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May 15, 2017

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

RE: Wilder, Bellows Falls, and Vernon Hydroelectric Projects (FERC Nos. 1892-026, 1855-045, & 1904-073)
Comments on revised study reports and supplemental information

Dear Ms. Bose:

The Vermont Agency of Natural Resources (Agency) herein provides comments on the revised study reports filed by TransCanada Hydro Northeast, Inc. (TransCanada; now Great River Hydro, LLC) for Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) hydroelectric projects.

TransCanada filed an revised study reports with the Federal Energy Regulatory Commission (FERC) for the lower Connecticut River hydroelectric projects between November 30, 2016 and March 15, 2017. TransCanada held a study report meeting on March 30, 2017. After reviewing the revised study reports and participating in the meeting, the Agency offers the following comments on the revised study reports.

Comments on Study Reports

Study 6: Water Quality

General Comment

Comment: The stated goal of the water quality study as described in the Revised Study Plan is "to determine potential project effects on water quality parameters". The final study report describes a similar goal, "to determine potential effects of Wilder, Bellows Falls, and Vernon operations on water quality parameters of water temperature, dissolved oxygen (DO), conductivity, turbidity, pH, nutrients, and chlorophyll-a" and includes a specific objective to "determine potential impacts of project operations on water quality and temperature"

The final report provides a comprehensive characterization of water quality parameters in the Connecticut River, including their temporal and spatial variation, however the report lacks a robust analysis of the potential effects of operations on these parameters, consistent with the FERC approved study plan. Analysis of the potential effect of operations on water quality parameters appears limited to graphical representations of one week of data for each parameter at one station in each reach. While these graphs are useful in illustrating the general response of water quality parameters to operations, it is not a robust analysis that characterizes the range of responses of water quality parameters to operations. Without such an analysis, the value of the report to inform future operational decisions will be limited.

Section Specific Comments

6.0 –Assessment of Project Effects

The report states, "In addition, the assessment of project effects examined how water quality varied temporally in response to varying flows at the project tailraces due to varying generation levels."

Comment: While the Agency acknowledges the study examined how water quality varied temporally, please describe how the responses to varying flows and generation levels were examined.

The report states, "Over the duration of the study, any effect of generation levels on water temperature was generally indistinguishable from the daily water temperature fluctuations (e.g., Figure L-7 in Appendix L and Figure F-12 in Appendix F). However, during the high temperature low-flow monitoring period, water temperatures in the tailraces generally increased very slightly during higher generation flows. When only minimum flows were being passed, water temperatures in the tailraces decreased very slightly (Figure 6.0-1)."

Comment: In comparing any effect of generation levels on water temperature and daily water temperature fluctuations, please describe how each component was quantified. Please quantify increases/decreases in water temperature observed over the tailrace and describe how the changes were calculated.

Study 9: Instream Flow

General Comment

Comment: The Vermont water quality standards seek to provide high quality aquatic habitat necessary to support healthy aquatic communities and other designated uses. Specifically, the Standards list the Connecticut River as Class B waters and shall be managed to achieve and maintain high quality aquatic habitat to protect and maintain all expected functional groups and support of all life-cycle functions of aquatic biota and wildlife, including overwintering and reproductive requirements. Currently, the Connecticut River from the upper extent of the Wilder impoundment to 5.5 miles below the Vernon dam is listed on the Agency's List of Priority Waters Outside the Scope of Clean Water Act Section 303(d) as being altered for streamflow which results in the waters not fully supporting the aquatic biota and habitat.

By the request of the Agency, the applicant held a conference call with the aquatic working group to discuss the instream flow study report on April 14, 2017. During the conference call the resource agency requested the data for each transect be made available to conduct further analysis and to inform the Agency comments. Additionally, the resource agencies requested the habitat time series be further broken down to evaluate habitat during a particular season or life stage. The applicant has indicated they will provide this information to the Agency, and we will supplement our commenta, as needed once we have received this data and had time to conduct our analysis.

Section Specific Comments

Section 4.10 Critical Reach Evaluation section states, "The concept of a critical reach (CR) is that certain habitat types or features are important to some or all target species and life stages being evaluated through the instream flow study. A critical reach does not necessarily need to comprise groups of closely spaced transects or specific study sites, and may involve single transects widely spread out within a given reach." The section goes on further to state, "In order not to diminish or increase the effect of any one transect or habitat type, particularly riffles which are rare, all transects were weighted equally for the CR analysis. The only exceptions are small side channels associated with Hart Island in Wilder reach 3, and at the top of the Vernon reach. Transects in these two channels were weighted based on proportions of length and area they represented relative to the reach."

Comment: For this portion of the analysis, the aquatic work group requested that all riffles transects, diverse habitats associated with islands, mid-channel bars, and point bars, and transects that encompass identified Sea Lamprey spawning areas or potential lamprey spawning areas be included. The initial proposed approach from that applicant was to use a representative reach approach were transects are weighted in accordance with the relative abundance of each mesohabitat (i.e. pool, riffle, run, etc.) type so as to represent the entire river reach. However, the Agency does not agree with combining data from riffles, pools and runs in a representative reach approach. Doing so does not show the true effects on riffles as they are essentially averaged in with the other types. Riffle areas are the most sensitive to flow changes and are also critical to the

river's ecological functions. A flow regime that is adequate for riffle areas is likely to satisfy the needs for food production, fish passage, spawning and rearing. Other habitat types (runs, pools) will also be protected since they are less sensitive to flow changes. The Agency considers riffles, and other habitat areas identified above to be critical habitat which should be studied using a "critical reach" approach. Ultimately, a flow regime that provides high quality habitat conditions in riffles must be provided. Additionally, the Agency request for using the critical reach approach is that each transect representing one of the above habitats be analyzed separately without any weighting being applied, equal or otherwise. The analysis presented in Section 5.2 of the report groups the transect to represent the critical reach for each of the projects.

Request: The Agency request that all individual 1D transects that represent the identified criteria to be consider a critical reach be analyzed and present separately.

Section 5.4 Habitat Modeling section of report presents the AWS for the 1D modelling for the reaches at Wilder, Bellows Falls and Vernon. These results are also presented in Appendix D.

Comment: The report does not make it clear whether this analysis treats the transects as weighted or unweighted. For all instances in which transect data is pooled results both weighted and unweighted should be presented and clearly defined.

Section 5.7 Dwarf Wedgemussels and Co-Occurring Mussels states, "Both DWM and co-occurring mussels display relatively flat habitat versus flow relationships for the Johnston Island 2D site, indicating little effect on habitat with changes in flow."

Comment: The Agency notes that the relationship between dwarf wedgemussel and co-occurring mussels is likely flat because the life stage, adult mussel, is not a flow sensitive life stage, so will not provide much information in terms of determining a flow regime to provide high quality habitat. The Agency provides further comment and suggest an approach in its comments to Study 24.

Study 17: Upstream Passage of Riverine Fish Species

General Comments

Comment: The attraction water system for the Vernon fish ladder was not operating at night during the 2015 fish ladder assessment, but was operational when the fish ladder was open in 2016.

Request: The Agency request that data from 2015 and 2016 be compared to determine whether there is a difference in passage rates during the night hours, especially considering some species, such as walleye, typically make their spawning migrations at night.

Comment: The report currently present cumulative data plots verse time for each species passed at the three projects.

Request: The Agency request that for the cumulative data plots verse time for all species combined, resident fish species, and diadromous fish species for each project.

Section specific comments

Section 4.4.2 Comparison of Normal Operating Season to Extended Season – Vernon states, "The first net passage in 2016 occurred on April 17 for Walleye and on April 16 for White Sucker, and 100% net passage occurred on May 17 and May 23, respectively. Overall, more net passage was recorded for both species during the shorter 2015 period from May 5 through May 31, 2016 than during the longer period from April 15 through May 31, 2016 which suggests that earlier fish ladder opening for these species in spring is not warranted."

Comment: The review of the 2016 salmonsoft data was requested by the Agency to supplement the 2015 data because the fish ladder was not open till May 5, and likely missed the early walleye and white sucker runs. Both in 2015 and 2016 walleye and white suckers were observed in the fishway upon opening the fish ladder. These results suggest that given the opportunity walleye and white sucker will utilize the fish ladder for spawning migrations. Additionally, the observation of these species in the fish ladder almost immediately upon opening of the ladder bring into question whether spawning migration are being delayed as a result of the fish operations schedule, but further analysis of the environmental conditions is needed. Further, the

statement that "earlier fish ladder opening for these species in spring is not warranted", seems to be concluded without consideration of annual variability of the streamflow and other environmental conditions. The Agency believes the bar for fish passage is providing timely fish passage. Therefore, when environmental and streamflow condition cue fish to move they should be given the opportunity. Furthermore, it should be noted that the current CRASC Fish Passage Operations Schedule typically requires the Vernon fish ladder open by April 15.

Study 18: American Eel Upstream Passage - Supplement

Section specific comments

Section 4.1 Systematic Survey shows a figure that indicates where the nighttime visual surveys were conducted in 2016 at the below Vernon dam, and whether eels were observed at the location or not.

Comment: The Agency would find it helpful if the location of the temporary eel pass was included in this figure to discern where the eel pass was relative to the eel survey observations.

Study 19: American Eel Downstream Passage

Section specific comments

The Executive Summary section on Route Selection and Residency for Vernon states, "Ten eels that passed via the turbine units had tailrace residency times between 2 and 49 days but were detected at Stebbins Island following that period."

Comment: Due to the long residency time of these individual in the Vernon tailrace, there is a strong likelihood that these individuals were sustained serious injuries or were mortalities and drifted downstream to Stebbins Island given the close proximity (1.2 km) to Vernon dam.

The Executive Summary section on Turbine Survival states, "The results of this survival study show that eels fare better passing through the tested Francis turbines compared with the tested Kaplan (propeller type) turbines. As such, eels passing the Francis units at Bellows Falls and the larger Francis units (Units 9 and 10) at Vernon should provide safe passage to most eels. The smaller Francis units (Units 1-4) at Vernon should also provide relatively high survival but would inflict some bruising. Lower passage survival is expected for eels passing the Wilder project and the Kaplan units at Vernon (units 5-8); of the two discharge rates tested at the Vernon Kaplan units, the lower showed greater survival."

Comment: Although the survival study showed eels survival was higher through Francis turbines compared to Kaplan turbines. The Agency notes that mortality appeared to be lower for eels that did not pass through the units. Additionally, the Agency does not believe that units are an acceptable means to providing safe, effective, and timely eel passage, especially considering the cumulative impacts to eels including stress and injury, associated with passing multiple projects.

Section 4.3.6 Assessment of Injuries includes a table (4.3.6-1) which provides guidelines for major and minor injury classifications for fish passage survival studies using the HI-Z Tags. The table states that a fish with only Loss of Equilibrium (LOE) is classified as major if the fish dies within 1 hour. If it survives or dies beyond 1 hour it is classified as minor.

Comment: The guidelines for major and minor injury classification in Table 4.3.6-1 underrepresent major injuries resulting in death. The Agency request that all classifications be changed such that if a fish dies within 48-hours holding period it is classified as a major injury.

Section 5.1.1 Wilder Downstream Movement and Timing, the section on *Tailrace Residency Duration* states, "The minimum, maximum, median, and mean tailrace residency duration for eels documented as passing downstream are provided in Table 5.1.1-6. There were no statistically significant differences detected among the mean tailrace residency times between downstream routes (Kruskal Wallis test; $\chi 2 = 6.1987$; df = 3; p = 0.1023)."

Comment: While there were no statistically significant differences (at the 0.05 P value) detected among the mean tailrace residency times between downstream routes at the Wilder project, mean residency time was much greater for unit 3 (65 hours) compared to 18 and 7 hours for the units 1-2 and trash/ice sluice. These results support the findings from the survival portion of the study that the current configuration of unit 3, with the majority of the flow directed into the fish ladder, has the potential to result in injury to eels. However, the degree of injury could not be ascertained because individuals could not be recaptured.

Section 5.1.3 Vernon present presents results in the section titled Release and Passage Route Selection. This section has a series of tables (5.1.3-1 – 5.1.3-10) summarizing the passage results and routes through the projects.

Comment: The report should clarify at what point (residency time) an eel was considered dead and or is no longer exhibiting migratory behavior. For example, a fish that has a residency time for 49 days but was detected at Stebbins Island is likely dead. Fish that are determined to be dead should be eliminated from summaries (e.g. Table 5.1.3-10.). Not only does this reduce the variability but it better illustrates the migratory behaviors of these fish once they encounter and pass a project.

Appendix E provides maps of eel movement through each of the projects.

Comment: The Agency notes that although the majority of the eels passed the projects in less than 24 hours most of them exhibited wandering or searching behavior.

Study 24: Dwarf Wedgemussel and Co-occurring Mussel

General Comments

Comment: The Vermont water quality standards seek to provide high quality aquatic habitat necessary to support healthy aquatic communities and other designated uses. Specifically, the Standards list the Connecticut River as Class B waters and shall be managed to achieve and maintain high quality aquatic habitat to protect and maintain all expected functional groups and support of all life-cycle functions of aquatic biota and wildlife, including overwintering and reproductive requirements. Currently, the Connecticut River from the upper extent of the Wilder impoundment to 5.5 miles below the Vernon dam is listed on the Agency's List of Priority Waters Outside the Scope of Clean Water Act Section 303(d) as being altered for streamflow which results in the waters not fully supporting the aquatic biota and habitat.

The goal and objective of this study was to assess the influence of the flow regime and water level fluctuations on dwarf wedge mussels, co-occurring mussels, and mussel habitat. This particular report addressed the development of habitat suitability criteria co-occurring mussel species. The study relies the relative abundance of Eastern Ellipto within the project area, and using these populations to account for local characteristics of aquatic habitat and environmental conditions. While the assumption and approach relied on for the development the habitat suitability criteria for the adult mussels appear to be reasonable, the criteria developed tend to reflect a stationary aquatic organism that has adapted to a range of flows that would be experienced in a system with a natural flow regime. Furthermore, the Connecticut River is a regulated river with frequent fluctuations in flow that result in changes in velocity and depth, two components of the habitat suitability criteria. Therefore, the Agency does not believe that this life-stage, adult mussels, habitat suitability criteria alone provide much information for the Agency to determining a flow regime that will meet Vermont water quality standards.

However, for most fish species of interest in instream flow studies, habitat suitability criteria for different life-stages have been developed, including reproduction or juvenile life-stage. Freshwater mussel reproduction is a relatively complex cycle with males releasing sperm into the water towards the females, the eggs developing in the female till the larvae or glochida are ready to be release and attach to a host fish species to metamorphoses, before dropping off the fish as juvenile mussel on to the river substrate. Although the complexity and different stages of the reproduction cycle may not lend themselves to the development of the habitat suitability criteria, it is reasonable to assume that there are certain streamflow conditions (depth and velocity) that increase the probability of successful reproduction, especially during the stage when male are releasing sperm and the females are releasing the glochida in the water column. While the former, the release of sperm by males into the water column, may be difficult to determine

streamflow conditions or criteria that potentially increase success at this stage, and not lend itself to traditional development of criteria. The streamflow conditions that potentially increase the success of the females release glochida to attach to host fish species could be investigated further using the data collected as part of this study and instream flow study (Study 9). The assumption being since the location of the mussels are known, time of year the release occurs, the host fish species for the species of mussels have been identified and are included in the instream flow study, an analysis could evaluate whether high quality habitat is present near mussel beds during this critical time period. For example, this approach could be used to evaluate tessellated darter habitat in relation to the dwarf wedge mussels when the release of glochida occurs. The Agency suggest that this approach may help inform decision about the flow regime needed below each of the project to help protect mussel populations.

Study 25: Dragonfly and Damselfly Inventory

General Comments

Comment: Overall, the goals of this study were to inventory the odonate assemblages dependent on large rivers in the project-affected areas, including life history, ecology, and behavior information for each species; and assess the potential influence of project operations on river-dependent odonate larval emergence/eclosion and habitat. The Agency believes that some of the assumptions incorporated into the analysis result in an underestimation of the project effects on odonate species. First, the report appears to not differentiate between odonate species and their habitat preference. That is neither the report nor the analysis distinguish between species that prefer lotic habitat of the riverine section versus those species that are generalist or select the semi-lotic habitat of the impounded reaches. The importance of making this distinction is that project operations effect the impoundment sections of the river differently than the riverine sections. In general, riverine sites had lower abundance of odonates than the impounded sites. The completion of this type of analysis would allow the resource agencies to determine whether project operations are having a disproportional effect on odonate using riverine sections versus the impounded reaches. The Agency acknowledges that given the limited observations of eclosion of different species that this is difficult. However, without this distinction and analysis we cannot conclude that project operations are not having a significant effect on odonates species, especially in the riverine reaches of the project effected area.

Second, the assumptions used as part of the usable habitat elevations and the approach to the analysis evaluates water level rise potentially results in an underestimate of projects effects. While the report identifies two potential effects of project operations, the first being inundation of usable habitat, define as steep bank. The report also indicates that no consistent trend was found in substrate or habitat preference based on observed odonates or abundance. Acknowledging that there may be differences in species habitat / substrate preference for emergence it would be more informative to provide information on the proportion of habitat types available below the low habitat elevation being used identified in the report, especially for the riverine habitat where there is between 1.5 – 4 feet of substrate that was documented being used by odonates.

Additionally, as discussed in the Agency's comments below, the analysis of water level rise of 8-inches over a 30 minute as a result of project operations is an underestimation of the project effects. During the surveys the full eclosion process was observed a limited amount of time, and for those observed it ranged of 20 – 45 minutes with a mean of 31 minutes. This time step does not include the time for the teneral to harden and take flight. The Agency believes that this analysis should at least evaluate water level rise from project operations over a 45-minute period. However, the Agency recommends that a conservative approach be taken for this analysis and evaluate the water level rise over the course of one-hour.

Section Specific Comments

Section 4.2 Site Selection states, "Appropriate habitat for odonates generally consists of fine aquatic bed substrates (sand and silt) for larvae, although some species have been reported to be associated with gravel substrate (*G. abbreviates, G. vastus;* McLain et al., 2004)"

> *Comment*: It should be noted that *Gomphus quadricolor* and *Stylurus amnicola* larvae have also been reported to be associated with gravel substrate which may be more abundant in the riverine sections of the river.

(Dunkle 2000). Additionally, it should be noted that some species of odonates prefer the lotic habitat of the riverine section, such as *Ophiogomphus rupinsulensis* while other species will be more apt to use the semi-lentic habitat of the impounded reaches.

Section 5.2 Focal Species states, "Although it was found at four different sites, *Gomphus abbreviatus* was only observed ten times on transects. Nine of the ten observations came from sites in impoundments, and seven of those were in sites immediately upstream of the dams, suggesting that the species may be more likely to occur in impounded areas of the river."

Comment: In Section 4.2 Site Selection of the report, *Gomphus abbreviatus* is identified with being associated with gravel substrate which is more abundant downstream of the projects in the riverine sections of the Connecticut River. While the survey only found this species in the impounded reaches of river were the substrate is likely to be more silt is different from what is reported as larvae habitat. Although the report suggest that *G. abbreviatus* may be more likely to occur in the impoundment areas then the riverine, this could also suggest that the species is using suboptimal habitat and that populations of this species are being effected in the riverine sections.

Section 5.2 Focal Species states, "*Gomphus vastus* was detected at nine study sites, and was the most frequently found species during transect surveys. However, it was not found at study sites immediately upstream and downstream of Wilder dam (Sites 25-03 and 25-04). This species was also not found in the vicinity of these sites during 2005-2006 field work (Hunt et al., 2010)."

Comment: It should be noted that Sites 25-03 and 25-04 near Wilder dam also were recorded as having rates of water level change that were greater than 8 inches over 30 minutes for a percentage of the time.

Section 5.3 Habitat and Eclosion Behavior section provides information on the vertical distance an exuviae was found from the water surface for each species. The report states, "For this analysis, the vertical distance from the water surface at which an exuvia was found was assumed to be the vertical distance from the water surface at which the individual eclosed."

Comment: As stated during the March 30, 2017 study report meeting, the above approach likely results in an overestimate of the distance traveled by an individual. The Agency agrees with the conclusion that the method as described above and the report likely overestimates the vertical distance from the water surface at the time of emergence. The Agency suggest a method to potential way to limit the overestimation of the distance travel is for each sampling period at each site the mean, maximum, and minimum water level be presented for a one week period prior to the survey.

Section 6.1 Habitat Inundation, Figures 6.1 – 6.11 depict the low and high habitat elevations in relation to water levels from the operations model using the five years of five different hydrologic years.

Comment: The Agency notes from the figures that at the riverine sites the low habitat elevation ranges between 1.5 feet to approximately 4 feet above the minimum water elevation during minimum flow operations with the Bellows Falls riverine site having the greatest distance between minimum water level elevation and the low habitat elevation. The analysis conducted as part of the report only looks at project effects on steep bank habitat even though no consistent trend was found in substrate or habitat used by odonates for emergence. Further, this approach considers the 1.5 feet to 4 feet between the minimum water level elevation and what is being considered the low habitat elevation as being not used by odonates. However, Appendix B survey data indicates that odonates are using this by evidence of exuviae and observing individual eclosion in this area. Therefore, not including this area in that analysis likely underestimates the projects impacts, especially in the riverine sites which tended to have the lowest odonate abundance.

Section 6.2 Direct Mortality states, "In the case of *Stylurus spiniceps*, most individuals observed during field surveys were eclosing 8-16 inches above the water surface. As discussed in Section 5.4, the entire eclosion process takes approximately 30 minutes. Water level logger data at each site were used to evaluate water level rises since the operations model operates on a one-hour time step, while loggers recorded at 15-minute intervals. During normal project operations, the rate of water level rise typically was considerably slower than 8 inches in 30 minutes, and therefore unlikely to cause mortality to odonates."

Comment: The analysis of that evaluates project operations that lead to water level fluctuations at a rate of 8 inches over a 30-minute likely underestimates the projects impacts on odonate emergence and survival. While the frequency of a water level rise of 8 inches over a 30-minute period was relatively low frequency this analysis period does not adequately provide time for some odonates to complete the eclosion process or for tenerals to harden and take flight. In section 5.3 Habitat and Eclosion Behavior it states that of the observations of the full eclosion process the time ranged from 20 – 45 minutes, with an average of 31 minutes. Meaning potentially half the odonates emerging could be impacted by project operations. The Agency believes that this analysis should at least evaluate water level rise from project operations over a 45-minute period. However, a conservative approach to this analysis would be to look at the water level rise over the course of one-hour. This time step would also better align with the operations model which is on a one-hour time step.

Request: The Agency request that the rate of water level increase as result of project operations be analyzed over one-hour for all the survey sites.

Literature Cited

Dunkle, S. 2000. Dragonflies through Binoculars. Oxford University Press, New York. 266 pp.

Support of Comments and Study Modification Requests of Resource Agencies

In addition to the comments and requested modification described above, the Agency will also supports the comments submitted by New Hampshire Department of Environmental Service, New Hampshire Department of Fish and Game, and US Fish and Wildlife Service, as they will also inform the § 401 water quality certification process and help ensure that the Projects will comply with Vermont water quality standards.

The Agency thanks the Commission for the opportunity and consideration of these comments.

Sincerely,

Jeff Crocker
River Ecologist

c: John Ragonese, Great River Hydro
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