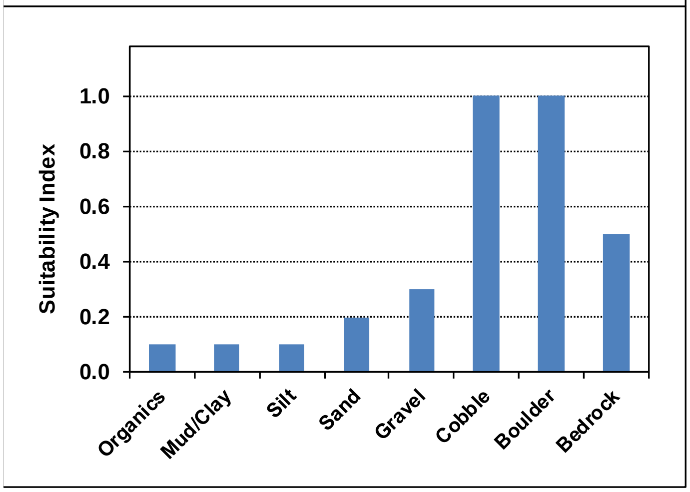
Groshens and Orth 1994

Velocity (ft/s)	SI
0.00	0.30
0.17	0.66
0.33	0.90
0.50	0.93
0.66	1.00
0.83	1.00
0.98	0.93
1.15	0.87
1.31	0.84
1.47	0.77
1.64	0.70
1.81	0.62
1.98	0.47
2.30	0.27
2.62	0.17
2.95	0.09
3.94	0.03
4.59	0.00



Leonard et al, 1986

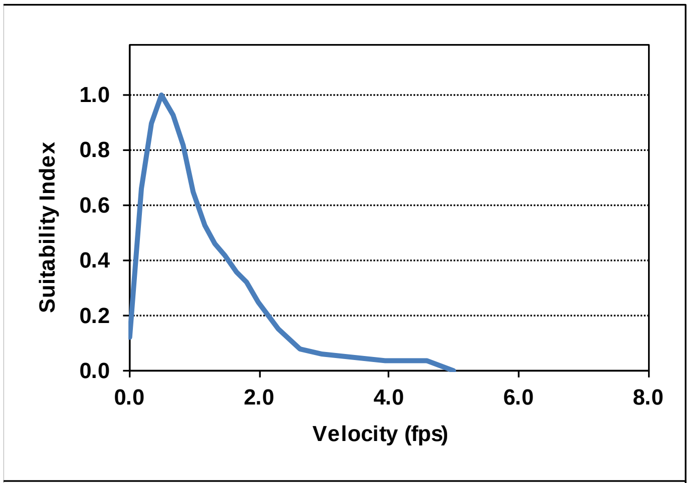
Depth (ft)	SI
0.00	0.00
0.52	0.00
0.67	0.03
2.15	1.00
10.00	1.00

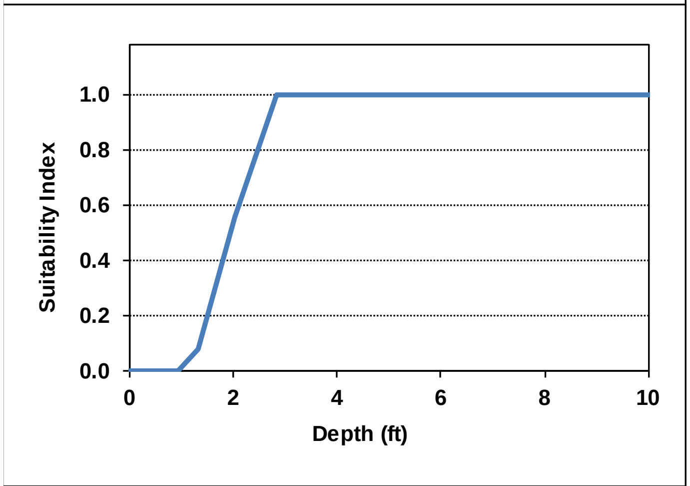


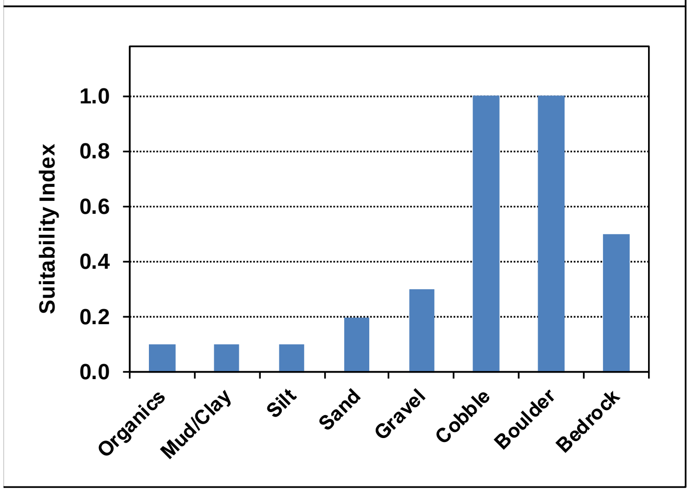
Leonard et al, 1986

Substrate	SI
Organics	0.10
Mud/Clay	0.10
Silt	0.10
Sand	0.20
Gravel	0.30
Cobble	1.00
Boulder	1.00
Bedrock	0.50

Smallmouth Bass Adult







Source:

Groshens and Orth 1994

Velocity (ft/s)	SI
0.00	0.12
0.17	0.66
0.33	0.90
0.50	1.00
0.66	0.93
0.83	0.82
0.98	0.65
1.15	0.53
1.31	0.46
1.47	0.42
1.64	0.36
1.81	0.32
1.98	0.25
2.30	0.15
2.62	0.08
2.95	0.06
3.94	0.04
4.59	0.04
5.00	0.00

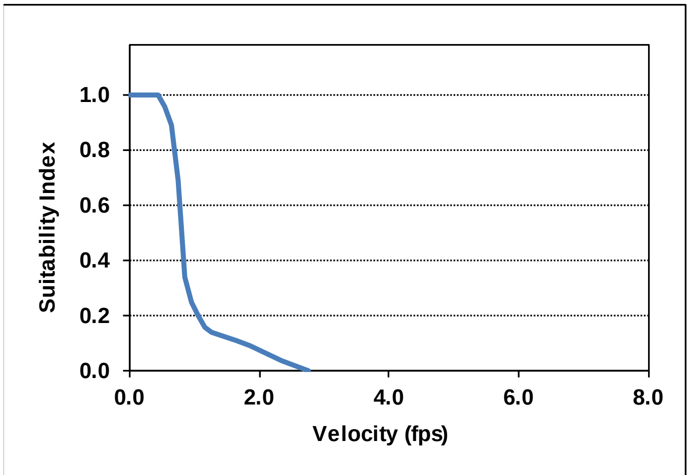
Leonard et al, 1986

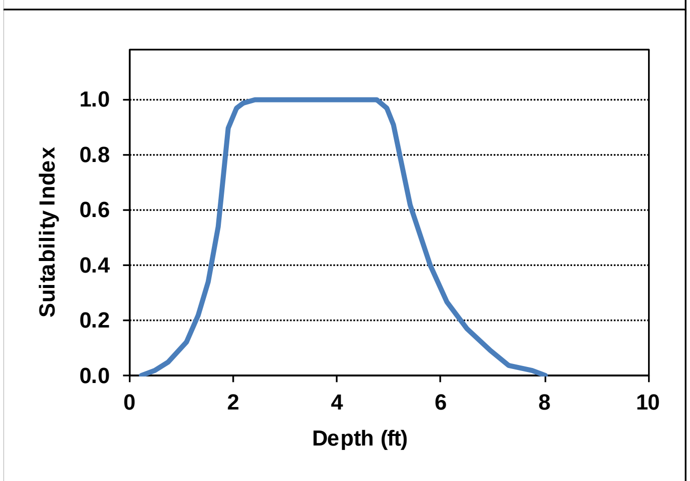
Depth (ft)	SI
0.00	0.00
0.92	0.00
1.31	0.08
2.03	0.56
2.82	1.00
6.00	1.00
10.00	1.00

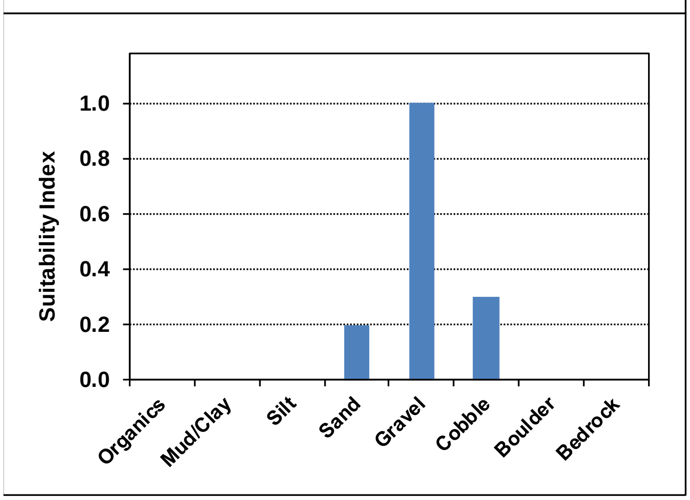
Leonard et al, 1986

Substrate	SI
Organics	0.10
Mud/Clay	0.10
Silt	0.10
Sand	0.20
Gravel	0.30
Cobble	1.00
Boulder	1.00
Bedrock	0.50

Smallmouth Bass Spawning







Source:

Allen, 1996

Velocity (ft/s)	SI
0.00	1.00
0.45	1.00
0.55	0.96
0.65	0.89
0.75	0.69
0.85	0.34
0.95	0.25
1.05	0.20
1.15	0.16
1.25	0.14
1.65	0.11
1.85	0.09
2.35	0.04
2.55	0.02
2.75	0.00

Edwards et al., 1983

Depth (ft)	SI
0.22	0.00
0.50	0.02
0.74	0.05
1.10	0.12
1.32	0.22
1.53	0.34
1.70	0.54
1.90	0.90
2.05	0.97
2.18	0.99
2.40	1.00
4.75	1.00
4.95	0.97
5.10	0.91
5.40	0.62
5.80	0.40
6.10	0.27
6.50	0.17
6.95	0.09
7.30	0.04
7.75	0.02
8.00	0.00

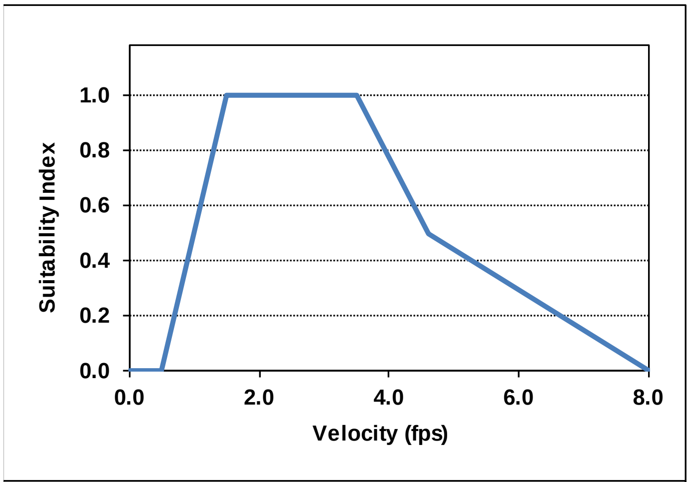
Allen, 1996

Substrate	SI
Organics	0.00
Mud/Clay	0.00
Silt	0.00
Sand	0.20
Gravel	1.00
Cobble	0.30
Boulder	0.00
Bedrock	0.00

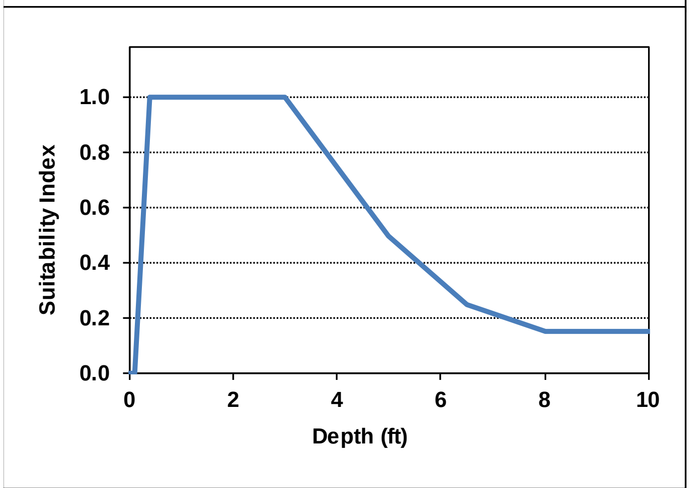
Macroinvertebrates

Source:

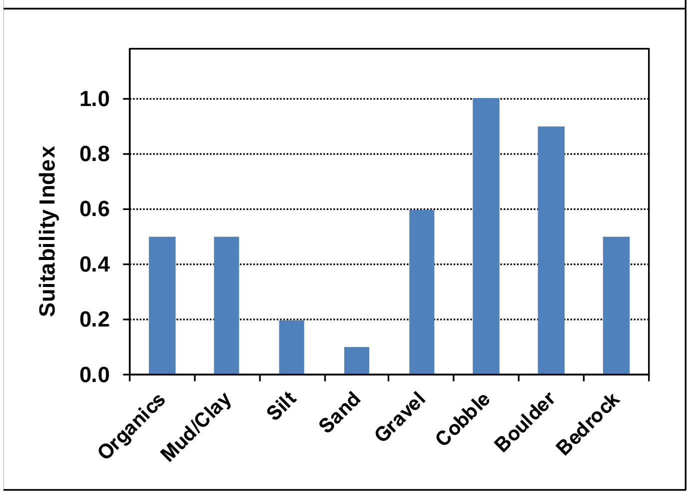
Gomez and Sullivan, 2000



Velocity (ft/s)	SI
0.00	0.00
0.50	0.00
1.50	1.00
3.50	1.00
4.60	0.50
8.00	0.00



Depth (ft)	SI
0.00	0.00
0.10	0.00
0.40	1.00
3.00	1.00
5.00	0.50
6.50	0.25
8.00	0.15
10.00	0.15
100.00	0.00



Substrate	SI
Organics	0.50
Mud/Clay	0.50
Silt	0.20
Sand	0.10
Gravel	0.60
Cobble	1.00
Boulder	0.90
Bedrock	0.50

VERMONT

Department of Fish and Wildlife *Agency of Natural Resources*
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Distributed Electronically

July 9, 2015

Jennifer Griffin
TransCanada Hydro Northeast
N. Walpole Hydro Office
2 Killeen St., N. Walpole, NH 03609

RE: Comments and Recommendations for Study 9 Instream Flow Habitat Suitability Criteria
Wilder Hydroelectric Project – FERC No. 1892
Bellows Falls Hydroelectric Project – FERC No. 1855
Vernon Hydroelectric Project – FERC No. 1904

Dear Jennifer,

Representatives from the U.S. Fish and Wildlife Service, New Hampshire Fish and Game Department, Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department and the Nature Conservancy have been working together to respond to TransCanada's December 15, 2014 report, ILP Study 9 Instream Flow Habitat Suitability Criteria - Draft for Stakeholder Review. Since this topic area includes a number of details, we have collaborated so as to provide you with this unified response. We are providing feedback about the representative species and life stages to be included in the study, their periodicity, habitat suitability criteria (HSC) and some related topics.

Our recommended changes are included in the attached spreadsheet and summarized below.

We agree with all the proposed HSC except for that for tessellated darter, where we recommend alternate HSC for depth and velocity. We agree with the substrate criteria from Minnesota[1] proposed by TransCanada. At the Turners Falls project, First Light is using criteria developed from the Fenton River in Connecticut.[2] The Fenton River has a watershed area of about 24 square miles in the study area vicinity, with summer low flows commonly less than 10 cfs, which is of course much less than the Connecticut River. The small size of the river may explain why

[1] Aadland, L., and A. Kuitunen. 2006. Habitat suitability criteria for stream fishes and mussels of Minnesota. Minnesota Department of Natural Resources, Special Publication 162, St. Paul.

[2] Warner, G.S., F.L. Ogden, A.C. Bagtzoglou, and P. Parasiewicz. 2006. Long-Term Impact Analysis of the University of Connecticut's Fenton River Water Supply Wells on the Habitat of the Fenton River. March 7, 2006

the HSC do not include depths and velocities that extend up nearly as much as Minnesota's HSC for Johnny darter.

TransCanada is proposing to use depth and velocity criteria adapted from Jason Persinger's work on the Shenandoah River, Virginia.[3] However, Persinger did not develop HSC for tessellated darter; he developed guild criteria. Only one fish of this species was collected in his study. Based on that occurrence, it was categorized in the pool-run guild, which was one of four guilds he developed to categorize the fish community in the Shenandoah River. This guild contained nine fish species which is likely the reason why it includes a wider range of suitable conditions than the HSC from either the Fenton River or from Minnesota. We do not find the Shenandoah River study to be suitable for extrapolation to tessellated darter HSC.

We recommend the tessellated darter HSC included in the spreadsheet. The curve is the same as the Fenton River curve on the low end but matches the Minnesota curve to include greater depths and velocities. However, we do not include the long tail of the Minnesota curves. This may be a minor point, but doing so will only include extra habitat of very low quality.

Rainbow trout adults are found in the river as a result of stocking and holdover. Therefore, we recommend the addition of this species-life stage. We have attached proposed HSC, although we need to discuss the substrate coding as related to velocity refuges.

Longnose dace was included in TransCanada's draft report. Our recommendation is to include this species if it is found in the study area as part of other studies (such as fish assemblage) and if not, to exclude it. If it is found, we recommend that the young-of-the-year life stage be included along with the juvenile and adult stages.

In addition to the species-life stage HSC, we recommend inclusion of what we are calling generalized habitat criteria (GHC). While these are similar to the guild HSC used at Turners Falls (which came from a chain of other studies), they are not the same and are not intended to represent specific fish species groups. Rather, they are intended to represent certain broad habitat types that have been identified in the literature as important to stream fishes (shallow-slow, shallow-fast riffles, deep-fast and deep slow habitats). These GHC are intended to provide us with an overview of the availability of these habitat types. We propose binary criteria for depth and velocity and no criteria for substrate. Substrate has been mapped and can be examined as another map layer if necessary. The rationale for using GHC is explained further in an attached document.

We have included in the spreadsheet a number of revisions to the seasonal periodicity information that was in the draft report.

Substrate coding and the treatment of subdominant types were discussed during the WebEx meeting on February10, 2015. Our understanding is that Normandeau recorded the percentage of each substrate type (8 types), so it is possible to determine a cell's overall substrate

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[3] Persinger, J.W. 2003. Developing habitat suitability criteria for individual species and habitat guilds in the Shenandoah River basin. MS Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 207pp.

suitability by averaging of the suitability ratings of reach substrate type present, weighted by its percentage. We agree with using this approach.

An approach that provides habitat results (WUA) in the form of a weighted average of all mesohabitat types (i.e. riffles, runs and pools) may provide misleading results. Riffles are critical habitats and “biological hotspots” in rivers, being responsible for much of the biomass production. Riffles are also typically the most sensitive to flow changes and so deserve the most attention in an instream flow study. Weighting transect data based on habitat mapping emphasizes abundant habitat and discounts rare habitat which in this case is the most valuable habitat. Study results for each mesohabitat type should be analyzed and calculated separately. Mathematically averaging these together masks the habitat-flow relationship of each type, which is likely to differ.

As discussed previously, we will want to see a dual flow analysis (also known as effective habitat or habitat persistence) to examine the influence of hydropeaking. We will at some point need to discuss the details of this analysis, including the 1) selection of a subset of the representative species-life stages that are relatively immobile and 2) selection of specific relevant base-peak flow combinations. These decisions are often made after the steady-state habitat-flow modeling results can be reviewed.

We would also like to see habitat maps for both persistent habitat and to show steady-state habitat color-coded by combined suitability categories. These maps can be easily produced for the 2D modeled reaches. We would like to discuss options for showing similar information for the 1D reaches.

Thank you, and we look forward to working with you to complete the studies.

Sincerely,

Rod Wentworth

Rod Wentworth, Fisheries Scientist

Cc: Lael Will, Jeff Crocker, Eric Davis, Gabe Gries, John Warner, Melissa Grader, Katie Kennedy, John Ragonese, Maryalice Fischer

Attachments:

Spreadsheet
Generalized habitat criteria supplemental document
Rainbow trout adult HSC

Instream Flow Study - Vernon, Bellows Falls, Wilder
from TC HSC Selection Report 15Dec2014 with proposed changes
see notes further down on this sheet

	Species	Life stage	Periodicity	Study Reaches	Addition to TC report?	Notes
1	Shad	J	June 7 - Nov 30	V, B		
2	Shad	A	May 1 - June 30	V, B		
3	Shad	S	May 1 - July 15	V, B		
4	Walleye	FR	May 1 - July 1	V, B, W		Bluebook HSC for fry is late spring to early summer
5	Walleye	J	Year round	V, B, W		
6	Walleye	A	Year round	V, B, W		
7	Walleye	S	April 1 - May 31	V, B, W		
8	Fallfish	FR	June 1 - July 1	V, B, W		
9	Fallfish	J	Year round	V, B, W		
10	Fallfish	A	Year round	V, B, W		
11	Fallfish	S	May 1 - June 30	V, B, W		HSC included in TC report but not its appendix
12	W sucker	FR	June 1 - Sep 30	V, B, W		
13	W sucker	J	Year round	V, B, W		
14	W sucker	S	April 1 - June 30	V, B, W		
15	LN dace	J	Year round	TBD		LND to be included if the species is found during sampling for the fish assemblage study.
16	LN dace	A	Year round	TBD		LND to be included if the species is found during sampling for the fish assemblage study.
17	LN dace	Y	July 1 - Sep 30	TBD	Yes	LND to be included if the species is found during sampling for the fish assemblage study.
18	Tess. Darter	A	Year round	V, B, W		TC proposed HSC from a VA guild study with just 1 such darter sampled. Not HSC for this target species. **HSC change recommended**, modified from Fenton R & MN HSC.
19	Sea lamprey	S	May 1 - July 15	V, B, W		
20	SM bass	Y	July 1 - Sep 30	V, B, W		
21	SM bass	J	Year round	V, B, W		Includes fish 2-9" in Deerfield study; about 4-8" in Groshens & Orth
22	SM bass	A	Year round	V, B, W		
23	SM bass	S	May 1 - June 30	V, B, W		
24	Macroinvertebrates		Year round	V, B, W		
25	Rainbow trout	A	Year round	V, B, W	Yes	Recommended HSC use substrate coding for abundant or few velocity refuges. Discussion needed on how to handle this.
26	GHC shallow-fast	SF		V, B, W	Yes	
27	GHC shallow-slow	SS		V, B, W	Yes	
28	GHC deep-fast	DF		V, B, W	Yes	
29	GHC deep-slow	DS		V, B, W	Yes	

Notes:

LIFE STAGE abbreviations

A	adult
J	juvenile
S	spawning and incubation
Y	young-of-year
FI	fingerling
FR	fry

Study Reaches:

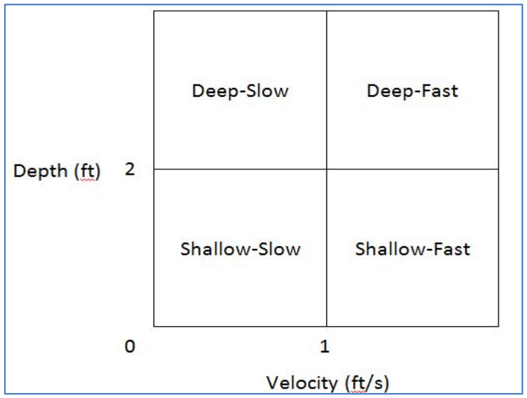
V	Vernon
B	Bellows Falls, below powerhouse
W	Wilder

Target species and life stages for the Bellows Falls bypass study will be determined later.

GHC = generalized habitat criteria
Y lasts until the end of the first growing season.
FR is a specified part of the first growing season.

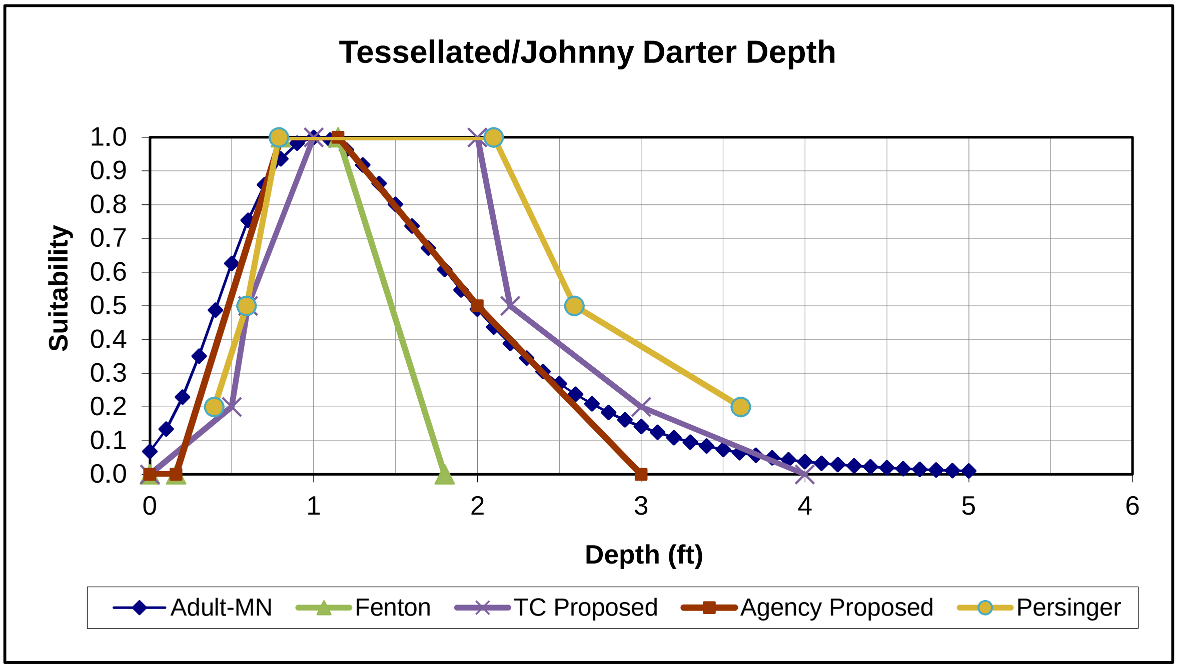
Generalized Habitat Criteria:

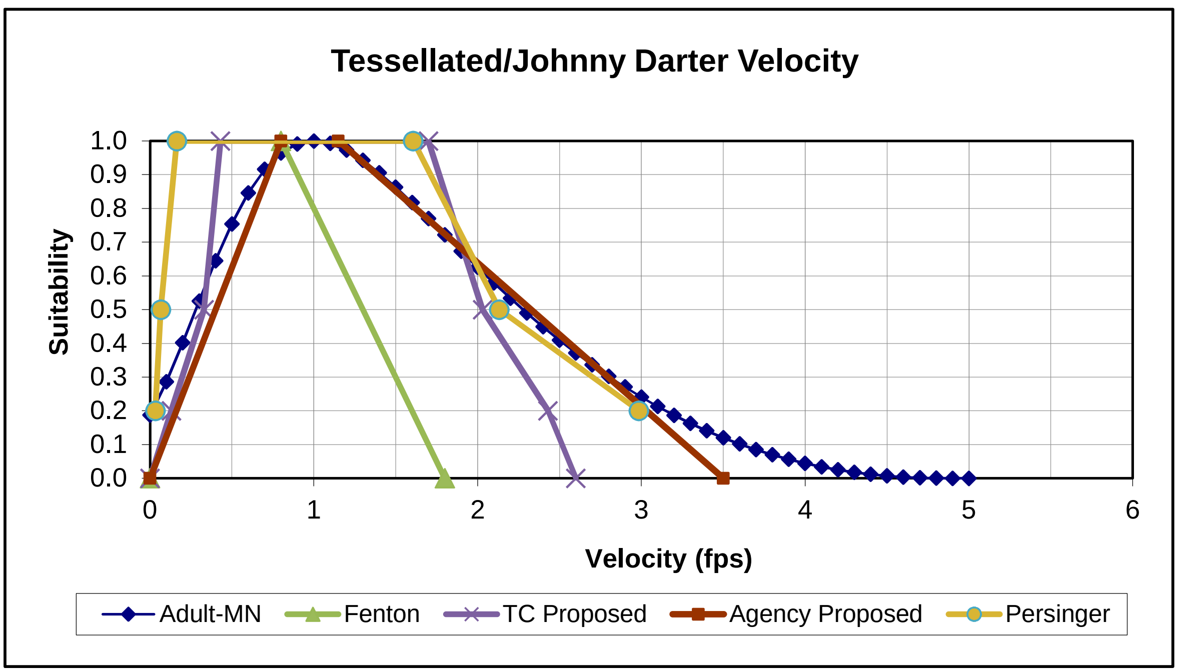
	General Type Definitions	
Habitat Type	Velocity (fps)	Depth (ft)
GHC shallow-fast	>1	≤2
GHC shallow-slow	≤1	≤2
GHC deep-fast	>1	>2
GHC deep-slow	≤1	>2



The use of these criteria in the TC study are not intended to represent fish species guilds but to see how these four habitat types respond to flow conditions.

Tessellated/Johnny Darter
See notes below graphs





Source: Bell Bend, PA (original: Fenton River)

V (fps)	SI Adult/Juv
0	0
0.8	1
1.8	0

D (ft)	SI Adult/Juv
0	0
0.16	0
0.8	1
1.15	1
1.8	0

Source of HSC used in Bell Bend:

Impact Analysis of the University of Connecticut's Fenton River Water Supply Wells on the Habitat of the Fenton River. March 7, 2006

These HSC were developed based on Fenton River fish sampling.

Source: Proposed in TC 12/15/2014 HSC Selection Report

Modified from Persinger 2003; Shenandoah River, VA

V (fps)	SI Adult
0	0
0.13	0.2
0.33	0.50
0.43	1.00
1.7	1.00
2.03	0.50
2.43	0.20
2.6	0.00

D (ft)	SI Adult
0	0
0.5	0.2
0.6	0.5
1	1
2	1
2.2	0.5
3	0.2
4	0

Source: Persinger 2003

HSC for Pool-Run guild ; Shenandoah River, VA

Tessellated darter was included in this guild of 9 species

V (fps)	V (m/s)	SI Adult	D (ft)	D (m)
0.03	0.01	0.2	0.39	0.12
0.07	0.02	0.5	0.59	0.18
0.16	0.050	1	0.79	0.24
1.61	0.490	1	2.10	0.64
2.13	0.650	0.5	2.59	0.79
2.99	0.910	0.2	3.61	1.1

Source: Modification of MN and Fenton R HSC proposed for CT R study

V (fps)	SI Adult/Juv
0	0
0.8	1
1.15	1.00
3.5	0.00

D (ft)	SI Adult/Juv
0	0
0.16	0
0.8	1
1.15	1
2	0.5
3	0

Rationale: MN HSC are based on rivers closer to the size of the CT R.
Long tails of MN HSC are reduced so as to not include large amounts of low-grade habitat in the WUA totals.
Lower part of HSC follow Fenton R HSC.

Accept substrate criteria proposed by TC (from MN).

Tessellated/Johnny Darter

Source: MN 2006

	Johnny Darter			
ALPHA	30.95	14.82	30.5	0
BETA	760000000	582100000	150	150.999
GAMMA	33300000	18220000	2.3	24.571
DELTA	46500000	138000000	10.6	0.183

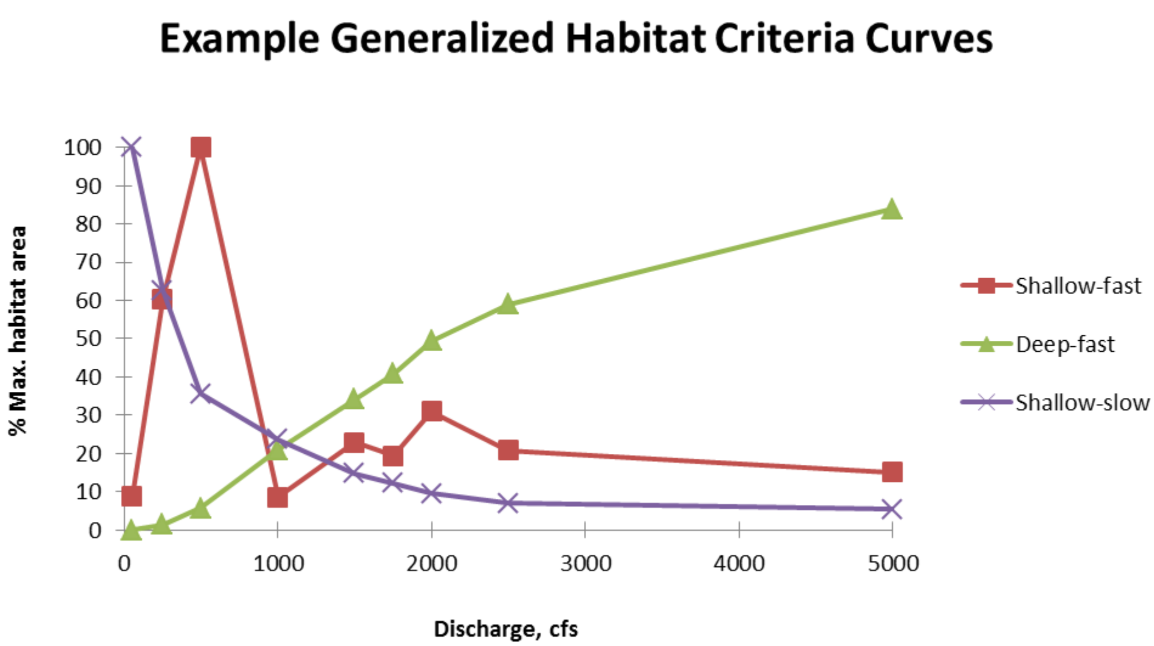
D (ft)	D (cm)	Adult SI	YOY SI	V (ft/sec)	V (cm/sec)	Adult SI	YOY SI
0	0.00	0.068	0.022	0	0.00	0.187	1.000
0.1	3.05	0.134	0.192	0.1	3.05	0.287	0.999
0.2	6.10	0.230	0.528	0.2	6.10	0.402	0.996
0.3	9.14	0.351	0.821	0.3	9.14	0.525	0.991
0.4	12.19	0.488	0.969	0.4	12.19	0.645	0.984
0.5	15.24	0.626	0.999	0.5	15.24	0.754	0.975
0.6	18.29	0.754	0.966	0.6	18.29	0.846	0.963
0.7	21.34	0.859	0.905	0.7	21.34	0.916	0.949
0.8	24.38	0.936	0.834	0.8	24.38	0.964	0.933
0.9	27.43	0.982	0.764	0.9	27.43	0.991	0.914
1	30.48	1.000	0.697	1	30.48	1.000	0.893
1.1	33.53	0.992	0.634	1.1	33.53	0.993	0.869
1.2	36.58	0.963	0.577	1.2	36.58	0.973	0.843
1.3	39.62	0.918	0.525	1.3	39.62	0.943	0.814
1.4	42.67	0.863	0.477	1.4	42.67	0.905	0.784
1.5	45.72	0.802	0.434	1.5	45.72	0.863	0.751
1.6	48.77	0.737	0.394	1.6	48.77	0.817	0.715
1.7	51.82	0.672	0.358	1.7	51.82	0.770	0.678
1.8	54.86	0.608	0.326	1.8	54.86	0.721	0.639
1.9	57.91	0.547	0.296	1.9	57.91	0.673	0.599
2	60.96	0.490	0.269	2	60.96	0.625	0.558
2.1	64.01	0.437	0.245	2.1	64.01	0.579	0.515
2.2	67.06	0.389	0.222	2.2	67.06	0.534	0.473
2.3	70.10	0.345	0.202	2.3	70.10	0.491	0.430
2.4	73.15	0.305	0.184	2.4	73.15	0.449	0.387
2.5	76.20	0.269	0.167	2.5	76.20	0.409	0.345
2.6	79.25	0.238	0.152	2.6	79.25	0.372	0.304
2.7	82.30	0.209	0.138	2.7	82.30	0.336	0.264
2.8	85.34	0.184	0.126	2.8	85.34	0.302	0.226
2.9	88.39	0.162	0.114	2.9	88.39	0.271	0.191
3	91.44	0.142	0.104	3	91.44	0.241	0.158
3.1	94.49	0.125	0.094	3.1	94.49	0.213	0.129
3.2	97.54	0.109	0.086	3.2	97.54	0.187	0.102
3.3	100.58	0.096	0.078	3.3	100.58	0.163	0.079
3.4	103.63	0.084	0.071	3.4	103.63	0.141	0.060
3.5	106.68	0.074	0.064	3.5	106.68	0.120	0.043
3.6	109.73	0.064	0.059	3.6	109.73	0.102	0.030
3.7	112.78	0.056	0.053	3.7	112.78	0.085	0.020
3.8	115.82	0.049	0.048	3.8	115.82	0.070	0.013
3.9	118.87	0.043	0.044	3.9	118.87	0.056	0.007
4	121.92	0.038	0.040	4	121.92	0.044	0.004
4.1	124.97	0.033	0.036	4.1	124.97	0.034	0.002
4.2	128.02	0.029	0.033	4.2	128.02	0.025	0.001

4.3	131.06	0.025	0.030	4.3	131.06	0.018	0.000
4.4	134.11	0.022	0.027	4.4	134.11	0.012	0.000
4.5	137.16	0.019	0.025	4.5	137.16	0.007	0.000
4.6	140.21	0.017	0.023	4.6	140.21	0.004	0.000
4.7	143.26	0.015	0.020	4.7	143.26	0.002	0.000
4.8	146.30	0.013	0.019	4.8	146.30	0.000	0.000
4.9	149.35	0.011	0.017	4.9	149.35	0.000	0.000
5	152.40	0.010	0.015	5	152.40	#NUM!	#NUM!

Using Generalized Habitat Criteria in TransCanada's Instream Flow Study (Study 9)

We propose using generalized habitat criteria (GHC) in addition to individual species and life history stage habitat suitability criteria (HSC) in the habitat-flow models for TransCanada's Instream Flow Study (Study 9). Generalized habitat criteria are different from guild suitability criteria in that GHC are not specific to particular fish and life history stages, but are representative of individual habitat types used by various fish and life history stages. Certain broad habitat types have been identified in the literature as important to stream fishes, including shallow-slow habitats, shallow-fast riffles, and deep-fast runs (Schlosser 1982; Bain et al. 1988; Lobb and Orth 1991; Rabeni and Jacobson 1993; Bowen et al. 1998; Freeman et al. 2001).

While it is of course useful to understand the specific suitability of habitat in an area for a given species (using WUA, for example), it is also helpful to understand the general pattern of habitat across the landscape and how this pattern changes with changing flows (i.e., habitat persistence). The mesohabitat mapping conducted for TransCanada by Normandeau Associates was conducted at the lowest available flow, which while informative, tends to be biased toward shallower habitats. As flows increase, shallow habitats generally become less prevalent; for example, a reach that is a categorized as a riffle (dominated by shallow-fast habitat) at lower flows may become a run (dominated by deep-fast habitat) at a higher flow (see figure below).



Data: M. Freeman and E. Irwin

Normandeau Associates have mapped habitat types in the riverine reaches below Wilder, Bellows Falls, and Vernon dams as a percent of each type (by length) available under low flow conditions. Evaluating GHC across a range of flows will both allow for more precision in the definition of habitat types at lower flows and for evaluation of how the mapped habitat types change with increasing flows. Furthermore, since substrate has been mapped as well, it may also be possible to incorporate this important habitat variable into the evaluation of habitat across time and space.

Generalized habitat criteria may also be used to evaluate any changes in the availability and persistence of habitat that occur as distance increases from each dam. This may be especially relevant in the longer reaches (e.g., the 17 miles below Wilder); however detection of spatial differences will be dependent upon the magnitude of the dam effect. Spatial differences in habitat availability and persistence could, in turn, be related to data collected in other studies – for example, the fish assemblage, tessellated darter, or resident fish spawning studies. Generalized habitat criteria have been used in other studies to examine relationships between habitat (availability and persistence) and fish assemblage structure (Bowen et al. 1998) as well as juvenile fish abundance (Freeman et al. 2001).

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Lobb, M.D. III, and D.J. Orth. 1991. Habitat use by an assemblage of fish in a large warmwater stream. Transactions of the American Fisheries Society 120:65-78.

Rabeni, C.F., and R.B. Jacobson. 1993. The importance of fluvial hydraulics to fish-habitat restoration in low-gradient alluvial streams. Freshwater Biology 29:211-220.

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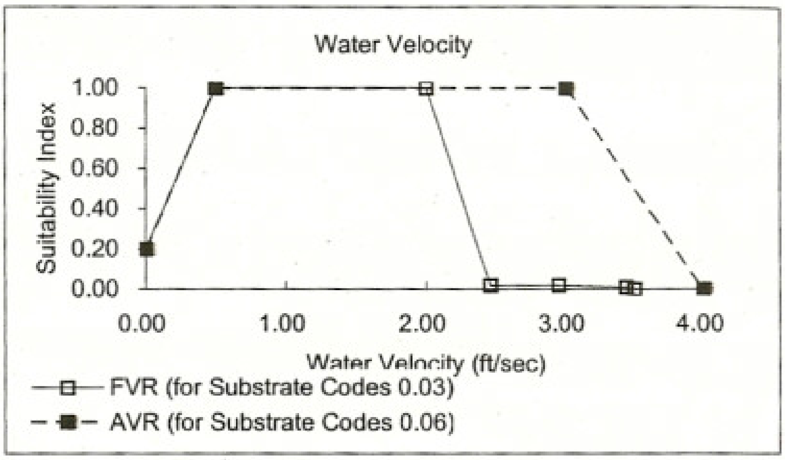
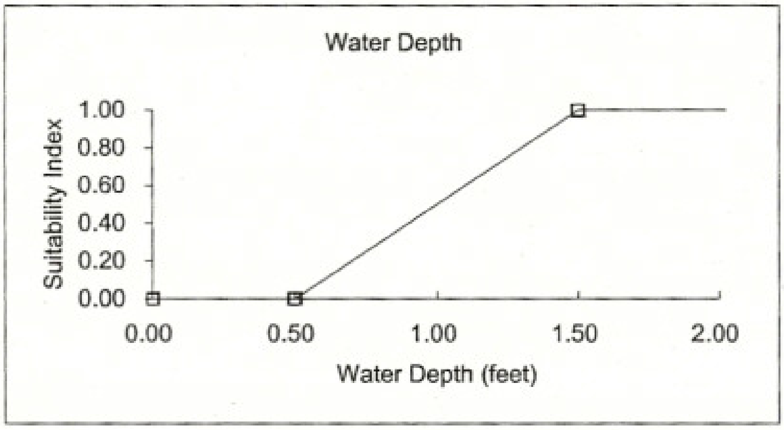
Species: Rainbow Trout
Lifestage: Adult (Few and Abundant Velocity Refuges)

Few Velocity Refuges		Abundant Velocity Refuges	
Velocity	SI Value	Velocity	SI Value
0.00	0.20	0.00	0.20
0.50	1.00	0.50	1.00
2.00	1.00	3.00	1.00
2.46	0.02	4.00	0.00
2.95	0.02	100.00	0.00
3.44	0.01		
3.50	0.00		
100.00	0.00		



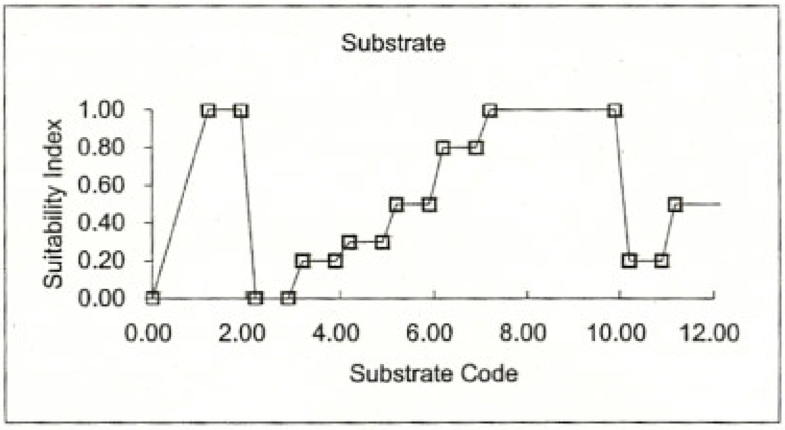
Depth

Depth	SI Value
0.00	0.00
0.50	0.00
1.50	1.00
100.00	1.00



Substrate

Substrate	SI Value
0.00	0.00
1.20	1.00
1.90	1.00
2.20	0.00
2.90	0.00
3.20	0.20
3.90	0.20
4.20	0.30
4.90	0.30
5.20	0.50
5.90	0.50
6.20	0.80
6.90	0.80
7.20	1.00
9.90	1.00
10.20	0.20
10.90	0.20
11.20	0.50
100.00	0.50



Note: This SI curve does not show embeddedness because it is not related to habitat quality.

Reference: USFWS "Bluebook", modified for Clyde River study (1991).

CENTRAL VERMONT PUBLIC SERVICE CORPORATION
LAMOILLE RIVER INSTREAM FLOW STUDY
SUBSTRATE CODING SYSTEM

Substrate Codes:

1- Roots, Snags, Undercut Banks, Overhead Cover
2- Clay
3- Silt
4- Sand
5- Small Gravel (< 2")
6- Gravel (2"-4")
7- Cobble (4"-10")
8- Boulder (10"-2')
9- Boulder (>2')
10- Ledge
11- Detritus, Vegetation

Percent Embeddedness Codes:

.2	-	0-25% Embeddedness
.5	-	26-50% Embeddedness
.7	-	51-75% Embeddedness
.9	-	76-100% Embeddedness

Embeddedness = Amount of fine material in interstitial spaces

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Cover Codes:

0.03 Cover- Few Velocity Refuges
0.06 Cover- Abundant Velocity Refuges

where Abundant Velocity Refuges are defined as: Large Boulder >25% or,
Small Boulder >75% or,
Instream Structural Cover >50%

Memorandum

Monday, September 07, 2015

TO: John Ragonese, Jen Griffin - TransCanada
FROM: Steven Eggers, Fishery Biologist
SUBJECT: Study 9 Instream Flow Habitat Suitability Criteria

In a letter dated July 9, 2015, representatives from the U.S. Fish and Wildlife Service, New Hampshire Fish and Game Department, Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department and the Nature Conservancy (stakeholders) provided comments and recommendations to TransCanada's (TC's) December 15, 2014 report, ILP Study 9 Instream Flow Habitat Suitability Criteria - Draft for Stakeholder Review.

All originally proposed HSC with the exception of Tessellated Darter were accepted by the stakeholders. We agree with the use of Johnny Darter HSC as a surrogate for Tessellated Darter, and modifications made to depth and velocity that incorporates curves for depth and velocity from the Fenton River study. Additionally, stakeholders requested the inclusion of HSC for Longnose Dace fry and Rainbow Trout adult. TC agrees to these additions.

Longnose dace may not occur in the study area and will only be modeled if they are found during fish assemblage studies. Application of Rainbow Trout adult substrate/cover component will need to be determined prior to modeling.

Stakeholders recommend using binary "generalized habitat criteria" (GHC) intended to provide information on availability of habitat types. TC agrees to these additions.by combinations of depth can provide

TC accepts the species periodicity table provided by stakeholders. The updated table is based on local knowledge and is an improvement over the generic periodicity table included in the HSC draft report.

APPENDIX C

Study 19 – American Eel Downstream Passage Assessment

Eel Importation Supplemental Documents

New Hampshire
Fish and Game Department

HEADQUARTERS: 11 Hazen Drive, Concord, NH 03301-6500
(603) 271-3421
FAX (603) 271-5829

www.WildNH.com
e-mail: info@wildlife.nh.gov
TDD Access: Relay NH 1-800-735-2964

April 9, 2015

Steve Leach
Senior Biologist
Normandeau Associates, Inc.
917 Rte. 12, #1
Westmoreland, NH 03467

Re: TransCanada Hydro Northeast Inc.'s Revised Study Plan, Study19 Modifications

Dear Mr. Leach,

On February 5th, 2015 it was brought to the attention of New Hampshire Fish & Game Department (Department) staff that as part of a downstream passage assessment of American Eels (Eels) in the Connecticut River (River) a certain number of Eels would need to be imported into the River from an inter-basin source. The Department has been having dialogs with the other New England States that would have interest regarding fish importation to the Connecticut River. While the agencies are supportive of the downstream passage assessment, as documented in the August 14, 2015 TransCanada Hydro Northeast Inc.'s Revised Study Plan, there are a number of fish health concerns involving the implications of the proposed modification to the study.

The Department views inter-basin fish importation of wild-acquired fish as a high risk activity for extending the geographic distribution of dangerous fish pathogens which could compromise a number of fish species in the receiving water basin. In addition to Eel management in the River, there are a number of other species that could be affected by an importation of inter-basin Eels (i.e. Atlantic salmon, American shad, etc.). Therefore, the Department would request that the research team for the Eel downstream passage assessment provide the Department with a revised study plan for review that would address the Department's concerns involving the risk of spreading fish pathogens into the River. Enclosed are a number of topics and recommendations that the Department would require to be addressed in order to allow the movement of inter-basin, wild-acquired Eels into the River for the downstream passage assessment.

If you have any questions or concerns, please do not hesitate to contact me by phone at 603-271-1744 or by email at jason.smith@wildlife.nh.gov. We look forward to reviewing your proposed modifications.

Sincerely,

Jason M Smith

Jason M Smith
Chief, Inland Fisheries Division
New Hampshire Fish & Game Department
11 Hazen Drive
Concord, NH 03301

Enclosure: American Eel Importation Proposal Review – Recommended Topics of Discussion

Cc: John Ragonese, TransCanada (email)
Gabe Gries, New Hampshire Fish and Game Department (email)

<u>American Eel Importation Proposal Review - Recommended Topics of Discussion</u>

The following are a list of questions and topics that Vermont Fish and Wildlife Department (Department) would like to see discussed in a proposal to import American Eels (Eels) for the downstream passage study. The proposal would be presented to the Department for review and subsequent approval, denial, or additional questioning prior to the start of the proposed research activities. Although not specifically outlined in this document, researchers should coordinate with other states of regarding fish health management on the Connecticut River to obtain concurrence with the study (i.e. New Hampshire, Massachusetts, Connecticut).

<u>**Topic #1: Donor water source information. Including:**</u>

- The specific location of the donor waterbody (HUC-10). ***<u>Recommendation</u>: The Department understands that a similar inter-basin importation of Eels (2011) was conducted in New York from the Sebasticook River – East Branch in Maine. Although not required, it would be the preference of the Department that researchers collect Eels from the same source since they were effectively imported into New York from this location.***

- Fish pathogen / aquatic invasive species (ANS) profile of the donor water basin (HUC-2).

    - Status of the listed fish pathogens in the donor water basin (HUC-2) (presence, absence, unknown). Please describe listed pathogens detected, the detection date, and the pathogen distribution in the basin. To include: Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), *Ceratomyxa Shasta*, Spring Viremia of Carp virus, Proliferative Kidney Disease (*Tetracapsuloides bryosalmonae*), Whirling Disease (*Myxobolus cerebralis*), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus.

    - Status of the listed fish pathogens in the donor water sub-basin (HUC-4) (presence, absence, unknown). Please describe the listed pathogens detected, the detection date, and the pathogen distribution in the sub-basin.To include: Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), American eel swimbladder parasite (*Anguillicoloides crassus)*.

    - Status of ANS in the donor sub-basin (HUC-4) (presence, absence, unknown). Please describe the ANS detected, the detection date, and the pathogen distribution in the sub-basin.

    - Have there been any fish kills which have resulted in the detection of a specific pathogen in the specific watershed (HUC-10)?

Topic #2: Fish health testing / biosecurity protocols of the individuals to be imported.

***Recommendation*: The Department would require the imported Eels to undergo fish health screening and stringent biosecurity protocols prior to stocking in the Connecticut River. Review of a fish health certificate outlining fish health screening results of the tested Eels would be required prior to stocking.**

- The number of Eels to be collected

- The number of individuals to be sacrificed for disease testing. ***Recommendation*: Sixty (60) individuals**

- The specific fish pathogens that the individuals will be tested for. ***Recommendations:* Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), Anguillicoloides crassus – nematode (testing by gross observation), any bacteria growth of significance shall be identified and reported as well as any cytopathic effect (CPE) producing agent identified and reported.**

- Who would be doing the fish health testing? Would the Department be granted consent to communicate with the testing laboratory? ***Recommendation:* A laboratory that is experienced with regularly conducting fish health diagnostics and inspections (i.e. Kennebec River Biosciences, USFWS Lamar Fish Health Center) would be recommended. The Department would desire the ability to communicate with the testing laboratory.**

- The location and facility that the collected Eels would be held at while awaiting fish health testing results. ***Recommendation:* An isolation facility in accordance with the New England Fish Health Guidelines (https://www1.maine.gov/ifw/fishing/health/newengland_guidelines.pdf) if fish are held in the donor watershed (HUC-10). If fish were held in the receiving basin (HUC-2) effluent disinfection would need to be incorporated into the facility design. Fish should be held in an approved isolation / quarantine until disease inspection results were shared with the Department.**

- Explanation of the transportation method of fish from the donor water source to the holding facility to the receiving water source. ***Recommendation:* Transportation should be conducted in clean, pathogen/ANS free water.**

- ***Analysis of ANS. Recommendation: Presence of any ANS species during the fish health assessment shall be noted on the fish health assessment report.***

- Explanation of how a detection of the above tested pathogens in a fish health screening would affect the final stocking of the Eels. ***Recommendation:* It would most likely be recommended**

that the fish being held be destroyed and holding facility properly disinfected in a manner that would prevent the spread of the detected fish pathogen. Stocking would more than likely be prohibited but could be authorized if the affected states were in general consensus that stocking diseased fish would be an acceptable risk.

<u>Topic #3: Receiving water source information. Including:</u>

- Status of fish pathogens and ANS in comparison to the donor water source (presence, absence, unknown). ***<u>Recommendation:</u> Comparison of the status of ANS and fish pathogens including but not limited to: Anguillicoloides crassus , Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Ceratomyxa Shasta, Spring Viremia of Carp virus, Proliferative Kidney Disease (Tetracapsuloides bryosalmonae), Whirling Disease (Myxobolus cerebralis), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus, Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri).***

VERMONT

Department of Fish and Wildlife
1 National Life Drive, Davis 2
Montpelier, VT 05620-3702
www.vtfishandwildlife.com

[phone] 802-241-3700
[fax] 802-828-1250

Agency of Natural Resources

March 25, 2015

Steve Leach
Senior Biologist
Normandeau Associates, Inc.
917 Rt. 12, #1
Westmoreland, NH 03467

Through:

Lael Will, Fisheries Biologist
Vermont Agency of Natural Resources
Fish & Wildlife Department
100 Mineral Street, Suite 302
Springfield, VT 05156-3168

Re: TransCanda Hydro Northeast Inc.'s Revised Sturdy Plan, Study19 Modifications

Dear Mr. Leach,

On February 5th, 2015 it was brought to the attention of Vermont Fish & Wildlife Department (Department) staff that as part of a downstream passage assessment of American Eels (Eels) in the Connecticut River (River) a certain number of Eels would need to be imported into the River from an inter-basin source. It is the Department's primary recommendation that all efforts be made to obtain Eels from within the River basin. While the Department is supportive of the downstream passage assessment as documented in the August 14, 2015 TransCanada Hydro Northeast Inc.'s Revised Study Plan, the Department has a number of fish health and aquatic nuisance species concerns involving the implications of the proposed modification to the study.

The Department views inter-basin fish importation of wild-acquired fish as a high risk activity for extending the geographic distribution of dangerous fish pathogens and aquatic nuisance species which could compromise a number of aquatic organisms in the receiving water basin. Enclosed are a number of topics and recommendations that the Department would require to be addressed in order to authorize the movement of inter-basin, wild-acquired Eels into the River for the downstream passage assessment.

The Department would request that the research team for the Eel downstream passage assessment provide the Department with a revised study plan for review that would address the Department's concerns involving the risk of spreading fish pathogens/aquatic nuisance species into the River.

If you have any questions or concerns, please do not hesitate to contact me by phone at 802-793-6781 or by email at tom.jones@state.vt.us. We look forward to reviewing your proposed modifications.

Sincerely,

Tom J

Tom Jones
Fish Health Biologist
Vermont Agency of Natural Resources
Fish & Wildlife Department
1 National Life Drive, Davis 2
Montpelier, VT 05620-3702

Enclosure: American Eel Importation Proposal Review – Recommended Topics of Discussion

Cc (electronic only):
Adam D. Miller, Fish Culture Operations Manager, Vermont Fish & Wildlife Department
Eric Palmer, Fisheries Division Director, Vermont Fish & Wildlife Department
Rod Wentworth, Fisheries Biologist, Vermont Fish & Wildlife Department

<u>American Eel Importation Proposal Review - Recommended Topics of Discussion</u>

The following are a list of questions and topics that Vermont Fish and Wildlife Department (Department) would like to see discussed in a proposal to import American Eels (Eels) for the downstream passage study. The proposal would be presented to the Department for review and subsequent approval, denial, or additional questioning prior to the start of the proposed research activities. Although not specifically outlined in this document, researchers should coordinate with other states of regarding fish health management on the Connecticut River to obtain concurrence with the study (i.e. New Hampshire, Massachusetts, Connecticut).

<u>Topic #1: Donor water source information. Including:</u>

- The specific location of the donor waterbody (HUC-10). ***<u>Recommendation</u>: The Department understands that a similar inter-basin importation of Eels (2011) was conducted in New York from the Sebasticook River – East Branch in Maine. Although not required, it would be the preference of the Department that researchers collect Eels from the same source since they were effectively imported into New York from this location.***

- Fish pathogen / aquatic invasive species (ANS) profile of the donor water basin (HUC-2).

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    - Status of ANS in the donor sub-basin (HUC-4) (presence, absence, unknown). Please describe the ANS detected, the detection date, and the pathogen distribution in the sub-basin.

    - Have there been any fish kills which have resulted in the detection of a specific pathogen in the specific watershed (HUC-10)?

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***Recommendation:** The Department would require the imported Eels to undergo fish health screening and stringent biosecurity protocols prior to stocking in the Connecticut River. Review of a fish health certificate outlining fish health screening results of the tested Eels would be required prior to stocking.*

- The number of Eels to be collected

- The number of individuals to be sacrificed for disease testing. ***Recommendation:** Sixty (60) individuals*

- The specific fish pathogens that the individuals will be tested for. ***Recommendations:** Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), Anguillicoloides crassus – nematode (testing by gross observation), any bacteria growth of significance shall be identified and reported as well as any cytopathic effect (CPE) producing agent identified and reported.*

- Who would be doing the fish health testing? Would the Department be granted consent to communicate with the testing laboratory? ***Recommendation:** A laboratory that is experienced with regularly conducting fish health diagnostics and inspections (i.e. Kennebec River Biosciences, USFWS Lamar Fish Health Center) would be recommended. The Department would desire the ability to communicate with the testing laboratory.*

- The location and facility that the collected Eels would be held at while awaiting fish health testing results. ***Recommendation:** An isolation facility in accordance with the New England Fish Health Guidelines (https://www1.maine.gov/ifw/fishing/health/newengland_guidelines.pdf) if fish are held in the donor watershed (HUC-10). If fish were held in the receiving basin (HUC-2) effluent disinfection would need to be incorporated into the facility design. Fish should be held in an approved isolation / quarantine until disease inspection results were shared with the Department.*

- Explanation of the transportation method of fish from the donor water source to the holding facility to the receiving water source. ***Recommendation:** Transportation should be conducted in clean, pathogen/ANS free water.*

- ***Analysis of ANS. Recommendation:** Presence of any ANS species during the fish health assessment shall be noted on the fish health assessment report.*

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that the fish being held be destroyed and holding facility properly disinfected in a manner that would prevent the spread of the detected fish pathogen. Stocking would more than likely be prohibited but could be authorized if the affected states were in general consensus that stocking diseased fish would be an acceptable risk.

<u>**Topic #3: Receiving water source information. Including:**</u>

- Status of fish pathogens and ANS in comparison to the donor water source (presence, absence, unknown). ***<u>Recommendation:</u> Comparison of the status of ANS and fish pathogens including but not limited to: Anguillicoloides crassus , Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Ceratomyxa Shasta, Spring Viremia of Carp virus, Proliferative Kidney Disease (Tetracapsuloides bryosalmonae), Whirling Disease (Myxobolus cerebralis), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus, Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri).***

May 11, 2015
Via email

Tom Jones
Fish Health Biologist
Vermont Agency of Natural Resources
Fish & Wildlife Department
1 National Life Drive, Davis 2
Montpelier, VT 05620-3702

Jason M. Smith
Chief, Inland Fisheries Division
New Hampshire Fish & Game Department
11 Hazen Drive
Concord, NH 03301

Re: Importation of Wild American Eel for Connecticut River FERC Studies

Dear Mr. Jones and Mr. Smith:

Attached please find our "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015", prepared in response to your letters dated March 25, 2015, and April 9, 2015, respectively, relative to the TransCanada Hydro Northeast Inc (TransCanada) Study Plan 19 – American Eel Downstream Passage Assessment.

Normandeau Associates Inc. and Kleinschmidt Associates (on behalf of FirstLight Power Resources and their similar FERC Study No. 3.3.5) have jointly investigated options for procuring sufficient numbers of adult American Eels to implement these studies in 2015. We have evaluated the pathological concerns and recommendations provided by your agencies, and by the Massachusetts Division of Fisheries and Wildlife. The attached Plan describes the only practical option for eel procurement which is from a source in Newfoundland. The Plan also provides details on procurement, holding and transportation, as well as testing of potential pathogens of concern for the Connecticut River.

While we understand and appreciate agency preferences for obtaining eels from within the Connecticut River basin, it is extremely unlikely that the number needed (~ 1,100) can be collected from within basin in a timely manner. Potential sources in the Delaware and Kennebec river basins could each only provide a portion of the number of eels needed, which would dramatically complicate pathogen testing, and study-related costs.

We believe that this Plan is responsive to agency concerns; will ensure that only healthy fish are imported; and provides the only viable alternative to obtain sufficient numbers of American Eels for these studies. Given the seasonal timing of adult eel procurement and the time needed to conduct and report on pathogen testing, we request your concurrence on the approach detailed in the Plan by May 31, 2015. We would be happy to convene a teleconference at your convenience should additional discussion be needed. Please contact me at (603) 757-4004 or sleach@normandeau.com with any questions you may have.

Sincerely,

Steven D. Leach
Senior Biologist

Attachment

cc via email:

VTDFW:	Adam Miller
	Eric Palmer
	Rod Wentworth
	Lael Will
NHFGD:	Gabe Gries
USFWS:	Ken Sprankle
	John Warner
TransCanada:	John Ragonese
	Jennifer Griffin
Normandeau:	Maryalice Fischer
	Doug Royer
Kleinschmidt:	Bryan Apell
	Chris Tomichek

Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015

Prepared for:

TransCanada Hydro Northeast Inc. and FirstLight Power Resources Inc.

Prepared by:

Normandeau Associates, Inc. and Kleinschmidt Associates

May 8, 2015

Table of Contents

1.0 Introduction

Currently five Hydroelectric Projects are engaged in relicensing processes through the Federal Energy Regulatory Commission's (FERC) Integrated Licensing Process (ILP): FirstLight's Turners Falls and Northfield Mountain Projects and TransCanada's Vernon, Bellows Falls, and Wilder Projects. State and federal natural resource agencies and other stakeholders have identified several studies involving route of passage determination and turbine passage survival of silver-phase American Eel (*Anguilla rostrata*). The agencies and stakeholders, and the utilities have a common interest to ensure that silver-phase American Eel studies are successfully implemented.

The collective sample size required for all studies is approximately 1,000 adult American Eels. The silver-phase of American Eel life history is the physiological state of adult eels undergoing the spawning migration. Within freshwater rivers, the only reliable time to collect silver-phase eels is when they are actively engaged in emigration from the system. In the Connecticut River, this primarily occurs in the late summer through fall with the majority in late September and October.

Required sample sizes for Connecticut River relicensing studies of silver-phase American Eels during 2015. Totals do not include pathology samples.

2015 Silver Eel Needs for TransCanada Studies			2015 Silver Eel Needs for FirstLight Studies		
Project	**Study**	**N**	**Project**	**Study**	**N**
Wilder	Turbine Survival	100	Cabot	Turbine Survival	50
Bellows Falls	Turbine Survival	50	Station # 1 Smaller	Turbine Survival	50
Vernon	Turbine Survival	150	Station # 1 Larger	Turbine Survival	50
All, controls	Turbine Survival	75	Bascule Gates	Gate Survival	63
Wilder	Route Selection	50	Tainter Gates	Gate Survival	62
Bellows Falls	Route Selection	50	All above, Controls	Survival	25
Bellows Falls	Route Selection	50	Northfield	Route Selection	72
Vernon	Route Selection	50	Turners Falls	Route Selection	30
			Turners Falls Canal	Route Selection	30
Total		**575 +pathology sample**	**Total**		**432 +pathology sample**

2.0 Eel Sources

Due to the number of eels required, it would be difficult and likely impossible to collect the required sample size from the Connecticut River Basin in one season. The samplers at Holyoke Dam and Cabot Station are not expected to provide sufficient numbers, so collections would require an impractical amount of exploratory sampling. Therefore, Normandeau and Kleinschmidt propose to obtain eels from out-of-basin sources. Several potential sources were identified including the Kennebec River Maine, Delaware River, Pennsylvania, and coastal rivers of western Newfoundland, Canada.

2.1 Option 1: Delaware and Kennebec River Basin Sources

Two eel fishermen operating in the Kennebec River basin, Maine, and one operating in the Delaware River basin, Pennsylvania were contacted. They indicated a willingness to provide eels, and a preference to provide eels for research purposes rather than for the consumer market. However, discussions suggest that each may only be able to supply ~300-400 eels, therefore all three sources would be necessary to fulfill the study needs. This is exacerbated by the shortening of the commercial fishing season in Maine, leading to probable exclusion of one or both sources from the Kennebec River. Finally, it is not clear that the Kennebec and Delaware River sources have facilities suitable to hold eels in quarantine while a sample is tested for pathogens.

2.2 Option 2: Newfoundland Source (North Atlantic Aquaponics Ltd.)

Adult American Eels would be harvested from the Little Barachois Brook and Flat Bay Brook located in the southwest of Newfoundland, and if required from the Brig Bay area of the northern peninsula of Newfoundland, Canada. Depending on stock availability, the eels will be fished preferably from one river but two rivers will probably be required to obtain the necessary sample size as expeditiously as possible. The reason for this is that health assessments can take another three weeks post-capture to complete, and the experiment schedule requires eels in a timely fashion. The eels will be transferred from the catch location using sterilized tanks to North Atlantic Aquaponics Ltd.'s holding facility in Robinson, Newfoundland, where the fish will be held in quarantine, by river, while awaiting health assessment results from AVC-UPEI. Fishing occurs in September, so depending on timing and catch, a single lot will be held or multiple discrete lots will be held while undergoing health diagnostics. In this option, the vendor would be responsible for the appropriate export permitting in conjunction with an import number provided from Normandeau and Kleinschmidt along with appropriate U.S. agency permits. Fish will be transported in oxygenated plastic bags, on ice and in Styrofoam coolers. No water is added and the ice is free of any contaminants or pathogens. If ice is an issue, freezer packs can also be used. This shipping procedure allows shipping time to be upwards of 36 hours.

Normandeau and KA are proposing to use Option 2 based on several factors:

- Limited catches and limited commercial fishing seasons in the Kennebec and Delaware River fisheries;
- Recent indication that a key fisher in the Kennebec system has decided not to fish due to tightened season restrictions;
- The assurance of the vendor that the requisite number will be available;
- The ability for the vendor to maintain the lot(s) in quarantine while awaiting the results from the required health assessments being conducted. This eliminates the need to import any eels until health assessment is complete, which can take up to three weeks.

In Option 2 the Newfoundland source, approximately 1,120 silver-phase eels would be harvested by a commercial fisher, (North Atlantic Aquaponics Ltd.) from the Little Barachois Brook and Flat Bay Brook in southwest Newfoundland, and if required, from the Brig Bay area of the northern peninsula of Newfoundland, Canada. Both rivers would be fished to obtain as many eels as quickly as possible in order to initiate the required health assessments in a timely manner. The eels would be held in quarantine at the commercial operation in Robinson, Newfoundland. North Atlantic Aquaponics Ltd. specializes in the exportation of eels and maintains indoor holding facilities with independent water circulation and filter systems, assuring no cross-contamination between tanks.

Captured American Eels would be transferred from the river fished to the aquaculture facility using sterilized transfer tanks and the eels held at the aquaculture facility in pre-disinfected, quarantined holding tanks, by river, until the appropriate number of fish are captured. Once the sample size has been reached (i.e., ~1,120), a random sample of 60 fish would be selected from each river (i.e., each lot) to undergo health assessment diagnostics at the Atlantic Veterinary College - University of Prince Edward Island (AVC-UPEI).

Once each 'lot' has been submitted for health assessment, these tanks would be segregated in quarantine and no other fish could be added to these tanks pending the test results. If required and subsequent to sample submission of these two 'lots' from Barachois Brook and Flat Bay Brook to AVC-UPEI, American Eel fished from Brig Bay would be treated as a separate lot and would require another independent health assessment (e.g., Lot 3). Upon receipt of a signed certification that the fish are pathogen free from AVC-UPEI, the lot(s) would then be shipped to the U.S. via air freight over the season of Connecticut River silver-phase eel outmigration.

3.0 Pathogens

3.1 Pathogens Detected in Eels

The National Wild Fish Health Database (http://ecos.fws.gov/wildfishsurvey/database/page/intro) was queried to evaluate known pathogens in American Eels in the U.S.

Only six cases of American Eel have been tested (Oconee R., GA; Connetquot Brook, Long Island, NY; Conowingo Dam, Susquehanna R., MD; Octoraro Cr., Susquehanna River, MD (mouth of Octoraro Cr., and Lakawaxan River, PA. No tests for pathogens in any of the six cases yielded positive results. Lakawaxan River is a tributary to the Delaware River; 82 fish of 14 species, including 10 American Eel, were tested. No pathogens were detected. American Eel test specifics for that case are summarized in Table 3.1:

Table 3.1. Test Specifics for ten Lakawaxan River sourced American Eel tested for pathogens.

Species Code	Specimen	Number Tested	Preliminary Assay	Corroborative Assay	Pathogen Detected
AME	Spleen/Kidney	10	EPC/CHSE-214 Cell Culture	Not Applicable	None
"	Kidney	10	Brain-Heart Infusion Agar Culture	Not Applicable	None

The parasitic adult nematode *Anguillicoloides crassus* infects the swimbladders of eels and can readily spread among eel populations after introduction to a body of water. Studies indicate that it is established in most states along the Atlantic seaboard including South Carolina, Maine, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida (Zimmerman 2009). Aieta and Oliverira (2009) detected 60% prevalence in Kennebec River samples, and they found *A. crassus* in eels collected from all Massachusetts rivers tested. They did not test the Connecticut River because they had determined that the parasite was already established there (citing S. Gephard, CT Department of Environmental Protection, personal communication).

Ottolenghi et al. (2004) reviewed several pathogens known to occur in capture-based aquaculture of several species of eels. While their review appeared to focus primarily on Japanese and European Eels, regarding American eel, they referenced a single study that identified the common gill parasites *Pseudodactylogyrus anguillare* (Monogenea) and *Ergasilus celestis* (copepoda) occurring in wild American Eels collected in from one watershed in Nova Scotia (citing Barker and Cone 2000).

3.2 Pathogens Detected in the Connecticut River

The National Wild Fish Health Database (http://ecos.fws.gov/wildfishsurvey/database/page/intro) was queried to evaluate known pathogens in the Connecticut River. In the Connecticut River Basin, dozens of cases have been tested; only four cases yielded positive results:

- Saxtons River, Atlantic salmon, *Renibacterium salmoninarum* (collected 1999, tested 2009).
- Lull's Brook, Brook Trout, *Renibacterium salmoninarum,* 1998.
- Holyoke Dam, Sea Lamprey, *Aeromonas salmonicida*, 2012
- West Branch, Farmington River, CT, Atlantic Salmon, *Aeromonas salmonicida*,1999

3.3 Pathogens Detected in Newfoundland Source Rivers

American Eel health diagnostics in Canada was required for a glass eel translocation program that spanned 7 years (2004 - 2010). Glass eels were obtained from several commercial sources operating along the east coast of Canada, including the Gulf of St. Lawrence. Prior to translocation, these fish underwent a rigorous health assessment testing protocol (Threader et al. 2011). We propose to use the same rigid protocols that were used in the Threader et al. (2011) study. In general, eels were held in quarantine with flow-through isolated from other tanks, and pending results of health assessment. Health assessments were conducted by the AVC-UPEI, Fish Diagnostics Section. Eels were tested for six viruses, two bacteria, and the nematode *A. crassus* (see Table 3.2 below) all of which have been identified in North Atlantic waters. One lot tested 2009 was positive for Enteric Red Mouth (*Yersinia ruckeri*). Using histological techniques, small numbers of eels collected from Nova Scotia were found to be infected with *A. crassus* in 2007 in what was thought to be the first report of natural infection from Nova Scotia waters. From 2008 to 2010, no observations of *A. crassus* infection were made from several river sources in eastern Canada. No pathogens or parasites were identified from Newfoundland sources as part of the glass eel stocking program. Other information on pathogens or Aquatic Invasive Species (AIS) from the pristine watershed of Newfoundland where fishing is proposed to take place (e.g., Little Barachois Brook and Flat Bay Brook) is unknown.

Table 3.2. Summary of virology and bacteriology testing methodology and results reported by Threader et al. (2011).

Parameter	Description	Detection Method	Results
European Eel Herpesvirus (EEHV)	Manifests in dermal hemorrhagic lesions mainly in the pectoral fin and opercular regions, and by congestion and destruction of gill filaments.	Polymerase chain reaction (PCR) - uses DNA polymerase enzyme to replicate a DNA template, potentially generating millions of copies of the original template and enabling analysis of extremely small amounts of sample.	All sample pools negative for EEHV.
Viral Hemorrhagic Septicemia (VHS)	Infection characterized by bulging eyes, bloated abdomen, erratic behavior and hemorrhaging of the eyes, skin, gills and fin bases. Increasingly widespread in the Great Lakes/St. Lawrence system, resulting in some massive die-offs.	Nested PCR - modified procedure to reduce contamination from unwanted end-product DNA; uses two successive runs of PCR to amplify a secondary target within the first-run target.	All sample pools negative for VHS.
Infectious salmon anemia virus (ISAV)	Highly infectious disease of Atlantic salmon which may also be carried by several trout species. Symptoms include paling of gills, liver congestion, and severe anemia.	Reverse Transcription (RT) PCR - amplifies a piece of RNA by first reverse transcribing it to its DNA complement, which is then amplified using PCR.	All sample pools negative for ISAV.
Infectious pancreatic necrosis virus (IPNV)	Widespread disease causing characteristic “corkscrew” swimming behavior and sudden increase in mortality.	RT-PCR - as above.	All sample pools negative for IPNV.
Infectious Hematopoietic Necrosis Virus (IHNV)	Infection characterized by abdominal distension, bulging eyes, skin darkening, anemia, fading of gills, and hemorrhaging. Necrosis common in kidney and spleen.	RT-PCR - as above.	All sample pools negative for IHNV.

Parameter	Description	Detection Method	Results
Spring Viremia of Carp Virus (SVCV)	Infection characterized by darkening of skin, exophthalmia, ascites, pale gills, protruding vent with a thick mucoid fecal cast. Internally, edema, inflammation, and pinpoint hemorrhages in organs, including swim bladder.	RT-PCR - as above.	All sample pools negative for SVCV.
Virus Isolation	All virus strains (HPA, VHS, ISA, and IPN) tested.	CHSE/SHK/FHM cell lines: tissue sample incubation occurred at 15-16^{o}C for 28 days. EK-1 cell line: samples were done in three passes of 7 days each, and were incubated at 26^{o}C.	No virus isolated in any cell line.
Furunculosis	Infection characterized by internal and external hemorrhaging; welling of vents and kidneys; boils; ulcers; liquefaction; and gastroenteritis.	Standard plate culture with biochemical identification of isolates for sugar metabolism. Positives confirmed by slide agglutination with specific antibodies and mass spectrophogometer.	All sample pools negative.
Enteric Red Mouth	Infection characterized by reddening of mouth; subcutaneous hemorrhaging of mouth, fins, and eyes; and internal organ hemorrhaging.	Standard plate culture with biochemical identification of isolates for sugar metabolism. Positives confirmed by slide agglutination with specific antibodies and mass spectrophogometer.	One lot infected in 2009; all other lots negative.

4.0 Importation and Holding Plan

All American Eels collected from Newfoundland Rivers have been in the watershed since coming in as glass eels (i.e., 10 to 20+ years). Silver-phase American Eels collected in Newfoundland will be retained in quarantine by North Atlantic Aquaponics Ltd. at their facilities in Robinson, Newfoundland pending health assessment certification. Eels will be quarantined in one or more lots, depending on timing of collection and pathology testing. A random sample of 60 eels from each lot will be released for health assessment. These eels will be shipped live, by lot, from the holding facility to AVC-UPEI by air transport. A chain of custody form will accompany each shipment. Approximately 30 eels will be shipped each day to allow for processing in the laboratory at AVC-UPEI. Pending results of the assessment, eels would then be imported from Newfoundland to Normandeau for release in the Connecticut River under permits for New Hampshire and Vermont, and to Kleinschmidt for release in the Connecticut River under permit from Massachusetts (to be applied for pending development and approval of this Plan).

Virus identification through tissue culture takes three weeks, the longest of all health assessment test protocols. However, an RT-PCR analysis which runs concurrently for these same viruses takes just over one week. It may be possible to ship based on a negative PCR results but this is a decision to be made by the agencies.

5.0 Pathogen Testing

5.1 Guidelines

The Northeast Fish Health Committee Guidelines for importation (NEFHC 2008) recommends:

- Imported fish must be accompanied by a fish health inspection report prepared and signed by a qualified AFS fish health inspector or qualified fish health inspector (AVC-UPEI). Prior to shipment, the inspector will furnish to the receiving member state a statement confirming that the fish has been inspected for the presence of each listed pathogen.
- No fish from a water body known to be infected with Infectious Hematopoietic Necrosis Virus, Viral Hemorrhagic Septicemia Virus, Heterosporis, Infectious Salmon Anemia Virus, Spring Viremia of Carp, *Myxobolus cerebralis*, *Ceratomyxa shasta*, or *Tetracapsula bryoszoa*, may be imported.
- Fish health inspection reports must include results of the examinations for family specific pathogens.
- Sample collection and sample lots must follow family specific testing requirements.
- For wild fish inspection, the general requirement is 60 fish per lot.
- Sample collections and fish health certification reports must be made by a qualified fish health inspector. Methods used for collections and fish health inspections must be recognized by either the American Fisheries Society or the World Organization of Animal Health.

- For the purposes of collecting wild fish, a "lot" of fish is a pooled collection of a single species that is held in a self-contained holding structure with a pathogen free water source.

NEFHC (2008) provided no family specific guidelines for Anguillidae fishes (American Eel). However, the New York Department of Environmental Control (NYSDEC) has specified pathogens to be tested for importation of American Eel from the Sebasticook River (Kennebec River Basin) to the Hudson River. Those were Viral Hemorrhagic Septicemia virus, *Yersinia ruckeri*, Infectious Pancreatic Necrosis Virus, Spring Viremia of Carp virus, and *Aeromonas salmonicida* (*A. salmonicida* is a present in the Connecticut River). NYSDEC was also involved in defining the pathogens to be tested in the Ontario stocking program (Threader et al. 2011).

5.2 Proposed Pathogen Tests

Based on previously recommended health assessment testing requirements for each lot of American Eel (Threader et al, 2011) and recommendations of Vermont Department of Fish and Wildlife (VTDFW, see Appendix A), Normandeau and Kleinschmidt propose to have samples of 60 fish per lot tested for:

- Viral Hemorrhagic Septicemia (VHS);
- Infectious Pancreatic Necrosis Virus (IPNV);
- Infectious Salmon Anemia Virus (ISAV);
- Infectious Hematopoietic Necrosis Virus (IHNV)
- Infectious Pancreatic Necrosis Virus (IPNV),
- Spring Viremia of Carp Virus (SVCV)
- Furunculosis (Aeromonas salmonicida) [present in Connecticut River);
- Enteric Red Mouth Virus (Yersinia ruckeri); and
- Anguillicoloides crassus

In addition, the following pathogens will be tested at AVC-UPEI as requested by the Massachusetts Division of Fisheries and Wildlife (MADFW) and VTDFW:

- Largemouth Bass virus (LMBv);
- Koi Herpesvirus, Ceratomyxa shasta,
- Proliferative Kidney Disease (Tetracapsuloides bryosalmonae);
- Bacterial Kidney Disease (Renibacterium salmoninarum); and,
- Whirling Disease (Myxobolus cerebralis).

5.3 Testing Protocol

Normandeau and Kleinschmidt propose to use AVC-UPEI, Fish Diagnostics Section: (http://avc.upei.ca/diagnosticservices/aquatic/services). This facility is experienced in health certification for aquatic species, and specifically for American Eel. They also adhere to standard industry protocols including American Fisheries Society "Bluebook" and World Organization for Animal Health (OIE), and have experience in conducting fish health testing for American Eel. Pathology specimens (60 fish per lot) will be released live from the vendor to the Fish Diagnostics Section for pathology / health assessment and will be sacrificed at AVC-UPEI. The remainder of the study lots will be held at the vendor's facility in quarantine until diagnostic testing is complete and the lot(s) are certified and results have been reviewed by the agencies. If any lot is denied for importation, it will be disposed of at the vendor's discretion.

All laboratory diagnostic results will be delivered to the agencies for review and approval prior to importation. This assumes that a positive test result will not necessarily preclude approval, particularly in the case of pathogens known to exist in the Connecticut River. Upon approval, lot(s) will be exported by the vendor (North Atlantic Hydroponics, Ltd.) to the United States where Normandeau and Kleinschmidt will take delivery for distribution to the Connecticut River, Massachusetts (FirstLight projects) or Vermont / New Hampshire for tagging and release under state importation permits (to be applied for).

Results of the health diagnostics will be compiled in a fish health certification report prepared by the testing facility and provided to VTDFW, New Hampshire Fish and Game Department (NHFGD), MADFW, and Connecticut Department of Energy and Environmental Protection for review prior to transport/importation. Because there is a narrow seasonal window, this assumes a rapid review by agencies. It should also be recognized that a single lot testing procedure can take three weeks to complete, especially if RT-PCR is not accepted as the primary method of virus detection. If all tests are negative (i.e., free of pathogens, fellow travelers and AIS), we assume approval for importation. However, we understand that a positive test does not necessarily preclude importation, but will be subject to review by the agencies. In particular, we note that Aeromonas salmonicida and Angullicoloides crassus are present in the Connecticut River.

Once testing is complete and a signed certification issued that the fish are free of defined viruses, bacteria, other specific pathogens and specified invasive species, the quarantined eels will be transported live via air-freight to an airport in the region for release to Normandeau and Kleinschmidt.

6.0 Comments

In the event that one or more lots are denied for importation, or an insufficient number of eels is available for the studies overall, Normandeau and Kleinschmidt will rely on USFWS in consultation with TransCanada and FirstLight to prioritize studies and sample size allotments.

7.0 Literature Cited

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Appendix A

Response to Comments Submitted by VTDFW and NHFGD

On March 25, Vermont Department of Fish and Wildlife submitted a letter detailing topics that they felt needed to be addressed in a study plan to be submitted for agency review in order for permission to be granted for importation of American Eels from out-of-basin sources. Those topics are covered in this Plan and outlined below in response to the VTDFW and NHFGD comment letters (which follow the responses). Also attached following the VTDFW and NHFGD letters is a similar letter MADFW to KA. Normandeau and KA believe that this Plan addresses the agency issues of concern.

Topic #1: Donor water source information

- Specific location of the donor waterbody (HUC-10).

Response: Maine source locations are not proposed at this time because of limited catch and increasing regulatory restriction has reduced or potentially eliminated those sources. Instead, we propose to use a commercial vendor with fishing operations in Brig Bay area of the northern peninsula of Newfoundland. The source cannot be specifically identified to HUC-10 because Newfoundland is not delineated in the USGS Hydrologic Unit Code. Fishing will take place in Little Barachois Brook and Flat Bay Brook, and possibly in the Brig Bay area. American eel caught from the northern Newfoundland rivers have been in these river system from the glass eel phase when they entered from the sea. (i.e., 10 - 20+ years).

- Fish kills attributed to specific pathogen?

Response None reported to date. Unknown.

No fish kills have been observed in Little Barachois Brook or Flat Bay Brook that we are aware (North Atlantic Aquaponics pers. comm.) or could be found in the literature.

Topic #2: Fish Health Testing

Response: The items detailed under this heading were addressed in the plan. As described therein, use of American eels collected in Newfoundland, and tested at AVC-UPEI eliminates concern for importation of untested fish into the United States.

- Number of eels that will be collected:

Response: Up to 1,120 adult American eels (i.e., silver) will be collected.

- Number of eels that will be imported into Massachusetts:

Response: Up to 1000, pending acceptable health diagnostic results.

- Testing must be done for the following diseases by a fish health inspector and laboratory according to the protocols in the Fish Health Section of the American Fisheries Society Blue Book or the Manual of Diagnostic Tests for Aquatic Animals (OIE – World Organization for Animal Health): Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), American eel swimbladder nematode (Anguillicoloides crassus) (gross observation). Any bacteria of significance or cytopathic effect (CPE) producing agent shall be identified and reported. Sixty (60) individuals must be tested.

Response: The additional testing requirements for other pathogens and 'fellow travelers' as suggested have been included in the Plan. Sixty randomly selected individuals from each lot will be tested.

- The facility where the wild-caught eels are held and maintained until results of the fish health inspection and diagnostic tests are complete must meet the following conditions: 1) facility must be free of listed fish pathogens and completely biosecure, 2) facility must have a biosecurity plan in place (provide a copy of the biosecurity plan), 3) no other fish species may be held at the facility while the eels are kept there, 4) facility must have a disease-free well water supply; if the water is not well water only, provide a full description of how the water is sterilized and kept free of listed fish pathogens and AIS, 5) all holding tanks and equipment must be fully sterilized (or new), 6) no additional eels may be added to the population of eels being held in the facility once the fish health inspector inspects the fish and takes samples for the diagnostic tests, and 7) all equipment, water and ice used to package and transport the eels to Massachusetts must be pathogen/AIS free.

Response: Many of these comments have been addressed in the Study Plan.

(1) The holding tanks and all associated piping and filter systems are disinfected prior to bringing fish into the aquaculture facility in Robinson, Newfoundland. There has never been a known incidence of any of the pathogens, disease, bacteria or other 'fellow travelers' identified in this study plan at North Atlantic Aquaponics Ltd.'s Robinson facility. (2) The facility is biosecure and has both a Quality Management Plan (2014) and a Export Certification Control Program (2014) in place which can be provided for review if a decision is made to obtain adult American eel from North Atlantic Aquaponics Ltd. Titles of the Operating Procedures are, but not limited to:

- Employee Hygiene;
- Visitors & Agency Inspections;
- Security Procedures;
- Plant - Clean up Procedures;
- Sanitation Procedures;
- Receipt & Storage of Packaging Materials and Ingredients (including feed);
- Product Monitoring Procedures;
- Sampling of Incoming Product;

- Sampling during Packaging;
- Sampling of final product;
- Inspection & Storage of Cleaning Agents, Sanitizers & Lubricants;
- Pest Control;
- Town Water;
- Corrective Action Plan; and
- Amendment Log Books.

(3) No other fish species will be held in North Atlantic Aquaponics Ltd.s Robinson facility while holding or awaiting health assessment test results for the above study plan. (4) The water supply to the Robinson facility is from an artesian well and contains no known pathogens. (5) All tanks , pipelines, filters and equipment will be disinfected prior to bringing any eels meant for this study into the facility. The water is directly infused into each holding tank and each tank provides quarantine from other tanks. The water arrives at each tank through a flow through design to avoid any cross contamination between tanks. (6) Once a sample of fish has been sent for health diagnostics, the tank will be quarantined, labeled as such, and no further fish will be added to the tank until the results have been obtained from AVC-UPEI; (7) All efforts will be made to ensure a sterile environment when packaging eels for transport to the U.S.A. including the use of new plastic bags, disinfected styrofoam shipping containers, disinfected shipping room, and a guaranteed supply of clean ice or use of ice packs.

Topic #3: receiving water source information

Response: The items detailed under this heading wereare addressed in the plan.

VERMONT

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Agency of Natural Resources

March 25, 2015

Steve Leach
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Through:

Lael Will, Fisheries Biologist
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Fish & Wildlife Department
100 Mineral Street, Suite 302
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Re: TransCanda Hydro Northeast Inc.'s Revised Sturdy Plan, Study19 Modifications

Dear Mr. Leach,

On February 5th, 2015 it was brought to the attention of Vermont Fish & Wildlife Department (Department) staff that as part of a downstream passage assessment of American Eels (Eels) in the Connecticut River (River) a certain number of Eels would need to be imported into the River from an inter-basin source. It is the Department's primary recommendation that all efforts be made to obtain Eels from within the River basin. While the Department is supportive of the downstream passage assessment as documented in the August 14, 2015 TransCanada Hydro Northeast Inc.'s Revised Study Plan, the Department has a number of fish health and aquatic nuisance species concerns involving the implications of the proposed modification to the study.

The Department views inter-basin fish importation of wild-acquired fish as a high risk activity for extending the geographic distribution of dangerous fish pathogens and aquatic nuisance species which could compromise a number of aquatic organisms in the receiving water basin. Enclosed are a number of topics and recommendations that the Department would require to be addressed in order to authorize the movement of inter-basin, wild-acquired Eels into the River for the downstream passage assessment.

The Department would request that the research team for the Eel downstream passage assessment provide the Department with a revised study plan for review that would address the Department's concerns involving the risk of spreading fish pathogens/aquatic nuisance species into the River.

If you have any questions or concerns, please do not hesitate to contact me by phone at 802-793-6781 or by email at tom.jones@state.vt.us. We look forward to reviewing your proposed modifications.

Sincerely,

Tom

Tom Jones
Fish Health Biologist
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Enclosure: American Eel Importation Proposal Review – Recommended Topics of Discussion

Cc (electronic only):
Adam D. Miller, Fish Culture Operations Manager, Vermont Fish & Wildlife Department
Eric Palmer, Fisheries Division Director, Vermont Fish & Wildlife Department
Rod Wentworth, Fisheries Biologist, Vermont Fish & Wildlife Department

American Eel Importation Proposal Review - Recommended Topics of Discussion

The following are a list of questions and topics that Vermont Fish and Wildlife Department (Department) would like to see discussed in a proposal to import American Eels (Eels) for the downstream passage study. The proposal would be presented to the Department for review and subsequent approval, denial, or additional questioning prior to the start of the proposed research activities. Although not specifically outlined in this document, researchers should coordinate with other states of regarding fish health management on the Connecticut River to obtain concurrence with the study (i.e. New Hampshire, Massachusetts, Connecticut).

Topic #1: Donor water source information. Including:

- The specific location of the donor waterbody (HUC-10). ***Recommendation:** The Department understands that a similar inter-basin importation of Eels (2011) was conducted in New York from the Sebasticook River – East Branch in Maine. Although not required, it would be the preference of the Department that researchers collect Eels from the same source since they were effectively imported into New York from this location.*

- Fish pathogen / aquatic invasive species (ANS) profile of the donor water basin (HUC-2).

    - Status of the listed fish pathogens in the donor water basin (HUC-2) (presence, absence, unknown). Please describe listed pathogens detected, the detection date, and the pathogen distribution in the basin. To include: Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), *Ceratomyxa Shasta*, Spring Viremia of Carp virus, Proliferative Kidney Disease (*Tetracapsuloides bryosalmonae*), Whirling Disease (*Myxobolus cerebralis*), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus.

    - Status of the listed fish pathogens in the donor water sub-basin (HUC-4) (presence, absence, unknown). Please describe the listed pathogens detected, the detection date, and the pathogen distribution in the sub-basin.To include: Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), American eel swimbladder parasite (*Anguillicoloides crassus)*.

    - Status of ANS in the donor sub-basin (HUC-4) (presence, absence, unknown). Please describe the ANS detected, the detection date, and the pathogen distribution in the sub-basin.

    - Have there been any fish kills which have resulted in the detection of a specific pathogen in the specific watershed (HUC-10)?

Topic #2: Fish health testing / biosecurity protocols of the individuals to be imported.
Recommendation: ***The Department would require the imported Eels to undergo fish health screening and stringent biosecurity protocols prior to stocking in the Connecticut River. Review of a fish health certificate outlining fish health screening results of the tested Eels would be required prior to stocking.***

- The number of Eels to be collected

- The number of individuals to be sacrificed for disease testing. ***Recommendation:*** ***Sixty (60) individuals***

- The specific fish pathogens that the individuals will be tested for. ***Recommendations:*** ***Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), Anguillicoloides crassus – nematode (testing by gross observation), any bacteria growth of significance shall be identified and reported as well as any cytopathic effect (CPE) producing agent identified and reported.***

- Who would be doing the fish health testing? Would the Department be granted consent to communicate with the testing laboratory? ***Recommendation:*** ***A laboratory that is experienced with regularly conducting fish health diagnostics and inspections (i.e. Kennebec River Biosciences, USFWS Lamar Fish Health Center) would be recommended. The Department would desire the ability to communicate with the testing laboratory.***

- The location and facility that the collected Eels would be held at while awaiting fish health testing results. ***Recommendation:*** ***An isolation facility in accordance with the New England Fish Health Guidelines (https://www1.maine.gov/ifw/fishing/health/newengland_guidelines.pdf) if fish are held in the donor watershed (HUC-10). If fish were held in the receiving basin (HUC-2) effluent disinfection would need to be incorporated into the facility design. Fish should be held in an approved isolation / quarantine until disease inspection results were shared with the Department.***

- Explanation of the transportation method of fish from the donor water source to the holding facility to the receiving water source. ***Recommendation:*** ***Transportation should be conducted in clean, pathogen/ANS free water.***

- ***Analysis of ANS. Recommendation: Presence of any ANS species during the fish health assessment shall be noted on the fish health assessment report.***

- Explanation of how a detection of the above tested pathogens in a fish health screening would affect the final stocking of the Eels. ***Recommendation:*** ***It would most likely be recommended***

that the fish being held be destroyed and holding facility properly disinfected in a manner that would prevent the spread of the detected fish pathogen. Stocking would more than likely be prohibited but could be authorized if the affected states were in general consensus that stocking diseased fish would be an acceptable risk.

Topic #3: Receiving water source information. Including:

- Status of fish pathogens and ANS in comparison to the donor water source (presence, absence, unknown). ***Recommendation:*** ***Comparison of the status of ANS and fish pathogens including but not limited to: Anguillicoloides crassus, Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Ceratomyxa Shasta, Spring Viremia of Carp virus, Proliferative Kidney Disease (Tetracapsuloides bryosalmonae), Whirling Disease (Myxobolus cerebralis), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus, Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri).***

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April 9, 2015

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Re: TransCanada Hydro Northeast Inc.'s Revised Study Plan, Study19 Modifications

Dear Mr. Leach,

On February 5th, 2015 it was brought to the attention of New Hampshire Fish & Game Department (Department) staff that as part of a downstream passage assessment of American Eels (Eels) in the Connecticut River (River) a certain number of Eels would need to be imported into the River from an inter-basin source. The Department has been having dialogs with the other New England States that would have interest regarding fish importation to the Connecticut River. While the agencies are supportive of the downstream passage assessment, as documented in the August 14, 2015 TransCanada Hydro Northeast Inc.'s Revised Study Plan, there are a number of fish health concerns involving the implications of the proposed modification to the study.

The Department views inter-basin fish importation of wild-acquired fish as a high risk activity for extending the geographic distribution of dangerous fish pathogens which could compromise a number of fish species in the receiving water basin. In addition to Eel management in the River, there are a number of other species that could be affected by an importation of inter-basin Eels (i.e. Atlantic salmon, American shad, etc.). Therefore, the Department would request that the research team for the Eel downstream passage assessment provide the Department with a revised study plan for review that would address the Department's concerns involving the risk of spreading fish pathogens into the River. Enclosed are a number of topics and recommendations that the Department would require to be addressed in order to allow the movement of inter-basin, wild-acquired Eels into the River for the downstream passage assessment.

If you have any questions or concerns, please do not hesitate to contact me by phone at 603-271-1744 or by email at jason.smith@wildlife.nh.gov. We look forward to reviewing your proposed modifications.

Sincerely,

Jason M Smith

Jason M Smith
Chief, Inland Fisheries Division
New Hampshire Fish & Game Department
11 Hazen Drive
Concord, NH 03301

Enclosure: American Eel Importation Proposal Review – Recommended Topics of Discussion

Cc: John Ragonese, TransCanada (email)
Gabe Gries, New Hampshire Fish and Game Department (email)

American Eel Importation Proposal Review - Recommended Topics of Discussion

The following are a list of questions and topics that Vermont Fish and Wildlife Department (Department) would like to see discussed in a proposal to import American Eels (Eels) for the downstream passage study. The proposal would be presented to the Department for review and subsequent approval, denial, or additional questioning prior to the start of the proposed research activities. Although not specifically outlined in this document, researchers should coordinate with other states of regarding fish health management on the Connecticut River to obtain concurrence with the study (i.e. New Hampshire, Massachusetts, Connecticut).

Topic #1: Donor water source information. Including:

- The specific location of the donor waterbody (HUC-10). ***Recommendation*: *The Department understands that a similar inter-basin importation of Eels (2011) was conducted in New York from the Sebasticook River – East Branch in Maine. Although not required, it would be the preference of the Department that researchers collect Eels from the same source since they were effectively imported into New York from this location.***

- Fish pathogen / aquatic invasive species (ANS) profile of the donor water basin (HUC-2).

    - Status of the listed fish pathogens in the donor water basin (HUC-2) (presence, absence, unknown). Please describe listed pathogens detected, the detection date, and the pathogen distribution in the basin. To include: Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), *Ceratomyxa Shasta*, Spring Viremia of Carp virus, Proliferative Kidney Disease (*Tetracapsuloides bryosalmonae*), Whirling Disease (*Myxobolus cerebralis*), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus.

    - Status of the listed fish pathogens in the donor water sub-basin (HUC-4) (presence, absence, unknown). Please describe the listed pathogens detected, the detection date, and the pathogen distribution in the sub-basin.To include: Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), American eel swimbladder parasite (*Anguillicoloides crassus)*.

    - Status of ANS in the donor sub-basin (HUC-4) (presence, absence, unknown). Please describe the ANS detected, the detection date, and the pathogen distribution in the sub-basin.

    - Have there been any fish kills which have resulted in the detection of a specific pathogen in the specific watershed (HUC-10)?

Topic #2: Fish health testing / biosecurity protocols of the individuals to be imported.
Recommendation*: *The Department would require the imported Eels to undergo fish health screening and stringent biosecurity protocols prior to stocking in the Connecticut River. Review of a fish health certificate outlining fish health screening results of the tested Eels would be required prior to stocking.

- The number of Eels to be collected

- The number of individuals to be sacrificed for disease testing. ***Recommendation*: Sixty (60) individuals**

- The specific fish pathogens that the individuals will be tested for. ***Recommendations:* Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri), Anguillicoloides crassus – nematode (testing by gross observation), any bacteria growth of significance shall be identified and reported as well as any cytopathic effect (CPE) producing agent identified and reported.**

- Who would be doing the fish health testing? Would the Department be granted consent to communicate with the testing laboratory? ***Recommendation:* A laboratory that is experienced with regularly conducting fish health diagnostics and inspections (i.e. Kennebec River Biosciences, USFWS Lamar Fish Health Center) would be recommended. The Department would desire the ability to communicate with the testing laboratory.**

- The location and facility that the collected Eels would be held at while awaiting fish health testing results. ***Recommendation:* An isolation facility in accordance with the New England Fish Health Guidelines (https://www1.maine.gov/ifw/fishing/health/newengland_guidelines.pdf) if fish are held in the donor watershed (HUC-10). If fish were held in the receiving basin (HUC-2) effluent disinfection would need to be incorporated into the facility design. Fish should be held in an approved isolation / quarantine until disease inspection results were shared with the Department.**

- Explanation of the transportation method of fish from the donor water source to the holding facility to the receiving water source. ***Recommendation:* Transportation should be conducted in clean, pathogen/ANS free water.**

- ***Analysis of ANS. Recommendation: Presence of any ANS species during the fish health assessment shall be noted on the fish health assessment report.***

- Explanation of how a detection of the above tested pathogens in a fish health screening would affect the final stocking of the Eels. ***Recommendation:* It would most likely be recommended**

that the fish being held be destroyed and holding facility properly disinfected in a manner that would prevent the spread of the detected fish pathogen. Stocking would more than likely be prohibited but could be authorized if the affected states were in general consensus that stocking diseased fish would be an acceptable risk.

Topic #3: Receiving water source information. Including:

- Status of fish pathogens and ANS in comparison to the donor water source (presence, absence, unknown). ***Recommendation:*** ***Comparison of the status of ANS and fish pathogens including but not limited to: Anguillicoloides crassus, Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Ceratomyxa Shasta, Spring Viremia of Carp virus, Proliferative Kidney Disease (Tetracapsuloides bryosalmonae), Whirling Disease (Myxobolus cerebralis), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus, Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Bacterial Kidney Disease (Renibacterium salmoninarum), Furunculosis (Aeromonas salmonicida), Enteric Redmouth Disease (Yersinia ruckeri).***

April 7, 2015

Bryan Apell
Kleinschmidt Associates
35 Pratt St, STE 201
Essex, CT 06426

Re: Importation and use of wild-acquired American eels for Connecticut River FERC studies

Dear Bryan,

The purpose of this letter is to identify the steps that the Division of Fisheries and Wildlife will require for importation of wild-acquired American eels into Massachusetts for use in the proposed hydropower relicensing studies on the Connecticut River in Massachusetts. Per the Division's regulations an importation and liberation permit is required for this project. The Division will issue both permits under a single letter permit once all the conditions as set forth in this letter are met.

The Division has a number concerns regarding fish pathogens and other potential aquatic invasive species (AIS) that could result from inter-basin transfer of wild-acquired American eel. The information requested in this letter as well as all conditions set forth in this letter must be satisfactorily met before the importation permit and liberation permits are issued.

Information on the donor water source

The Division is requesting that the applicant provide as much information as is available regarding fish pathogens and AIS from the donor watershed. Specifically, provide available information on the following:

- The water body name(s) and specific location(s) (HUC-10) where the eels will be collected.
- Available information on the presence, detection date(s), affected fish species, distribution, as well as any other information for the following fish pathogens in the donor basin (HUC-2) and donor sub-basin (HUC-4): Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Infectious Pancreatic Necrosis virus (IPNv), Largemouth Bass virus (LMBv), Infectious Salmon Anemia virus (ISAv), Koi Herpesvirus, *Ceratomyxa shasta*, Spring Viremia of Carp virus, Proliferative Kidney Disease (*Tetracapsuloides bryosalmonae*), Bacterial Kidney Disease (*Renibacterium salmoninarum*), Furunculosis (*Aeromonas salmonicida*), Enteric Redmouth Disease (*Yersinia ruckeri*), American eel swimbladder parasite (*Anguillicoloides crassus*) Whirling Disease (*Myxobolus cerebralis).*
- Provide available information on any fish kills which have resulted in the detection of a specific pathogen in the specific watershed (HUC-10). Include dates, pathogens, and species of fish that were affected.
- Status of AIS in the donor sub-basin (HUC-4) (presence, absence, unknown). Please list any AIS detected and detection date.

Division of Fisheries and Wildlife
Field Headquarters, One Rabbit Hill Road, Westborough, MA 01581 (508) 389-6300 Fax (508) 389-7890
An Agency of the Department of Fish and Game

Fish health testing and biosecurity protocols for eels that will be imported and liberated

The Division requires that the imported eels undergo fish health screening and stringent biosecurity protocols for maintenance of the eels after collection and prior to shipment to Massachusetts. A signed, fish health certificate is required. The following information must be submitted to the Division before the eels may be imported into Massachusetts:

- Number of eels that will be collected.
- Number of eels that will be imported into Massachusetts.
- Testing must be done for the following diseases by a fish health inspector and laboratory according to the protocols in the Fish Health Section of the American Fisheries Society Blue Book or the Manual of Diagnostic Tests for Aquatic Animals (OIE – World Organization for Animal Health): Infectious Hematopoietic Necrosis virus (IHNv), Viral Hemorrhagic Septicemia (VHS), Spring Viremia of Carp virus, Infectious Pancreatic Necrosis virus (IPNv), Furunculosis (*Aeromonas salmonicida*), Enteric Redmouth Disease (*Yersinia ruckeri*), American eel swimbladder nematode (*Anguillicoloides crassus*) (gross observation). Any bacteria of significance or cytopathic effect (CPE) producing agent shall be identified and reported. Sixty (60) individuals must be tested.
- The facility where the wild-caught eels are held and maintained until results of the fish health inspection and diagnostic tests are complete must meet the following conditions: 1) facility must be free of listed fish pathogens and completely biosecure, 2) facility must have a biosecurity plan in place (provide a copy of the biosecurity plan), 3) no other fish species may be held at the facility while the eels are kept there, 4) facility must have a disease-free well water supply; if the water is not well water only, provide a full description of how the water is sterilized and kept free of listed fish pathogens and AIS, 5) all holding tanks and equipment must be fully sterilized (or new), 6) no additional eels may be added to the population of eels being held in the facility once the fish health inspector inspects the fish and takes samples for the diagnostic tests, and 7) all equipment, water and ice used to package and transport the eels to Massachusetts must be pathogen/AIS free.
- Once the eels are imported into Massachusetts they must be housed at a facility that is licensed as a Class 3C aquaculture facility that meets the following conditions: 1) facility must be completely biosecure, 2) facility must have a written biosecurity plan -- provide a copy of the plan, 3) no other fish species may be held in the facility where the eels are housed unless complete, biosecure isolation is maintained following a plan that is approved by the Division prior to importing the eels, 4) facility must have a disease free well water supply; if the facility is not a well-water only facility, provide a full description of how the water is sterilized and kept free of listed fish pathogens and AIS, and 5) all holding tanks, equipment, must be fully sterilized (or new) prior to receiving the eels.
- Provide specific location information where the eels will be liberated in Massachusetts.

If you have any questions or concerns, please do not hesitate to contact me by phone at 508-389-6331 or by email at caleb.slater@state.ma.us.

Sincerely,

Caleb Slater, PhD
Anadromous Fish Biologist

Cc: Ken Simmons, DFW Chief of Hatcheries

New Hampshire
Fish and Game Department

HEADQUARTERS: 11 Hazen Drive, Concord, NH 03301-6500
(603) 271-3421
FAX (603) 271-5829

www.WildNH.com
e-mail: info@wildlife.nh.gov
TDD Access: Relay NH 1-800-735-2964

June 4, 2015

Steve Leach
Senior Biologist
Normandeau Associates, Inc.
917 Rte. 12, #1
Westmoreland, NH 03467

Re: Comments on "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015"
FERC Project Numbers: P-1904 (Vernon), P-1855 (Bellows Falls), and P-1892 (Wilder), NH.

Dear Mr. Leach,

We have reviewed the "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015" that you submitted to us on May 8, 2015. We appreciate the large amount of work put into the document and for the thorough and detailed response to concerns raised in our April 7, 2015 letter as well as the associated agency letters from Massachusetts and Vermont.

Before we can fully endorse the proposed plan, we need clarification or answers to the following:

Eel Sources and Quarantine Holding Facility

We agree with the report assessment that the best source of eels is Option 2 (Section 2.2). Holding the eels prior to fish health testing at North Atlantic Aquaponics Ltd. is acceptable pending answers to the following:

1. How will quarantine be provided and maintained at North Atlantic Aquaponics, Ltd? Provide independent verification that the facility is fully biosecure and is designed such that there will be no cross contamination between tanks including splash, aerosol, escaped eels, nets, cleaning brushes, etc.. Acceptable independent verification could be a government inspector, a certified fish health inspector or other such qualified, independent person/firm.
2. Will there be other fish species and/or lots of eels held at the facility at the same time? If so, please provide detailed information and independent verification of how quarantine will be maintained from these fish.
3. What is the source of water that will be used to hold the eels? If it is from an open source, how will it be sterilized before being put into use at the facility? Are the eel units independent flow through or recirculating?

Importation and Holding Fish in Massachusetts Prior Release

New Hampshire Fish and Game Department regulations require a permit to import, possess, and release wildlife in New Hampshire. The Department will issue Normandeau Associates a single letter permit for these activities for this project (Note: the importation permit is a state permit and not the federal importation permit). The following information will be required for development of this permit: a) location of the facility where the fish will be held prior to release and b) details on how the fish will be held, including water source, holding facility description, waste discharge information, other species of fish that will be held in the facility, facility biosecurity, etc.. Please be advised that the fish must shipped directly to the permitted holding facility from Newfoundland to New Hampshire or the fish health certifications could be invalidated.

Pathogen Testing

1. Virus testing. Eels may only be shipped following completion of appropriate virus testing following AFS Blue Book cell culture protocols (Fish Health Section Blue Book: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens).

If you have any questions or concerns, please do not hesitate to contact me by phone at 603-271-1744 or by email at jason.smith@wildlife.nh.gov. We look forward to reviewing your proposed modifications.

Sincerely,

Jason M Smith

Jason M Smith
Chief, Inland Fisheries Division
New Hampshire Fish & Game Department
11 Hazen Drive
Concord, NH 03301

Cc: John Ragonese, TransCanada (email)
Gabe Gries, New Hampshire Fish and Game Department (email)

VERMONT

Department of Fish and Wildlife
1 National Life Dr., Davis 2
Montpelier, VT 05620-3702
www.vtfishandwildlife.com

[phone] 802-828-1000
[fax] 802-828-1250

Agency of Natural Resources

June 4, 2015

Steve Leach
Normandeau Associates Inc.
917 Route 12
Westmoreland, NH 03467

RE: Comments on "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015"

Dear Mr. Leech:

We have reviewed the "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015" that you submitted via e-mail on May 11, 2015. Thank you for providing a very detailed response to concerns raised in our March 25, 2015 letter as well as the associated agency letters from New Hampshire and Massachusetts.

Before we can fully endorse the proposed plan, we need clarification or answers to the following:

Eel Sources and Quarantine Holding Facility

We agree with the report assessment that the best source of eels is Option 2 (Section 2.2). Holding the eels prior to fish health testing at North Atlantic Aquaponics Ltd. is acceptable pending answers to the following:

1. How will "Quarantine" be provided and maintained at North Atlantic Aquaponics Ltd? Please provide independent verification that the facility is fully bio-secure and is designed such that there will be no cross contamination between tanks including splash, aerosol, escaped eels, nets, cleaning brushes etc. Acceptable independent verification could be a government inspector, a certified fish health inspector or other such qualified, independent person/firm.

2. Will there be other fish species and/or lots of eels held at the facility at the same time? If so, please provide detailed information and independent verification of how quarantine will be maintained from these fish.

3. What is the source of water that will be used to hold the eels? If it is from an open source, how will it be sterilized before being put into use at the facility? Are the eel holding unit's independent flow through or recirculating?

Pathogen Testing

1. In section 4 of your plan, you inquired on the use of RT-PCR for viral testing. Eels may only be shipped following completion of appropriate virus testing following AFS Blue Book cell culture protocols (Fish Health Section Blue Book: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens).

Fish Holding Facility

1. Where will the eels be held in Vermont or will they be directly transported to the Connecticut River from another holding facility?

Accompanying this letter you will find our Fish Importation application. Please provide the following information in Section 7 of the application: a) location of the facility where the fish will be held prior to release and b) details on how the fish will be held, including water source, holding facility description, waste discharge information, other species of fish that will be held in the facility, facility biosecurity, etc.

Please be advised that the fish must shipped directly to the authorized holding facility from Newfoundland or the fish health certifications could be invalidated.

Thanks you for giving the Vermont Fish & Wildlife Department an opportunity to comment on this plan. If you have any additional questions, please do not hesitate to contact me at 802-793-6781 or tom.jones@state.vt.us

Tom

Tom Jones
Fish Health Biologist

Cc: (electronic only)
Adam Miller, Fish Culture Operations Manager
Eric Palmer, Fisheries Division Director
Rod Wentworth, Aquatic Habitat Specialist
Lael Will, District Fisheries Biologist

Vermont Fish & Wildlife Department

1 National Life Drive, Davis 2
Montpelier, VT 05620-3702, 802-241-3700
STATUTORY AUTHORITY: 10 V.S.A. §§4709, 5207-5209

VERMONT

Application for Permits for Importation, Possession & Temporary Exhibition, Propagation Commercial Collection and Commercial Sales of Fish & Wildlife

1. **Application Type** (check all that apply)
   ___ Wildlife Importation/ Possession/Temporary Exhibition ($100 application fee)
   ___ Fish Importation ($50 application fee)
   ___ Wildlife Commercial Collection ($100 application fee)
   ___ Propagation/Breeding-New ($50 fee)
   ___ Propagation/Breeding- Renewal ($10 annual fee) Previous Permit #_________
   ___ Commercial Dealer (no fee)

2. **Applicant Information**
   Name: ______________________________
   Business/Institution (if applicable): ______________________________
   Principal Officer (CEO) of Institution: ______________________________
   Physical Address/Town/St/Zip: ______________________________
   Mailing Address (if different): ______________________________
   Telephone: ____________________
   E-Mail: ____________________

3. **Commercial Dealers only**
   Dealer Type: _____Wholesale Sales _____Retail Sales _____Breeder/Propagator

   Place a check next to each wild and/or domestic animal type you sell or intend to sell:

   Unrestricted Wild Animals (unrestricted, restricted and prohibited species lists at
   Wildlife: www.vtfishandwildlife.com/importation_commercial.cfm
   Fish: www.leg.state.vt.us/statutes/fullsection.cfm?Title=10APPENDIX&Chapter=002&Section=00121

   ___ Amphibians ___ Mammals ___ Crustaceans
   ___ Birds ___ Reptiles ___ Mussels
   ___ Fish ___ Arachnids ___ Other Invertebrates

   Domestic Animals
   ___□Mammals (e.g., dogs, ferrets, livestock)
   ___□Birds (e.g., parrots, parakeets, lovebirds, fowl)

   If selling only domestic animals, a Fish & Wildlife Department Dealer's Permit is not required, however, a Pet Merchant license is still required from the Agency of Agriculture Food and Market's Division.

4. **Species to be Imported, Possessed, Collected or Propagated:** *For importation or possession provide Veterinary Health Inspection reports or Fish Health Inspection reports certifying the disease free-status of the fish or wildlife to be imported. Attach additional information if necessary.*

Common Name	Scientific Name	Age Class (indicate "Egg", "Immature", "Mature")	Number of Animals	Place of Origin	Consignor/Seller (Name, address, ph#, email)

5. **Reason/justification to import, exhibit, possess, collect and/or propagate each species in section 4.** *Attach additional information if necessary.*

Field expands to accommodate text

6. **Exhibitions/Educational Display** If you see a permit to exhibit or display wildlife, provide: a) date(s) of exhibition and specific locations; b) the names of everyone who will assist you in the exhibition and/or care for the wildlife listed in section 4; c) clearly explain the program(s) you intend to present; and, e) the procedures you will employ to ensure public safety.

Field expands to accommodate text

7. **Propagation/Breeding Only: Describe the premises where each of the species listed above will be propagated**: In the field below provide full physical address, and describe the propagation facility and bounds including approximate acreage. Fish propagators indicate any use of public waters or discharge to public waters. Attach additional information if necessary.

   Is the Applicant is the owner or lessee of the lands or waters used for propagation? **(Circle)** If lessee, provide the owner's name and full contact information in the field below.

Field expands to accommodate text

8. **Required Attachments**

   ___ **Permit application fee** (if applicable) make checks payable to "Vermont Fish & Wildlife Department."

   ___ **Fish or Wildlife Propagation Permits**: Attach map of propagation/breeding facility.

   ___ **Fish Propagation Permit Renewals**: An Annual Accounting Report of all fish lots and/or eggs purchased or obtained since the submission of the previous application, source, number, species and size of fish and/or eggs. Renewals shall be submitted to the Vermont Fish & Wildlife Department at least 30-days prior to the anniversary of the initial issuance.

   ___ **Importation/Possession Permits**: attach Veterinary Health Inspection reports or Fish Health Inspection reports certifying the disease free-status of the fish or wildlife to be imported.

   ___ **Commercial Dealer Permits**: attach a copy of your Pet Merchant License issued by the Vermont Agency of Agriculture.

9. Certification by Signature

I hereby affirm, under penalty of perjury, that the information, as well as any exhibits, documentations, and maps, are truthful to the best of my knowledge, that I am not delinquent in any obligation to pay child support or that I am in good standing with respect to any unpaid judgment issued by the judicial bureau or district court for fines and penalties for a civil violation or criminal offense. I also understand that false statements made on this application are punishable pursuant to 10 V.S.A. §4267 of Vermont state law.

Signature: ______________________________ **Date:** ____________

Submit completed application via email (preferred) to jon.kart@state.vt.us or mail to "Permit Specialist" c/o VFWD at the address at the top of this form. Make application fee checks payable to "Vermont Fish & Wildlife Department"

Allow up to 30 days following a determination that the application is complete for processing.

Permits requested through this application form are issued under the following authority of 10 V.S.A. to protect the health, safety and welfare of animals, both domestic and wild and the safety and welfare of human inhabitants of the state of Vermont and to guard the health of Vermont's fish populations and prevent the introduction of fish and fish diseases that could have the potential to cause harm to fish populations in the waters of the state. Specific statues and regulations are as follows.

Commercial Sales (Dealer)-Fish: 10 V.S.A. § 4081(b) and 10 V.S.A App. § 122
Commercial Sales (Dealer)-Wildlife: 10 V.S.A. § 4709

Commercial Collection-Wildlife: 10 V.S.A. § 4709 and 10 V.S.A. App. § 18

Importation-Fish: 10 V.S.A. § 4605 and 10 V.S.A. App. § 139
Importation-Wildlife: 10 V.S.A. § 4709 and 10 V.S.A. App. § 18 and 10 V.S.A. App. § 19

Possession-Fish: 10 V.S.A. § 4605 and 10 V.S.A. App. § 121
Possession-Wildlife: 10 V.S.A. § 4709 and 10 V.S.A. App. § 18

Propagation (breeding)-Wildlife: 10 V.S.A. § 5207
Propagation (breeding)-Fish: 10 V.S.A. Chapter 119, §§ 5207-5209

Temporary Exhibition-Fish: 10 V.S.A. § 4605
Temporary Exhibition of Wildlife: 10 V.S.A. § 4709 and 10 V.S.A. App. § 18

NORMANDEAU ASSOCIATES
Environmental Consultants

July 16, 2015

VIA E-MAIL

Mr. Jason M. Smith
Chief, Inland Fisheries Division
New Hampshire Fish & Game Department
11 Hazen Drive
Concord, NH 03301

Re: Response New Hampshire Fish and Game's Comments on "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015"

Dear Mr. Smith:

We have received and reviewed your letter in response to the Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015 (Importation Plan), dated June 6, 2015. Thank you for your response and comments on the Importation Plan. The following information is provided to satisfy the need for additional information as required by the New Hampshire Fish & Game Department to endorse Option 2 of the Importation Plan in which adult American Eels (*Anguilla rostrata*) would be imported into the States of New Hampshire or Vermont from Newfoundland, Canada for use in studies being conducted on the Connecticut River in support of the Wilder (FERC No. 1892), Bellows Falls (FERC No.1855) and Vernon (FERC No.1904) Hydroelectric Projects relicensing efforts.

Eel Sources and Quarantine Holding Facility

Question 1:
How will quarantine be provided and maintained at North Atlantic Aquaponics Ltd? Provide independent verification that this facility is fully biosecure and is designed such that there will be no cross contamination between tanks including splash, aerosol, escaped eels, nets, cleaning brushes and all other fomites. Acceptable independent verification could be a government inspector, a certified fish health inspector or other such qualified, independent person/firm.

Response 1:
As silver eels are collected, they will be accumulated in independent holding tanks at the biosecure facility in Robinson, Newfoundland. Separate holding tanks will be used for different rivers. Once a sample of eels is submitted to the Atlantic Veterinary College - University of Prince Edward Island (AVC), the tank is then quarantined and no further fish can be added to this tank pending the health assessment results. The tank will be clearly marked as being quarantined. All efforts are made to prevent cross contamination between tanks. Separation distances between tanks, water levels in each tank, and tank designs all prevent cross contamination by escape, splash, and aerosol. All nets, brushes, and other equipment are disinfected before and between uses. Once a sample has been

submitted to AVC for health assessment, dedicated, disinfected nets and brushes will be used for that specific tank pending test results.

Independent verification that North Atlantic Aquaponics Ltd's holding facility is biosecure comes from North Atlantic Aquaponics Ltd's Quality Management Plan (2014) and Export Certification Control Program (2014). The facility is also inspected regularly for biosecurity by the Canadian Food Inspection Agency (CFIA) since the eels being held are for human consumption. A copy of this inspection could be provided upon request. Also, Ron Threader, a senior scientist with Kleinschmidt Associates - Canada, who has been working on American Eel health for over 10 years, will visit the holding facility to: (1) ensure compliance with biosecurity; (2) select the eels to be sampled for health diagnostics at AVC and assist in this process as required; and (3) assist in ensuring complete tank quarantine post-submission to AVC for health diagnostics. A report will be prepared documenting all procedures.

Question 2:
Will there be other fish species and/or lots of eels held at the facility at the same time? If so, please provide detailed information and independent verification of how quarantine will be maintained from these fish.

Response 2:
There will be no other species of fish held at this facility during the collection and health diagnostic testing period. There will be other American Eels collected and held in this facility during both the collection and the diagnostic testing periods (i.e., three weeks). However, given the study needs, it is anticipated that the first 1,120 silver eels caught will go to the Connecticut River Basin (CRB) studies and they will be quarantined from all other eels that subsequently arrive (see 1. above). The tanks used for CRB eels will be disinfected prior to use. Again, separate tanks will be used for different source rivers (i.e., a separate lot for diagnostic sampling) and once CRB samples have been submitted to AVC, the tank will be quarantined, labeled, and no other fish can be added or removed pending laboratory results.

Question 3:
What is the source of water that will be used to hold the eels? If it is from an open source, how will it be sterilized before being put into use at the facility? Are the eel units independent flow through or recirculating?

Response 3:
The water source is from an artesian well and contains no know pathogens. The water is also tested annually by the CFIA. Water supplied to each tank is from an independent flow through design to further avoid cross contamination between tanks.

Importation and Holding Fish in New Hampshire Prior Release

Normandeau understands that NHFG regulations require a permit to import, hold and liberate freshwater fish in New Hampshire. The following information is provided for development of that permit which you indicated in your June 4, 2015 response would be in the form of a letter permit.

a. *The location of the facility where the fish will be held prior to release.*

Holding tanks with circulating Connecticut River water will be installed at the Wilder, Bellows Falls, and Vernon Hydroelectric Projects in secure locations inside of the project fences. The primary holding facility will be on the Vermont side of Vernon Dam in the vicinity of the upstream terminus of the fish ladder. Holding facilities at the Bellows Falls and Wilder Projects will be installed for holding during experimental periods in the vicinity of the fish ladders.

b. *Details on how the fish will be held, including water source, holding facility description, waste discharge information, other species of fish that will be held in the facility, facility biosecurity, etc.*

The primary holding facility at Vernon Dam will consist of multiple tanks that will be disinfected prior to use. The tanks will be shaded with overhead canopies or tarps and securely covered to prevent escapement. A once-through circulating flow of Connecticut River water will be provided by multiple continuous duty submersible pumps powered by two independent electrical circuits, and flow manifolds so that each tank has continuously circulating river water supplied by more than one pump. The flow manifolds will be fitted with multiple discharge valves such that inflow to each tank can be equalized. This method will ensure continuous flow to all tanks in the event of a pump failure or electrical circuit trip. The tank water will be drained back to the river via a standpipe, which will also regulate the water surface level in the tanks. Secondary holding facilities will be installed similarly at Bellows Falls and Wilder Dams for project specific experiments.

No other fish species will be held in tanks holding eels, however, Juvenile American Shad will be held at the Vernon Project in independent tanks for purposes of conducting the TransCanada's relicensing study # 22 – Downstream Migration of Juvenile American Shad at Vernon during the same timeframe as the eel studies. Juvenile shad will be obtained from the Connecticut River or from the USFWS' North Attleboro National Fish Hatchery, produced from Connecticut River spawning stock.

We understand that the NHFG requires that the eels be delivered directly from Newfoundland to New Hampshire or the fish health certifications could be invalidated[1]. Given the rules and regulations for importation of live American Eels in to the United States the eels must be delivered to an international airport. The eels will be shipped via air directly from Newfoundland to Logan International Airport in Boston. Normandeau or Kleinschmidt Associates will take possession there, and will transport them in their original shipping containers by truck directly to the holding facility.

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[1] Note that the holding facilities will technically be located on the Vermont side of the projects, but eel releases will be made to New Hampshire waters.

If you have any questions or require additional information, please feel free to contact me at 603-757-4004 or sleach@normandeau.com.

Sincerely,

Steve D. Leach

Steve Leach
Senior Biologist

cc: Gabe Gries, New Hampshire Fish and Game Department (email)
John Ragonese, Jennifer Griffin, TransCanada (email)

NORMANDEAU ASSOCIATES
Environmental Consultants

July 17, 2015

VIA E-MAIL

Mr. Tom Jones
Fish Health Biologist
Vermont Agency of Natural Resources
Fish & Wildlife Department
1 National Life Drive, Davis 2
Montpelier, VT 05620-3702

Re: Response New Hampshire Fish and Game's Comments on "Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015"

Dear Mr. Jones:

We have received and reviewed your letter in response to the Plan for Importation of Adult American Eels to the Connecticut River Basin in 2015 (Importation Plan), dated June 6, 2015. Thank you for your response and comments on the Importation Plan. The following information is provided to satisfy the need for additional information as required by the Vermont Department of Fish and Wildlife to endorse Option 2 of the Importation Plan in which adult American Eels (*Anguilla rostrata*) would be imported into the States of New Hampshire and Vermont from Newfoundland, Canada for use in studies being conducted on the Connecticut River in support of the Wilder (FERC No. 1892), Bellows Falls (FERC No.1855) and Vernon (FERC No.1904) Hydroelectric Projects relicensing efforts.

Eel Sources and Quarantine Holding Facility

Question 1:
How will quarantine be provided and maintained at North Atlantic Aquaponics Ltd? Provide independent verification that this facility is fully biosecure and is designed such that there will be no cross contamination between tanks including splash, aerosol, escaped eels, nets, cleaning brushes and all other fomites. Acceptable independent verification could be a government inspector, a certified fish health inspector or other such qualified, independent person/firm.

Response 1:
As silver eels are collected, they will be accumulated in independent holding tanks at the biosecure facility in Robinson, Newfoundland. Separate holding tanks will be used for different rivers. Once a sample of eels is submitted to the Atlantic Veterinary College - University of Prince Edward Island (AVC), the tank is then quarantined and no further fish can be added to this tank pending the health assessment results. The tank will be clearly marked as being quarantined. All efforts are made to prevent cross contamination between tanks. Separation distances between tanks, water levels in each

tank, and tank designs all prevent cross contamination by escape, splash, and aerosol. All nets, brushes, and other equipment are disinfected before and between uses. Once a sample has been submitted to AVC for health assessment, dedicated, disinfected nets and brushes will be used for that specific tank pending test results.

Independent verification that North Atlantic Aquaponics Ltd's holding facility is biosecure comes from North Atlantic Aquaponics Ltd's Quality Management Plan (2014) and Export Certification Control Program (2014). The facility is also inspected regularly for biosecurity by the Canadian Food Inspection Agency (CFIA) since the eels being held are for human consumption. A copy of this inspection could be provided upon request. Also, Ron Threader, a senior scientist with Kleinschmidt Associates - Canada, who has been working on American Eel health for over 10 years, will visit the holding facility to: (1) ensure compliance with biosecurity; (2) select the eels to be sampled for health diagnostics at AVC and assist in this process as required; and (3) assist in ensuring complete tank quarantine post-submission to AVC for health diagnostics. A report will be prepared documenting all procedures.

Question 2:
Will there be other fish species and/or lots of eels held at the facility at the same time? If so, please provide detailed information and independent verification of how quarantine will be maintained from these fish.

Response 2:
There will be no other species of fish held at this facility during the collection and health diagnostic testing period. There will be other American Eels collected and held in this facility during both the collection and the diagnostic testing periods (i.e., three weeks). However, given the study needs, it is anticipated that the first 1,120 silver eels caught will go to the Connecticut River Basin (CRB) studies and they will be quarantined from all other eels that subsequently arrive (see 1. above). The tanks used for CRB eels will be disinfected prior to use. Again, separate tanks will be used for different source rivers (i.e., a separate lot for diagnostic sampling) and once CRB samples have been submitted to AVC, the tank will be quarantined, labeled, and no other fish can be added or removed pending laboratory results.

Question 3:
What is the source of water that will be used to hold the eels? If it is from an open source, how will it be sterilized before being put into use at the facility? Are the eel units independent flow through or recirculating?

Response 3:
The water source is from an artesian well and contains no know pathogens. The water is also tested annually by the CFIA. Water supplied to each tank is from an independent flow through design to further avoid cross contamination between tanks.

Pathogen Testing

Question 1:
In section 4 of your plan, you inquired on the use of RT-PCR for viral testing. Eels may only be shipped following completion of appropriate virus testing following AFS Blue Book cell culture protocols (Fish Health Section Blue Book: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens).

Response 1:
Virus testing will be conducted following AFS Blue Book cell culture protocols rather than the Reverse Transcription (RT) PCR method proposed in the Importation Plan.

Fish Holding Facility

Question 1:
Where will the eels be held in Vermont or will they be directly transported to the Connecticut River from another holding facility?

Response 1:

Eels will be held in Vermont. Holding tanks with circulating Connecticut River water will be installed at the Wilder, Bellows Falls, and Vernon Hydroelectric Projects in secure locations inside of the project fences. The primary holding facility will be on the Vermont side of Vernon Dam in the vicinity of the upstream terminus of the fish ladder. Holding facilities at the Bellows Falls and Wilder Projects will be installed for holding during experimental periods in the vicinity of the fish ladders. The primary holding facility at Vernon Dam will consist of multiple tanks that will be disinfected prior to use. The tanks will be shaded with overhead canopies or tarps and securely covered to prevent escapement. A once-through circulating flow of Connecticut River water will be provided by multiple continuous duty submersible pumps powered by two independent electrical circuits, and flow manifolds so that each tank has continuously circulating river water supplied by more than one pump. The flow manifolds will be fitted with multiple discharge valves such that inflow to each tank can be equalized. This method will ensure continuous flow to all tanks in the event of a pump failure or electrical circuit trip. The tank water will be drained back to the river via a standpipe, which will also regulate the water surface level in the tanks. Secondary holding facilities will be installed similarly at Bellows Falls and Wilder Dams for project specific experiments.

Normandeau understands that VTDFW regulations require a permit to import fish into Vermont; our Fish Importation Application is attached.

Additionally, we understand that the VTDFW requires that the eels be delivered directly from Newfoundland to an authorized holding facility or the fish health certifications could be invalidated. Given the rules and regulations for importation of live American Eels in to the United States the eels must be delivered to an international airport. The eels will be shipped via air directly from Newfoundland to Logan International Airport in Boston. Normandeau or Kleinschmidt Associates will take possession there, and will transport them in their original shipping containers by truck directly to the holding facility.

If you have any questions or require additional information, please feel free to contact me at 603-757-4004 or sleach@normandeau.com.

Sincerely,

Steve Leach
Senior Biologist

cc: (by email)
Adam Miller, Fish Culture Operations Manager, VFWD
Eric Palmer, Fisheries Division Director, VFWD
Rod Wentworth, Aquatic Habitat Specialist, VFWD
Lael Will, District Fisheries Biologist, VFWD
Jon Kart, Permit Specialist, VFWD
John Ragonese, TransCanada
Jennifer Griffin, TransCanada

Attachment: Application for Permits for Importation, Possession & Temporary Exhibition, Propagation, Commercial Collection, and Commercial Sales of Fish & Wildlife

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

REF: Eel Importation for Connecticut River Hydro Studies July 24, 2015

Mr. Brian Guzek
U.S. Fish and Wildlife Service
Division of Law Enforcement
70 Everett Ave., Suite 315
Chelsea, MA 02150

Dear Mr. Guzek:

We would like to provide clarification regarding our letter, dated July 16, 2015, that addressed a proposal to import adult American eel from Newfoundland, Canada for use in hydropower licensing studies to be conducted by First Light Power Resources (First Light) and TransCanada Hydro Northeast (TransCanada).

In that letter, we identified Kleinschmidt Associates as the agent for the two power companies with regard to eel importation. However, Kleinschmidt Associates is only the contractor for First Light, while Normandeau Associates of Bedford, New Hampshire is the contractor for TransCanada. Both firms will be involved in securing the eels for the studies upon importation.

As such, we want to clarify that we are supportive of eel importation for studies by both power companies and for the handling of eels upon importation by both Kleinschmidt Associates and Normandeau Associates.

If you have any questions regarding these comments, please contact John Warner of this office at 603-223-2541, extension 6420.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

cc: FERC
Normandeau Associates – Steve Leach, via email
John Ragonese – TransCanada, via email
NHFGD/Concord - Matt Carpenter, via email
NHFGD/Keene – Gabe Gries
NHDES – Owen David, via email
VDFW/Springfield - Lael Will, via email
VANR – Jeff Crocker, via email
NMFS – Bill McDavitt
USGS-Conte – Alex Haro
CRWC – David Deen, via email
FWS/CT River - Ken Sprankle, via email
FWS - Melissa Grader, via email
Reading file

ES: JWarner:7/24/15:603-223-2541