Great River Hydro

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June 13, 2017

VIA ELECTRONIC FILING

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

Re: Great River Hydro, LLC; FERC Project Nos. 1855, 1892, and 1904
November 30, 2016 through March 22, 2017 Updated Study Report – Response to Comments

Dear Secretary Bose:

Great River Hydro, LLC (Great River Hydro) 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, 2019. On October 31, 2012, TransCanada (the previous licensee) 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.

As required by 18 C.F.R. §5.15(f) and in accordance with the Revised Process Plan and Schedule for the ILP issued February 22, 2017 by the Commission, TransCanada submitted fourteen Updated Study Reports ("USRs") for the three projects between November 30, 2016 and March 15, 2017. Two additional USR's were filed on March 22, 2017. The USR meeting was held on March 30, 2017 in accordance with 18 C.F.R. §5.15(c)(3) and a meeting summary was filed April 14, 2017. With this filing, Great River Hydro submits responses to various comments and specifically to Disagreements and Requests to Amend Study Plans regarding the Study Reports filed between November 30, 2016 and March 22, 2017 for the three projects, as required by 18 C.F.R. §5.15(c)(5). Comments, Disagreements, and Requests to Amend Study Plans on the USR were filed by the following parties:

Name of Individual or Organization	Acronym Used in Comment / Response Table
Connecticut River Conservancy	CRC
Connecticut River Joint Commissions	CRJC
Mr. John Bruno, river abutter, CRJC	Bruno
Mr. O. Ross McIntyre, river abutter	McIntyre
Mr. John Mudge, river abutter	Mudge
New Hampshire Department of Environmental Services	NHDES
New Hampshire Fish & Game Department	NHFGD
Vermont Agency of Natural Resources	VANR
State of Vermont, Division for Historic Preservation	VDHP
Cowasuck Band of the Pennacook-Abenaki People	Cowasuck Band

Our responses are indicated in the attached table entitled *Response to November 30, 2016 - March 22, 2017 USR Comments*. Final study reports, revised study reports, or report supplements that were filed during that period are:

1. Study 2-3 – Riverbank Transect and Riverbank Erosion Study Final Report, February 4, 2017
2. Study 6 – Water Quality Study Revised Final Report, December 15, 2016
3. Study 9 – Instream Flow Study Final Report, March 22, 2017
4. Study 10 – Fish Assemblage Study Report Supplement, November 30, 2016
5. Study 14-15 – Resident Fish Spawning in Impoundments and Riverine Sections Revised Final Report, November 30, 2016
6. Study 17 – Upstream Passage of Riverine Fish Species Assessment Final Report, November 30, 2016
7. Study 18 – American Eel Upstream Passage Assessment Report Supplement, November 30, 2016
8. Study 19 – American Eel Downstream Passage Assessment Final Report, February 28, 2017
9. Study 21 – American Shad Telemetry Study Final Report, February 28, 2017
10. Study 22 – Downstream Migration of Juvenile American Shad Final Report, January 17, 2017
11. Study 23 – Fish Impingement, Entrainment, and Survival Study Final Report, November 30, 2016; and Report Supplement, February 28, 2017
12. Study 24 – Dwarf Wedgemussel and Co-occurring Mussel Study, Co-occurring Mussel Habitat Suitability Report, March 22, 2017
13. Study 25 – Dragonfly and Damselfly Inventory and Assessment Final Report, December 15, 2016
14. Study 27 – Floodplain, Wetland, Riparian, and Littoral Vegetation Habitats Study Report Supplement, November 30, 2016
15. Study 30 – Recreation Facility Inventory and Use & Needs Assessment Report Supplement

16. Study 33 – Phase II Archaeological Site Evaluation Surveys, Wilder and Vernon Projects, December 1, 2016

During the comment period, three letters were filed by the Cowasuck Band of the Pennacook-Abenaki People. Comments provided on May 9, 2017 are addressed herein. Consultation status under Section 106 of the NHPA is requested in the April 25, 2017 letter, and a privileged document was filed on May 9, 2017.

Comments were filed by the U.S. Fish and Wildlife Service on June 9, 2017, too late to be addressed here; a response will be filed at a later date.

Two studies are ongoing at this time at the Vernon Project: Study 18 – American Eel Upstream Passage Assessment, and Study 21 – American Shad Telemetry Study (downstream passage route selection). Report supplements for these studies will be filed late in 2017 once all field work is complete and all data have been analyzed.

Additional consultation related to Study 9 – Instream Flow Study and Study 24 – Dwarf Wedgemussel and Co-occurring Mussel Study is ongoing at this time and additional analysis of Habitat Suitability Criteria (HSC) is anticipated to occur during the spring and summer of 2017. Report supplements will be filed as applicable once consultation is complete and data have been analyzed.

Based on comments received on Study 25 - Dragonfly and Damselfly Inventory and Assessment Final Report, we will file by July 31, a study report supplement containing additional information and analysis.

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 jragonese@greatriverhydro.com.

Sincerely,

John L. Ragonese
FERC License Manager

Attachment: Response to November 30, 2016 - March 22, 2017 USR Comments

cc: Interested Parties List (distribution through email notification of availability and download from Great River Hydro's relicensing web site www.greatriverhydro-relicensing.com).

Study 2-3 – Riverbank Transect and Riverbank Erosion Study

Comment #	Source	Comment	Response
1	NHDES	The Executive Summary (ES) should be revised to be consistent with NHDES comments below.	Based on all comments received and in lieu of revising the report we are providing the additional information requested in figures and tables that follow these Study 2-3 comments (hyperlinks to the location of each figure or table are embedded in the applicable response).
2	NHDES	A sentence should be added to the S that clarifies the definition of unstable does not include armored banks or banks with notching unless there were other signs of erosion.	Bank types classified as unstable (the focus of the study) are defined in the ES.
3	NHDES	To show where the 37% of river bank with notching occurred, the Department requests that a graph similar to Figure 5.6.4-2 be included showing the percent of bank with notching on unstable and on stable banks (as defined in the report).	Notching and overhangs occur both where banks were mapped as stable and as unstable. While some variations occur by project (similar to Figure 5.6.4-2), the amount of notching/overhangs in areas mapped as stable is roughly the same as the amount found in unstable areas (see Comment #3 Figure below). Notching/overhangs represent areas that are potentially becoming destabilized and may experience future instability where found in areas presently mapped as stable and may sustain instability where present in areas already mapped as unstable. Areas not showing notching that are currently stable are more likely to remain stable than areas with notching, and areas where notching is not present on unstable banks may be more likely to become stabilized in the future. Note that the study (p. 81) found slightly more notching at stable and armored banks (21%) than at unstable banks (16%). See also response to Comment # 4c below.
4	NHDES	Limitations of [the erosion ratio] approach should be	See responses to Comment #s 4a – 4g below.

Comment #	Source	Comment	Response
		clearly explained in [Section 5.6.5a] and the Executive Summary. Examples of what the Department views as limitations [are included as comments 4a – 4g below.]	
4a	NHDES	The [erosion ratio] method only considers banks that categorized as [unstable]. It did not include banks that were armored or banks with notching [and no other evidence of erosion]. This could skew the results…since notching (the first step in the erosion cycle) corresponds to the median WSE fluctuation height…Notching and armored banks (which are armored because they were unstable) should be included in the analysis or in an additional analysis.	The erosion ratio analysis (Section 5.6.5a) was intended to relate spatial variations in observed erosion (e.g., unstable banks) to other features (e.g., bank height, location, riparian vegetation, WSE fluctuation), not to describe potential variations in non-eroding, stable banks (including those with notching and armor). One of the reasons for excluding notching was in order to avoid skewing comparisons with historical erosion data, and FERC supported this approach. Consistent with the study definitions of stable and unstable banks, we do not believe that the suggested additional analysis will provide clarity or additional information for the study. With regard to notching, we refer the commenter to FERC's November 29, 2016 Study Plan Determination (SPD) which summarizes Great River Hydro's position on the issue of notching: *"A notch or overhang on the* <u>*lower bank*</u> *does not indicate that the* <u>*upper bank will fail*</u> *(i.e., topple, slide, or fall)…classifying a riverbank as unstable or eroding based on the type and extent of erosion in the upper bank is consistent with historical erosion mapping efforts conducted within the project areas and on nearby sections of the Connecticut River."* FERC agreed with not including notches as unstable by stating in the SPD: *"The methods and techniques used to characterize bank stability in studies 2 and 3 are consistent with the methods used to characterize bank stability in historical erosion mapping conducted in 1958 and 1974. Characterizing all notches and overhangs as unstable would eliminate the ability to compare the*

Comment #	Source	Comment	Response
			current study results with historical mapping conducted in 1958 and 1974. Because the modification requested by the New Hampshire DES would eliminate comparisons with historical data, we do not recommend requiring TransCanada to reclassify all notches and overhangs as unstable." With regard to armored banks, it is important to note that not all banks were armored because they were eroding at the time of armoring. Page 83 of the final study report states: *"A considerable amount of armoring is associated with protecting the railroad grade that runs along much of the river in the study area. The Boston-Maine railroad secured an indenture for armoring and stabilizing banks along the railroad prior to the raising of the WSE associated with the development of the Wilder Project in 1950."*In addition for example, riprap was placed nearly continuously along the banks from Wilder dam to the Pine Park area immediately following dam opening. While one cannot be sure all of the banks were not eroding, this seems more likely to have occurred in response to the widespread concerns that the dams would cause erosion rather than responding to actual erosion.
4b	NHDES	The [erosion ratio] method ignores the fact that notching…corresponds to median WSE fluctuation heights.	See response to Comment # 4a above relative to the categorization of notching as stable.
4c	NHDES	The method [and data] represent a snapshot in time. Banks which were not defined as stable [*sic, NHDES likely meant banks which <u>were defined as stable</u>*] such as banks with notching might be unstable in the future.	See response to Comment # 4a above relative to the categorization of notching as stable without other evidence of erosion present. While it is true that banks with notching could become unstable in the future if flood flows remove material at the base of the banks, the goals of the study did not include making predictions of what might occur in the

Comment #	Source	Comment	Response
			future, but rather to characterize the current status of the banks and make comparisons to historical conditions. The comparison of erosion maps from different years show that the amount of banks that have gone from stable to eroding is roughly the same as banks that have gone from eroding to stable. To focus on notching and say that those banks will be eroding in the future may be true but one must also acknowledge that banks that are completely bare (the end of the erosion cycle) may also become stabilized in the absence of flood flows.
4d	NHDES	The analysis of erosion ratios was limited to only those 0.5-foot increments that occur along 10% of the banks… [so as not to skew the data at short bank lengths, see p. 102 of the report]…When the rather arbitrary cutoff of 10% was applied to the results, the study concludes that greater magnitudes of WSE fluctuation are not associated with greater levels of erosion. This seems counterintuitive to what one might expect. The Department requests that the data be interpreted without the 10% cutoff for bank length.	A review of the WSE and erosion ratio graphs (Figures 5.6.5-4a – 5.6.5-4f) show that while some WSE fluctuations of high magnitude with less than 10% of the bank length have a high concentration of erosion (i.e., high erosion ratio), no consistent trend emerges as other half-foot increments of high WSE fluctuations have low erosion ratios. If increasing magnitudes of WSE fluctuation were exerting a strong control on the location of unstable banks then a stronger pattern or trend would emerge. The fact that no such pattern emerges, regardless of whether a 10% cutoff is used or not, suggests that the spikes in the erosion ratio are due to skewing of results when such small bank lengths fall into some of the half-foot WSE fluctuation categories. The graphs related to the analysis are provided in the report and no pattern is visible to suggest that increasing fluctuations in WSE are associated with greater levels of erosion. No additional analysis is required as the findings of the report would remain unchanged.
4e	NHDES	Because not all armored banks were included in the analysis, the study indicates that the erosion ratio for inside river bends is more than for outside bends which is counter to what might be expected (p. 84).	The report acknowledges that the findings are counterintuitive relative to what might be expected in an <u>unaltered alluvial river</u> (p. 84); however the Connecticut River has been altered and was straightened due to log

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			drives (p. 9) which tends to increase channel slope and flow velocity (p. 20), as well as by preventative armoring (p. 83, and response to Comment #4a above). The study found no pronounced trend between unstable banks and bend geometry, and that armoring is nearly twice as likely to be found on outside bends and straight sections as on inside bends (p. 84-85). The reasons why armored banks were excluded from the erosion ratio analysis are provided on p. 105. Armored banks were included (along with failing armor banks) in the logistic regression analysis (Appendix E) which supported the findings of both the erosion ratio and armor ratio analyses.
4f	NHDES	Results and conclusions drawn from the [multiple logistic regression] analysis are questionable since the observations are not independent, which is a "violation of one of the usual assumptions of regression" (Appendix E, p. E-2). The Department requests that the study explain how this… "violation" could impact the results. Results and conclusions are also questionable because they did not include all banks with armor and notching.	The comment refers to the statement in appendix E that "*the structure of the data is such that observations are not independent, a violation of one of the usual assumptions of regression.*" Note that the lack of independence was explicitly acknowledged in the appendix, which went on to state that *"the models used here are useful for computing empirical estimates from the data, particularly through smoothing and estimation of additive effects and/or interactions."* For single predictors, the logistic regression coefficients are identical to estimated proportions computed from the raw data. For example, the coefficients of the model with bank height bins as the sole predictor are the same as the percent of feature length mapped as unstable in Table 5.6.5-1 (erosion ratio) of the study report. Directly computing such coefficients for additive or interacting effects would be onerous; directly computing smoothed estimates is not possible. In this analysis, the usefulness of the statistical model-fitting algorithms is in ranking the goodness-of-fit of the models, computing coefficients for multiple predictors including possibly with

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			interactions, and computing the shape of the relationships over continuous values of certain predictors rather than having to bin them. With regard to not including armored banks and notching in the analysis, see response to Comment #4a above.
4g	NHDES	The Department requests that the report include [comments edited]: a) More information regarding how channel average shear stress [from Study 4] was calculated and how it typically compares to near bank shear stress. The fact that critical shear stress was not calculated for comparison to the average channel shear stress adds another degree of uncertainty with the results and conclusions. b) The areas along the 250 mi of riverbank where the average velocities exceed the 2 ft/s threshold at the maximum station discharge. c) A discussion of how the logistic regression results would be affected if areas with velocities equal to or greater than 2 ft/s were included as a predictor variable instead of average shear stress. d) Modeled input and output should also be provided.	a) Channel average shear stress is computed from the hydraulic radius between the channel banks. Units are lb/sq ft. The equation is: $\tau = \gamma RS$ **γ** is the unit weight of water **R** is the hydraulic radius **S** is the local energy grade line slope (slope of the water surface). Since there are many variables that come into play in relation to estimating near bank shear stress (as well as near bank velocity vs. average channel velocity) due to site-specific conditions (e.g., eddies, vegetation, substrate), there is no "typical" comparison to be made between channel average shear stress and near bank shear stress. The reasons for this and for not including critical shear stress are discussed on pp. 103-104 of the final study report. b) Velocity is a function of flow which includes upstream and tributary inflows as well as station discharge. Velocity is also a function of local channel characteristics; therefore, it would be misleading to look only at 2 ft/s velocity along the entire 250 miles of river bank and try to draw conclusions about relationships to maximum station discharge. For example, just below Wilder dam, station discharge resulting in velocities of 2 ft/s vary between 12,000 6,000, 8,000, 15,000, and 20,000 cfs within the first five

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			model cross sections which span 0.172 miles (908 ft). The velocity results in Sections 5.9 and 6.1 of the final study report provide adequate indications of velocity in relation to station discharge (see also response to Comment #5b). Note that 2 ft/s is considered a very generalized and conservative estimate of the threshold entrainment velocity for the types of sediments found in the study area (see pp. 126-127). c) The logistic regression analysis would not be greatly affected if considering a threshold velocity of 2 ft/s versus average channel shear stress. Shear stress is related to flow velocity, so the results would be related and similar. The regression analysis of channel average shear stress showed that unstable banks do not preferentially occur where shear stress is higher. Consequently, we would not expect erosion to occur above or below a specified shear stress or velocity level. While 2 ft/s represents a threshold velocity above which transport of fine sand/silt occurs, its selection in the regression analysis could potentially be misleading as analyzing the distribution of erosion relative to 1 ft/s or 3 ft/s, for example, could show similar or even stronger trends. The analysis of a full range of shear stresses (as was done) or velocities allows a determination of whether erosion is preferentially found above any level, not just the threshold level, so is more informative. The lack of such a trend in the shear stress analysis suggests that shear stress exerts less of a control on the distribution of erosion than bank height. This does not mean that shear stress does not exert an actuating influence on erosion, but simply, that other factors more strongly control where that erosion occurs.

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			d) Inputs to the HEC-RAS model were described in the Study 4 report and outputs are specific to each study as described in study reports such as the Study 2-3 final study report. Providing massive model output datasets would undoubtedly lead to that data being misinterpreted and potentially misapplied since the output covers a range of WSE at the dams. Applying the various cases and interpreting the results requires an in-depth understanding of project operations and high water procedures at each project.
5	NHDES	Table 5.8-1 shows that velocities can increase from 36 to 400% in the impoundments when drawdowns are implemented to accommodate high flows. The Department requests that the report: a) Explain why the lower elevations and higher flows shown in Table 5.8-1 were selected and if they represent worst case conditions. b) Include calculation and presentation of velocities and velocity differences at stations downstream of the dams.	Note that the left hand and center "difference" columns of Table 5.8-1 compare velocities at two different WSEs for the same flows. The table shows that velocities do not change much with WSE changes, but rather with increases in flow. a) The lower flows listed in Table 5.8-1 represent the flow at maximum generating. The higher flows represent the flows at which Great River Hydro would lower WSE at the dam per its river profile high water operating procedure. WSEs are lower under higher flows which typically occur each year (see also response to Comment #9d below). b) The purpose of Table 5.8-1 was to show velocity at different flows and WSEs at the dams for study sites in the impoundments. Velocities at different flows are presented at downstream monitoring sites (see Comment #5 Table below). It is important to note that WSEs at the upstream dam are not relevant at riverine sites. WSEs in riverine sections are influenced by other factors such as tributary inflow, and in the case of Vernon, WSEs.
6	NHDES	[Relative to Study 4 predicted velocities and the	a) It is stated just above Table 6.1-1 in the final report that

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		velocity threshold for entrainment] The Department requests: a) That the rows labeled "Minimum flow needed for threshold velocity" in Tables 6.1-1 and 6.1-2…include "threshold velocity of 2 ft/s". b) That a discussion be included that compares near bank measured velocity at each transect to the average channel velocities used in the analysis. c) That a similar analysis be conducted for the rest of the 21 transects.	the more conservative 2 ft/s was used in the analysis. b) Near bank velocity measurements shown in Tables 6.1-1 and 6.1-2 were taken via ADCP at points across the channel including near the banks. The data is the average of those values across the ADCP transect. c) ADCP measurements were taken at a few locations for purposes of comparison with the HEC-RAS model predicted velocities. Site selection opportunistically included the few erosion monitoring sites included in Tables 6.1-1 and 6.1-2. ADCP Measurements were not taken at the other monitored study sites as this was beyond the scope of the study. d) See response d) to comment # 4g above.
7	NHDES	On p. 127, the report states that based on literature a reasonable range of threshold velocities to cause sediment entrainment is 2 to 3 ft/s. Based on a review of the NRCS (2007) reference…a threshold velocity of 2 ft/s (versus 3 ft/s) seems more reasonable.	The report (pp. 126-127) includes a discussion of the variability in literature-based threshold velocities and points out that those values are design parameters that include a safety factor and are therefore conservative. A threshold velocity of 2 ft/s was the baseline already used in the report to compare the ability of operational flows versus flood flows to transport sediment accumulating at the base of the banks from upslope erosion (Figure 6.1-1). Operational flows equaled or exceeded the 2 ft/s threshold at only 4 sites and only slightly. We acknowledge that at these sites the potential for operational flows to transport sediment but mention the 3 ft/s velocity because this represents a more realistic threshold condition when considering the actual site conditions with coarser sediment, vegetation and other factors that would increase the actual velocity required to transport sediment rather than the 2 ft/s threshold which represents what is required to transport the most easily transported particles. A few impoundment sites might have the potential during short periods during

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			normal project operations to transport sediment but we believe, given actual site conditions, that transport is unlikely even at those sites during project operations as a more realistic threshold velocity of 3 ft/s is not exceeded at any point during project operations.
8	NHDES	It was the Department's understanding that the study would include shear stress analysis at each of the 21 transects (monitoring sites)… A screening level shear stress analysis was conducted and analyzed by logistic regression for much of the study area but did not include values for critical shear stress needed to mobilize sediment… The Department requests an explanation as to why information needed to conduct a more complete shear stress analysis (including calculation of the critical shear stress based on site data) was not collected at the 21 transect sites.	Shear stress values were determined along the entire 250 miles of shoreline, thus encompassing the 21 monitoring sites included in Study 2 (see Section 5.6.5a of the final report). The HEC-RAS model can produce average channel shear stress estimates but other site-specific factors such as bank vegetation, secondary flow circulation, and bend geometry among others, can lead to widely varying shear stress levels when applied to a specific cross-section or over short lengths of bank (p. 103). Shear stress analysis was used to determine via the logistic regression analysis if higher shear stress is associated with higher likelihood of bank instability throughout the study area. That analysis (Appendix E) demonstrates that higher shear stress does not correlate with higher likelihood of bank instability. Pages 103-104 of the final study report discuss why near bank shear stress data was not collected at the 21 monitoring sites and why critical shear stress was not calculated However, average channel shear stress for all 21 study sites from the HEC-RAS model is provided in the Comment #8 Table below, at the flows and impoundment elevations used in Table 5.8-1. The table below shows that higher shear stress does not correlate with banks mapped as eroding.
9	NHDES	[This comment has been edited for brevity]. a) While WSE fluctuations associated with normal	a) The report (Sections 6.4 and 6.6) already characterizes project-related WSE fluctuations within the cycle of

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		plant operations alone may not immediately result in excessive erosion…they do contribute to notching and bank destabilization, and in some cases potential movement of sediment [e.g., downstream of Bellows Falls and Vernon dams]…and can significantly impact the erosion cycle by making some banks more prone to excessive erosion, by entraining sediments [again, downstream of Bellows Falls and Vernon dams], and by potentially increasing the rate and magnitude of erosion (because they are more susceptible). This should be included in the conclusions and Executive Summary [the comment lists several points from the report to support the comment]. b) The Department requests that [the finding that most if not all of the mapped notching occurs within the range of…normal project WSE fluctuations]…be added to the report and Executive Summary. c) If the frequency and magnitude of WSEs were reduced, daily changes in seepage forces and the rate and magnitude of notching would be reduced, which in turn would likely reduce the rate and magnitude of excessive erosion when high flows occur [both in impoundments and in riverine reaches]… d) The maximum hydraulic capacity of the turbines at Wilder, Bellows Falls, and Vernon are exceeded approximately 12%, 28%, and 22%, respectively…based on average daily flows and would be less if they were based on a shorter	erosion. b) This information is already included in the report (for instance on pp. 53-54). Note that notching was mapped only at the base of the banks where WSE normally fluctuates, and WSE under normal project operations was consistent with notching/ overhangs at only 8 of the 21 monitoring sites (p. 138). c) This comment is not supported by the study findings. Section 6.4 of the report states: *"While even small WSE fluctuations could still contribute to bank instability, the texture and stratigraphy of bank sediments are also important controls on the hydraulic gradient and associated seepage forces (Fox et al., 2010) such that the <u>stability of two adjacent banks with slight differences in bank composition could be very different despite experiencing identical</u> WSE fluctuations* [emphasis added]*, thereby complicating efforts in discerning whether bank instability is the result of project-induced WSE fluctuations."* d) The comment is incorrect. Exceedance of maximum hydraulic capacity of the projects would not be different based on a shorter time interval. Hourly project discharge data (which is readily available from 2001 – 2015) indicates that exceedance of station capacity occurs about the same amount of time as based on average daily flows (10%, 28%, and 23% at Wilder, Bellows Falls, and Vernon, respectively) Note that the exceedance values referenced in the comment are based on prorated average daily USGS gaged flows for the period 1979 – 2015, as described in FLA Exhibit E Section 3.4.1.1). e) This comment seems to suggest that if operated in a

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		time interval… e) Assuming power is generated and daily or sub-daily WSE fluctuations occur any time flows are less than the maximum turbine hydraulic capacity…suggests that if the projects were operated in a steady pond / run-of-river mode, the annual frequency of daily and sub-daily WSE fluctuations, of changes in bank seepage forces, and changes in velocities downstream of the dams could be significantly reduced...compared to existing project operation under normal conditions. f) Based on the above, the Department requests that the report include a discussion that describes how operation of the projects in a steady pond / run-of-river mode which would reduce the frequency and magnitude of daily and sub-daily WSE fluctuations could potentially benefit efforts to control erosion (including the rate of erosion)…This should be included in the report.	run-of-river mode, there would be no WSE fluctuations, which is incorrect. WSEs fluctuate both upstream and downstream of dams even if the elevation at the dam was held constant since WSEs fluctuate due to changing flow levels. With regard to changes in bank seepage forces, see response to Comment #9c above. With regard to changes in velocities downstream of the dams, the study shows that the locations of large WSE fluctuations do not align with locations of higher erosion levels (pp. 90 – 91). Note also that WSE fluctuations are influenced by tributary inflows, channel constrictions, and channel morphology in the riverine reaches as well as by project discharge (p. 90). WSE is more heavily influenced by inflows in the middle and upper potions impoundments than by project-related WSE fluctuations at the dams. Run-of-river mode would not eliminate WSE fluctuations in the impoundments, and to an extent would further exacerbate flow-related WSE impacts (e.g., at Wilder as discussed in FLA Exhibit E pp. 3-86 – 3-88, and Figure 3.4-15). f) This premise is false. Operating the project in a run-of – river mode would not decrease WSE fluctuations. In some cases it would increase it or expand portion of the impoundment where WSE is primarily affected by flow and the potential range of WSE changes due to changes in flow would be greater than that experienced under current operations. Comparison of potential alternative operations to current operations was beyond the scope of the study, and will be considered as possible mitigation within the context of all relicensing recommendations (including effects of potential alternatives on other resources) in an amended FLA or

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			during the course of FERC's post-filing environmental analysis. As discussed in Section 3.4.5.1 in Exhibit E of the FLAs, Great River Hydro is constrained in its ability to significantly alter flows and WSE fluctuations.
10	NHDES, CRJC, CRC (and Princeton Hydro)	The commenters reference FERC's November 29, 2016 SPD wherein FERC reports: *"TransCanada states that the results of the HEC-RAS modeling and a logistic regression statistical analysis that it proposes to conduct will be sufficient to identify the likely causes of erosion <u>at the 21 erosion monitoring sites</u>* [emphasis added]; *therefore, there is no need to use the River 2D model."*	We believe that FERC may have misinterpreted our response to comments on the initial study report (response filed October 31, 2016 and amended on December 5, 2016). Response to Comment #28 in that filing was made within the context of VANR's request for River 2D analysis, and was a 2-part response: Part 1 of our response: *"We believe that shear stress/velocity (1D average mid channel) in addition to statistical analysis will be adequate to assess these [potential causal] factors <u>to the extent that they can be assessed</u>* <u>[emphasis added].</u> It was not our intent to suggest that we would attempt to assess specific causes of erosion at the 21 monitoring sites which was beyond the scope of the monitoring study (Study 2) and likely impossible with any level of confidence. Rather, the intent was to assess, if possible, those factors associated with the presence of erosion more broadly across the entire study area (Study 3). The study report (Section 6.6) concludes: *"Erosion within the study area is ultimately the result of multiple causal mechanisms working in concert…Tractive forces generated by flood flows are the only mechanism capable of removing the sediment from the base of the bank that otherwise would lead to bank stabilization if not removed…"* Ultimately, the study showed that other than flood flows, potential factors do not appear to exert sufficient influence on erosion, either alone or in concert. See also response to Comment #8 above relative to shear stress.

Comment #	Source	Comment	Response
			Part 2 of our response: *"With regard to River 2D modeling, the study plan suggested that if necessary 2D modeling would be conducted at up to 6 of the monitored 21 sites if those sites were complex sites where HEC-RAS modeling does not adequately describe them (e.g., eddy flows or flow deflections). Based on the results of site monitoring, we do not believe this [River 2D] analysis is needed or would contribute additional useful information."* Since none of the 21 monitoring sites were particularly complex, River 2D modeling was not warranted.
11	CRJC	The final report does not clarify the proportion of erosion that is attributable to project operations.	The report clearly shows that under normal project operations: a) velocities in the impoundments are insufficient to entrain sediments; b) velocities below the dams could only entrain sediments (using the conservative 2 ft/s velocity value) at highest operational discharges at some locations; c) higher sheer stress does not correlate with higher likelihood of erosion; and d) erosion is not more likely where WSE fluctuations are highest. Further, the statistical analysis indicates that shear stress at the high end of normal operations and normal WSE fluctuations only predict a small likelihood of erosion, while bank height predicts more likelihood of erosion, although bank height is still a weak predictor in itself. Lastly, the study demonstrates that flood flows are the only mechanism capable of continuing the cycle of erosion and in the absence of flood flows, banks would tend to stabilize.
12	CRJC	Princeton Hydro's recent peer review memo (May 2, 2017 to CRC) points out that no velocity analysis, using the HEC-RAS model was included in the revised [report], and relevant discussions do not identify the	The comment is incorrect. Velocity analysis using the HEC-RAS model and field-measured velocities at a subset of sites is included in Section 6.1 of the revised report. The report in its entirety and the statistical analysis (Appendix E)

Comment #	Source	Comment	Response
		likely causes of erosion.	includes discussions of the relative importance of the various likely causes of erosion throughout the study area.
13	CRJC	[The] report concludes, without providing any new evidence, that "*notching at the base of the banks that initiates the cycle of erosion can result from a variety of potential factors such as flood flows, wave action, seepage forces generated by natural groundwater flows, or water level fluctuations.*" but no further discussion of these erosive forces is provided and the regression analysis was of no value in determining the relative importance of each of these forces.	The quoted passage comes from the ES of the report, which is a high level summary of the study findings. The study concludes in part (Section 6.6) *"Tractive forces generated by flood flows are the only mechanism capable of removing the sediment from the base of the bank that otherwise would lead to bank stabilization if not removed. While other processes such as waves or seepage forces created by project-related WSE fluctuations may exert some control on the cycle of erosion by potentially contributing to the destabilization of the banks, they cannot be considered as resulting in excessive erosion that negatively impacts other resources since ultimately the continuation of erosion depends on flood flows that sustain the cycle of erosion."* Within the report itself, all of these factors are discussed in detail. Since erosive forces such as wave action and groundwater flows were not measured within the context of the study plans, it is true that the regression analysis does not include them; however, other factors potentially contributing to erosion are included and their relative importance is quantified (Section 5.6.5 and Appendix E).
14	CRJC	Since the studies were unable to identify the effect of project-related water level fluctuations on erosion, Great River Hydro does not have sufficient information to determine the impact of project-related erosion on other public interest factors such as farmland, listed species, natural communities, archaeological sites, roads, and other infrastructure.	The erosion studies and the study report identify the relative potential of project-related WSEs to affect erosion. In similar fashion, erosion effects (whether project related or not) on other resources where data were available is qualitatively assessed (roads and infrastructure were not included in the study scope).
15	CRC	a) The input data for the regression analysis should be evaluated for spatial auto-correlation and	a) Spatial auto-correlation is a related, but broader type of lack of independence (see response to Comment # 4f

Comment #	Source	Comment	Response
		dependencies... b) If significant, an alternative statistical test should be completed. c) Regression analysis should be conducted on the…21 transects.	above). For multiple variables (in this case, one response variable and numerous candidate predictors), determination of spatial auto-correlation is not straightforward. The specific approach mentioned in the comment letter, Moran's I, is applicable to 2D (or 3D) spatial analyses, not to the 1D representation of space in the erosion dataset. In response to the comment, we evaluated the effect of spatial auto-correlation and determined that auto-correlation may contribute a little to the disappointing explanatory power of models of bank instability, but not to the extent the reviewers (Princeton Hydro) implied. Overall deviance explained with auto-correlation was less than 10% while the non-auto-correlated complete dataset resulted in 8.2% overall deviance (as discussed in the study report). b) The requests for a statistical analysis made by stakeholders were associated with concerns that the erosion ratio analysis was not a widely accepted scientific methodology. The erosion ratio analysis was conducted on the data generated from the bank stability and channel features mapping of the entire study area, which includes the locations of the 21 erosion monitoring sites. c) We assume FERC's mention of conducting a statistical analysis of the 21 erosion monitoring sites rather than the entire bank stability mapping data set was an oversight or misunderstanding (see response to Comment # 10 above) given the stakeholder interest in corroborating the results of the erosion ratio analysis and the fact that the causal analysis was part of Study 3 and not Study 2 for which the monitoring was

Comment #	Source	Comment	Response
			completed (although the results of the monitoring were utilized in the causal analysis). Furthermore, a regression analysis of the 21 erosion monitoring sites are unlikely to produce meaningful results as only 3 of the 21 sites showed measurable top-of-bank retreat and in each of those instances local conditions appear to adequately explain the causes for that bank retreat (p. 50). Data on such local conditions (e.g., slope increases due to a meander cutoff; backwatering of flow upstream of a tributary delta) were not systematically collected at all 21 sites and, therefore, the apparent cause of erosion at these sites would not be adequately described by the data collected (according to the approved study plans) at the sites.
16	CRC (and Princeton Hydro)	Great River Hydro should collect groundwater elevation data and observations of groundwater seepage or seepage-related erosion at the 21 monitored transects… [and] analyze that data to determine how operational WSE fluctuations potentially affect streambank stability.	This was not within the scope of the approved study plan. Furthermore, we feel this is unnecessary as we have sufficiently identified high flows as the principal driver and leading cause of continued erosion. WSE fluctuations due to project operations cannot cause seepage to the extent that it affects groundwater. Project operations are not responsible for the most sustained periods of high WSE which would in itself have the greatest potential for seepage and bank saturation.
17	CRC (and Princeton Hydro)	Great River Hydro should include additional mapping…and further assessment of potential impacts of ongoing bank erosion and release of fine sediments…to cobblestone tiger beetle habitat, water quality impacts related to sight-feeding and respiration of fish, aquatic habitat and substrate, spawning of riverine fishes, and freshwater mussels.	The assessment of potential impacts of erosion on other resources (Section 6.5) was conducted by comparing erosion mapping information with locations of other resources from other studies and represents the qualitative summary of the available information as required in the study plan. In many cases, species were found in locations which were not part of erosion mapping (islands, tributary mouths, backwater areas; or were located outside of project influence (e.g., Jesup's milk vetch).

Comment #	Source	Comment	Response
			Note that locational data related to cultural resources and rare, threatened, and endangered species is considered privileged data such that maps showing those locations in relation to areas of mapped erosion were not included in the Study 2-3 report.
18	CRC	There were numerous problems associated with the regression analysis. a) and comment d): We do not understand why TransCanada [did not] perform regression analysis on the 21…study sites. b) Sediment characteristics were not included in the regression analysis…[and should be] performed on the…21 sites. c) The regression analysis used shear stresses for two cases only…The range of flows under project operations was not assessed.	a) See response to Comment #15. b) See response to Comment #15 regarding difficulties with using regression at 21 monitoring sites. The velocity analysis at selected monitoring sites assumed sediment was fine sand/silt, representing the most easily transported material, while in actuality the sites included coarser (gravel) or more cohesive sediments (clay) that would require even higher threshold velocities to mobilize than were actually considered in study. A regression analysis of the 21 sites considering sediment composition is complicated by the fact that the native bank sediment was covered (p. 41) and difficult to accurately characterize for use in a statistical analysis. c) The shear stresses at the upper end of the operational flows were chosen for analysis because they produce the highest shear stresses within the operational range and therefore were considered to be the flows that would be most likely to be associated with erosion.
19	CRC	a) Section 6.3 [Historic Trends in Operations] indicates that project operations have changed…the 50% exceedance of Wilder impoundment elevation…has increased by 6 inches in the recent decade compared to previous decades. b) …exceedance curves for midnight do not capture	a) Section 6.3 discusses the differences at Wilder between earlier decades and the most recent decade, primarily the introduction in 2002 of licensed minimum flows from the upstream Fifteen Mile Falls Project. With increased continuous inflow, WSE in Wilder impoundment would stay slightly higher but that is not a function of Wilder operations. The data more

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		the full scope of “normal operation…”…The changing energy market could result in more hydropower peaking and therefore higher sub-daily fluctuations…or multiple peaks per day.	importantly points to less WSE fluctuation than in previous decades, which in the context of Study 2/3, does not correlate with trend observed in Study 1 suggesting greater erosion recently in portions of the Wilder impoundment; and certainly counters the stakeholder beliefs that recent market changes has exacerbated project related WSE fluctuations. b) This is simply not the case. The exceedance curves provide a good comparative indicator of current and past operations, in part because historic data was only available as midnight elevations. Furthermore inter-day peaking has always been in response to daily peaking demand and therefore would not be any different from what it is today. What is different from earlier decades is the inflow to these projects due to increased and significant minimum flows from upstream projects that were not present in the historical comparative timeframes. This would have resulted in a significant reduction in inflow to the projects from upstream storage during off-peak periods. In order to sustain minimum flow at the subject projects, impoundment storage would have to be utilized, which is not the case today.
20	CRC	a) Table 4 of Appendix E shows that…median fluctuations between 4 and 7 ft…add up to 36.7 miles of bank. b) [From graphs in the comment letter of water level logger data at the Mudge site and USGS Wells River gage]…show how water levels varied at the Mudge site in August [higher WSE] and October 2015 [lower WSE]. It also appears that midnight is a time when river levels are steeply	a) Higher median fluctuations occur in the uppermost portion of the Wilder impoundment (see Figure 3.4-15 in Exhibit E of the FLAs) and in the riverine reaches downstream of each dam. Note that 36.7 miles of bank equates to only about 10% of the length of all mapped bank. b) It is unclear why the commenter included the USGS graph for the Wells River tributary as mainstem flows are significantly higher than the Wells River. As shown

Comment #	Source	Comment	Response
		rising… c) [Based on the graphs]…the operations of the dams cause river fluctuations that are far from that of a natural river. d) The study report…did not look at periodicity and duration of WSE fluctuations, and shear stresses from project operations have only been looked at for the upper end [of normal operations]. Sub-daily fluctuations will undoubtedly have some effect on bank stability and it may not be entirely due to shear stress.	in the Comment #20 Graphs below, the mainstem gage (Connecticut River at Wells, VT gage #01138500) more clearly illustrates the overall pattern of inflows into the Wilder impoundment (excluding additional inflow from downstream tributaries - Oliverian Brook, Halls Brook, Waits River) and resulting discharges at Wilder dam. Differences in WSE fluctuations in the impoundments are associated both with project operations and changes in inflow. In August 2015, inflows were more variable than in October 2015 (see graphs that follow this study table). **c)** Note that the baseline for consideration of project effects is not a natural river, but rather the current operations of the projects within the broader context of the managed river. d) See response to Comment #16. Report findings include analysis of sub-daily fluctuations on bank stability.
21	CRC	The comment letter included a memo from Princeton Hydro containing additional comments. Those not already addressed above are included here: a) There is no mention of a HEC-RAS model in the revised study…and no results listed shear stress throughout the study reach….[and] output from the HEC-RAS model is not included. b) Section 6.1 focuses only on a single element of the cycle of erosion, the potential for sediment entrainment at the toe of the stream bank. c) The data presented in Table 5.8-1 suggests that periodic operation drawdowns in preparation for high flows could regularly mobilize sediment at the toe of the stream bank…However, the revised study…attempts to discount the	a) The HEC-RAS model is the model developed in Study 4 at over 1,100 cross sections within the 124-mile project reaches. Appendix E describes that at each flow there are over 1.3 million shear stress records that were analyzed. b) Section 6.1 focuses on this single element (sediment entrainment at the toe of the bank) since it is the only mechanism by which the erosion cycle can continue, ultimately leading to top of bank failure. c) The data in Table 5.8-1 compares the change in velocity based upon changes in WSE at the dam at similar flows and changes in velocity based upon changes in flow with WSE at the dam held constant/ It indicates that increases in velocity are largely a function of changes in flow and not a function of changes in WSE at the dam.

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		significance of this finding by running a scenario where only WSE fluctuates and flow remains constant… d) Armored banks were sufficiently unstable to such a degree to necessitate engineering intervention. e) The [regression] analysis produces a strongly counterintuitive finding that there are no unstable banks at the highest shear stresses and that bank instability does not increase with bank height, shear stress, and WSE fluctuation. f) The use of cross-section-averaged shear stress from a 1D model that is then extrapolated many thousands of feet from a modeled cross section may be of insufficient resolution to provide meaningful quantitative connection to bank stability. g) A statistical analysis of the...21 transect sites could incorporate the presence of bank materials and stratification which are acknowledged as factors that contribute to bank instability… h) The revised study emphasizes how the shear stresses at high flows are the primary driver of the cycle of erosion…however, Figure 6.1-1 on p. 131 does not support that statement. Assuming that the results can be compared relative to each other…this analysis finds high flow shear stresses to have less effect than WSE fluctuation and bank height… the results indicate that WSE fluctuation is one of the top three factors that determine bank stability, an admission that project operations are in fact a significant factor in causing bank instability.	Drawdowns associated with river profile high water procedures does not result in significant increases in velocities. d) See response to Comment #4a. e) The lack of congruence between shear stress at flood flows and the location of erosion may reflect the influence of other factors controlling the distribution of erosion at times when shear stress is high enough to transport fine sediments in most locations (p. 104). The resistance of the banks to erosion prevents erosion in some areas despite the high shear stresses while erosion occurs at other areas. If bank conditions were uniformly the same everywhere, then a stronger relationship between the location of erosion and shear stress at flood flows may have emerged. f) The HEC-RAS model developed over 1,100 cross sections, ranging from approximately 300 to 500 ft between them. The shear stress values were determined for each model cross section (node) and then interpolated for every foot between nodes. This provides more than adequate resolution when attempting to evaluate erosion on over 120 miles of river. g) See response to Comment #18b. h) See response to Comment #21e as to why the flood flow shear stress values might not show a strong relationship with the location of erosion. To state that WSE fluctuations are a significant factor in causing bank instability because it was in the top three of factors analyzed is incorrect. A more accurate statement based on the regression analysis is that none of the factors analyzed exerts a strong control on the location of

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			erosion (given the low percentage of variance explained by any factor) – this demonstrates the complexity of erosion and the myriad of factors involved in causing erosion, including many local factors that could not be adequately characterized and described within the context of a study investigating over 250 mi of river bank.
22	Bruno	I do not believe that an accurate measurement of historical limits of erosion can be determined using the methods [aerial photography and mapping] in Study 1.	Study 1 (filed March 1, 2016) used several methods to document historical bank conditions as described in Sections 4 and 5 of the study report. The problems associated with comparing bank positions using historical aerial photographs were discussed in the report and were taken into account when reaching conclusions about the results of the comparisons and is why only significant changes in bank position beyond the potential limits of error were considered (p. 23 and Study 1 report)
23	Bruno	The relatively short time period (2 years) of observing erosion…is insufficient data to make conclusions as to the extent of erosion in the study areas. Erosion occurs and continues over many years.	The 2-year monitoring period was the period approved by FERC in its SPD for the erosion studies. The purpose of the monitoring (in Study 2) was not to make conclusions about the extent of erosion in the study areas. Study 1 looked at the extent and context of erosion over time.
24	Bruno	The study claims that boat wakes are a major cause of erosion…It is my opinion that the few numbers of boats over the relatively short boating season would not have the effect on erosion that the studies represent.	The comment is incorrect, and the study does not claim that boat wakes are considered a "major" cause of erosion. The report references various literature sources and describes the action of boat wakes (pp. 14-15) which are considered one mechanism among others that leads to notching/overhangs at the base of the river banks (pp. 138-139).
25	Bruno	Although the intent of the studies was to determine the causes of the erosion in the study area and the studies do identify the potential causes, there is no technical data prepared or analyzed to provide any	We disagree with the comment. The study report includes extensive analysis of the relative significance of several potential causes of erosion, through the erosion ratio and logistic regression. WSE fluctuations related to normal

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		conclusions as to the degree of erosion as it is related to the potential causes, particularly dam operations.	project operations were included in that analysis which showed that WSE fluctuations have a lower potential to impact erosion than other characteristics such as bank height and flood flows. See also responses to Comment #s 11-12. Trying to quantify the degree to which erosion is caused by certain factors misrepresents the complexity of multiple factors associated with erosion. The velocity analysis strongly suggests that removal of sediment at the base of the banks occurs largely, if not exclusively, as the result of non-project related flood flows (Section 6.1 starting on p. 126). Without such flood flows the cycle of erosion would not continue and the banks would stabilize, thereby indicating flood flows are essential to sustain the continuing erosion in the study area
26	Bruno	None of the studies conducted any geotechnical or hydrogeological studies to determine the effects of the operational water level fluctuations on the streambank erosion. This would be the only way to determine the effects of water elevation fluctuation on streambank erosion.	The studies did not include geotechnical or hydrogeological studies as approved in FERC's SPD, which stated (p. B-7): *"Such an analysis could be useful in designing an embankment for a site-specific mitigation measure. However, because mitigation proposals and designs are premature at this stage of the licensing process, it is unclear how the requested information would inform potential license conditions."* Geotechnical and hydrogeological studies were beyond the scope of the approved studies. Furthermore, this type of analysis is not the only way to determine effects, nor is it likely to be any more definitive as it would only provide site-specific data based on soils, topography and land use [practices].
27	Bruno	[The erosion ratio] is not an accepted standard or methodology and it has not been peer reviewed. There are accepted modeling methods and procedures for determining bank erosion i.e., Bank and Toe Erosion Model from the USDA.	We have addressed this issue in prior responses on the initial study report. To reiterate here: the erosion ratio is merely a means for analyzing data of bank stability and other channel features mapped using standard methodologies. The erosion ratio was used in previous

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			FERC-accepted studies and the findings of Study 3 based on the erosion ratio have been corroborated by widely accepted statistical methods (p. 103).
28	Bruno	One of the conclusions of the report is that TransCanada operations and water level fluctuation are not a significant cause of the riverbank erosion. I find this hard to believe since boat traffic and ice only occurs over a relatively short period while the water level fluctuation….occurs [all year] even under ice during the winter.	While the frequency of a process might certainly relate to erosion, the magnitude of events is the more important driver. Flood flows occur frequently (12%, 28%, and 22% annually at Wilder, Bellows Falls, and Vernon, respectively) and are considered the most important factor in removing sediment from the base of the bank and sustaining the "cycle of erosion" that leads to bank recession.
29	Bruno	At all of the public meetings I have attended, TransCanada strongly opposed any studies that would determine the effects of water level fluctuations…riverbank erosion provides TransCanada with increased storage volume. Consequently it is in TransCanada's interest to have increased erosion.	Water level fluctuations were investigated thoroughly in these studies. The suggestion that Great River Hydro somehow receives any storage benefits from erosion is unfounded and false.
30	McIntyre	We [still] lack information about whether project operations [WSE fluctuations] cause erosion…	We disagree with the comment. The study does not point to project operations as a primary causal agent; rather study results indicate that high flows experienced on the Connecticut River and other rivers in this region that also have erosion occurring (absent a project –related operations) are the primary causal factor related to continued erosion. See also response to Comment #26.
31	McIntyre	[The mechanism of WSE fluctuation and seepage] that is most likely…a result of project operation…is dismissed as "unlikely" despite a growing body of evidence that [it] is important…	See response to Comment #s 9 and 29.
32	McIntyre	[T]he applicant's representatives have been careful to avoid mention of or to downplay the possible role that seepage is playing in erosive activity.	See response to Comment #s 9 and 29. The comment is incorrect. We have identified seepage as a possible contributing role but acknowledge that seepage potential is very site-specific and cannot be considered an overall major

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			contributing factor; in particular, as a function of project operations. Whereas, we have identified high flows, which exist throughout the project area, as a major critical factor in continued erosion.
33	Mudge	On January 28, 2013, at a FERC Scoping Meeting in West Lebanon, New Hampshire, Mr. John Ragonese…dismissed the need for any erosion studies since in 2012 a group of company employees had taken a boat trip on the entire Wilder pool and seen no evidence of erosion.	The comment is incorrect. At no time during the relicensing process has Mr. Ragonese indicated that riverbank erosion does not exist or that studies of erosion were not needed. The FERC transcript from the January 28, 2013 Scoping Meeting (available on the FERC elibrary [accession # 20130214-4008] and under the Scoping Phase tab at www.greatriverhydro-relicensing.com) refutes this characterization of comments made at that meeting by Mr. Ragonese. Page 28 of the transcript quotes Mr. Ragonese as stating *"…we did not propose any specific study on geology or soils [in the PADs…because] we want to hear what people's issues are…we did a shoreline survey…to identify the most active erosion locations..."* Page 34 of the transcript quotes Mr. Ragonese as stating *"The survey we did was from the river…we did not…walk everybody's roads, everybody's fields. It was a survey from the river to look at basically apparent, active erosion processes on the banks."* Note also that the shoreline survey referenced in the comment and this response was conducted by Kleinschmidt in 2010 (Kleinschmidt, 2011), not by company employees in 2012 as stated in the comment.
34	Mudge	No property owner has ever "armored" their property if there was no erosion.	The comment is made without factual basis and does not agree with available historical information as mentioned on Page 83 of the final study report, which states: *"A considerable amount of armoring is associated with protecting the railroad grade that runs along much of the*

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			river in the study area. The Boston-Maine railroad secured an indenture for armoring and stabilizing banks along the railroad <u>prior</u> to the raising of the WSE associated with the development of the Wilder Project in 1950." Findings from the study (p. 86) indicate: *"The upper and middle portions of Wilder impoundment show considerably more erosion than the lower impoundment (Figure 5.6.5-3a). The greater erosion could be related to the wider floodplain and more riverine character of the upper impoundment, but the significant armoring along the banks of the lower impoundment area more likely explain this discrepancy (Appendix C [referencing filed geodata]). The extensive armoring for the most part was completed as a preventative measure in the early 1950's shortly before and after raising of the Wilder dam and was not necessarily placed where banks were actively eroding."*
35	Mudge	a) Field uses an "Erosion Ratio" to argue that there is no erosion. b) …the citation for this [erosion] ratio is for Field (2007a). That citation reads: Fluvial Geomorphology Study of the Turners Falls Pool on the Connecticut River between Turners Falls, MA and Vernon, VT… That work appears to have been done for TransCanada.	a) These comments are incorrect. At no time during the relicensing process has Mr. Field indicated that riverbank erosion does not exist, and the final study report locates and quantifies erosion within the Project areas. The Erosion Ratio and the rationale for its use are discussed in Section 5.6.5a starting on page 83 of the final report. b) The Field 2007a study was conducted for FirstLight Power Resources at the Turners Falls and Northfield Mountain projects located downstream of the Vernon Project. Neither Great River Hydro nor any of its predecessors have ever owned, operated, or been affiliated with Firstlight or its predecessors operating those projects.
36	Mudge	a) I think it would be appropriate for any discussion	a) The FLAs were filed as public documents with the

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		about historic sites in the FLAs to be shared with the landowners. b) In the presentations about erosion I have never heard Ragonese or Field discuss the issue of cultural and historic sites. There is no mention of this in the [final Study 2-3 report]. c) I have never been contacted to discuss how the site on the Mudge property might be further protected.	exception of Exhibit E Appendix C which contained privileged maps of bald eagle nest sites. All privileged information on historic sites is also privileged information; however, such information associated with the Mudge property was provided on August 3, 2016 to Mr. Mudge (Phase II Archaeological Determination of Eligibility - Lampshire Meadow Site, August 1, 2016). b) Cultural and historic resources (Study 33) have been discussed at numerous meetings including scoping, study plan, and study report meetings. Note that Section 6.5.1 of the erosion studies final report and Section 3.10 in Exhibit E of the FLA includes discussion of cultural and historic sites in relation to erosion that could be shared publically. c) Section 3.10.4 in Exhibit E of the FLA, and the Phase II report of the Lampshire Meadow site both describe the process related to any applicable protection measures for historic resources pursuant to regulatory requirements and guidelines.
37	Mudge	Three surveys, all by licensed surveyors of a line on the Mudge property…shows that the line has been shortened by 40 feet [since 1961 and]… a difference of 15 feet between 1989 and 2015. When Field measured this line in the summer of 2015 he determined that there was an additional 8 feet of erosion since 1989.	We stand by the response to comments (filed October 31, 2016 and amended on December 5, 2016) to a similar comment made in the first draft of the report and believe the professional surveyor accurately measured to a stake placed 7 feet from the river bank and not to the river bank itself. If the commenter contends that all previous surveys were measured to a stake near the river bank but not to the actual edge of the river bank then that would call into question the utility of any of the surveys unless a uniform setback distance from the bank was used and accounted for in all previous surveys. However, no such evidence has been presented. The assumption is that the distances mentioned in the report reflect changes in distance to the river bank. In

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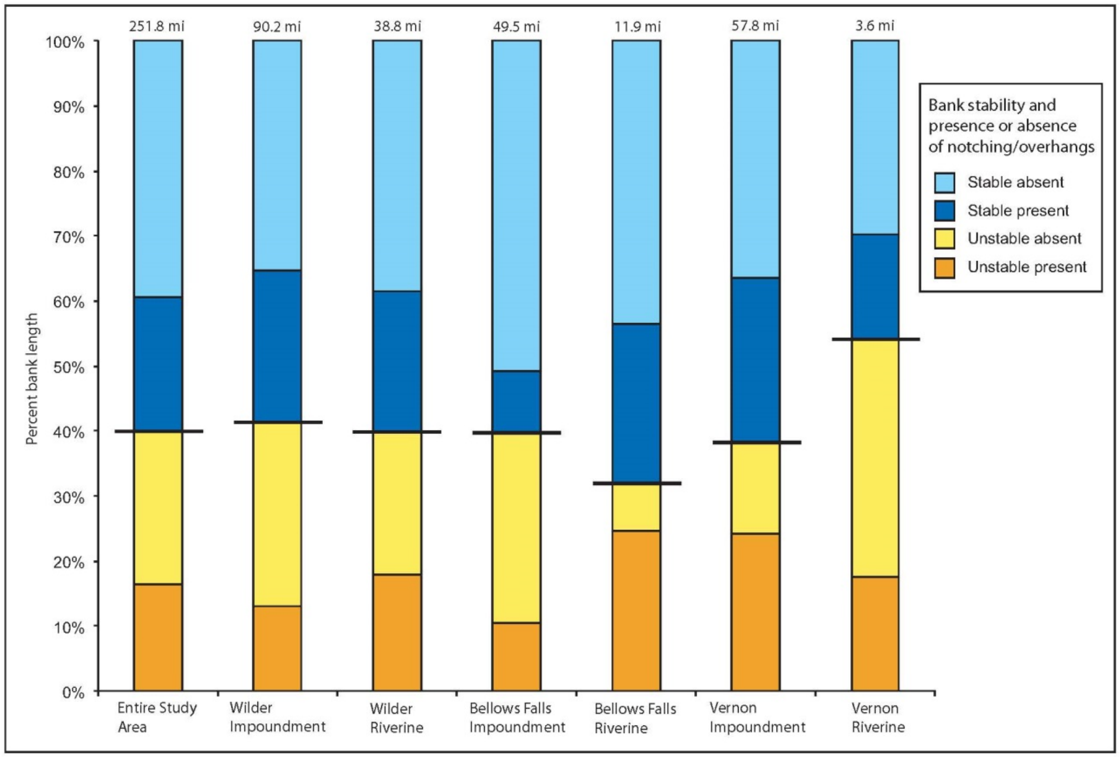
			any event, the more important point made in the report in relation to these surveys remains unchanged and that is that erosion rates vary dramatically in Wilder impoundment with rates of erosion of around 10 ft/yr at the Lewis property and less than 1 ft/yr at the Mudge property (p. 115-116). Regardless of whether an additional 7 ft of erosion occurred between 1989 and 2015 at the Mudge property the erosion rate would still be less than 1 ft/yr. The secondary point made that the erosion rate at Mudge has declined through time would also remain valid if an additional 7 ft of erosion had occurred between 1989 and 2015 (p. 116).

Comment #3 Additional Information:

Similar to Figure 5.8-1, this figure presents comparisons of presence and absence of notching/overhangs in areas of stable and unstable banks. The figure illustrates that the amount of notching/overhangs in areas mapped as stable is roughly the same as the amount found in unstable areas and varies by river reach.



Percentage of mapped bank stability and presence or absence of notching/overhangs by project area.

Comment #5 Additional Information:

This table presents velocity at the riverine monitoring sites at flows representing maximum station capacity and at flows higher than station capacity. Note that high flow values in Table 5.8-1 of the Study 2-3 final report for Bellows Falls and Vernon were not modeled at riverine erosion monitoring sites so the highest modeled flow (25,000 cfs) was used. The range of velocities for site 02-VR02 is based on the normal range of Turners Falls dam elevations.

	Wilder Discharge (cfs)		**10,000**	**16,000**	
Wilder Riverine	**Site**	**Node**	**Velocity Total (ft/s)**		**Difference (%)**
	02-WR01	864	1.7	2.2	29%
	02-WR-05	801	1.3	1.8	38%
	02-WR-08	730	2.7	3.3	22%
	02-WR09	703	2.6	3.0	15%
	Bellows Falls Discharge (cfs)		**11,000**	**25,000**	
Bellows Falls Riverine	**Site**	**Node**	**Velocity Total (ft/s)**		**Difference (%)**
	02-BR01	496	1.0	1.7	70%
	02-BR05	460	2.5	3.7	48%
	Vernon Discharge (cfs)		**17,000**	**25,000**	
Vernon Riverine	**Site**	**Node**	**Velocity Total (ft/s)**		**Difference (%)**
	02-VR01	148-VR	0.6	0.7 to 0.8	17% to 33%
	02-VR02	123-VR	1.7 to 2.4	2.1 to 2.6	8% to 24%

Comment #8 Additional Information:

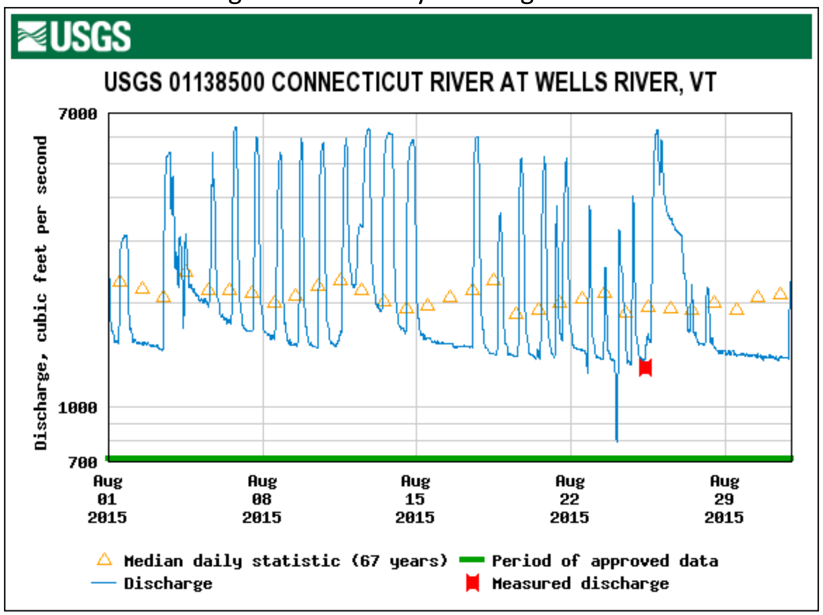
This table presents average channel shear stress at the 21 monitoring sites. Note that higher shear stress does not necessarily occur at banks mapped as eroding or with recession at the top or toe of bank.

	Elevation (NAVD88)		382.6	381.6	Stability Category	Recession of bank	
	Discharge (cfs)		10,000	16,000		Top	Toe
	Site	Node	Shear Chan (lb/ft^2)				
Wilder Impoundment	02-W02	1166	0.06	0.09	stable	no	no
	02-W03	1143	0.02	0.03	eroding	yes	yes
	02-W07	1040	0.02	0.04	eroding	no	yes
	02-W09	999	0.02	0.05	eroding	no	yes
	02-W10	985	0.01	0.03	eroding	no	no
	02-W12	919	0.01	0.03	failing armor	no	no
Wilder Riverine	02-WR01	864	0.03	0.05	eroding	no	no
	02-WR05	801	0.02	0.03	stable	no	no
	02-WR08	730	0.08	0.11	stable	no	no
	02-WR09	703	0.07	0.09	eroding	no	no
	Elevation (NAVD88)		**290.2**	**289.2**	**Stability Category**	**Recession of bank**	
	Discharge (cfs)		**11,000**	**50,000**		**Top**	**Toe**
	Site	**Node**	**Shear Chan (lb/ft^2)**				
Bellows Falls Impoundment	02-B01	686	0.09	0.13	eroding	yes	no
	02-B03	632	0.05	0.16	eroding	no	no
	02-B07	552	0.01	0.08	eroding	yes	no
	02-B09	523	0.00	0.06	healed erosion	no	no
Bellows Falls Riverine	02-BR01	496	0.01	0.05	stable	no	no
	02-BR05	460	0.07	0.23	vegetated eroding	no	yes
	Elevation (NAVD88)		**218.6**	**218.6**	**Stability Category**	**Recession of bank**	
	Discharge (cfs)		**17,000**	**45,000**		**Top**	**Toe**
	Site	**Node**	**Shear Chan (lb/ft^2)**				
Vernon Impoundment	02-V02	377	0.05	0.12	eroding	no	no
	02-V03	373	0.03	0.10	eroding	no	yes
	02-V06	194	0.02	0.11	vegetated eroding	no	yes
Vernon Riverine	02-VR01	148	0.00	0.01	eroding	no	no
	02-VR02	123	0.09	0.10	stable	no	no

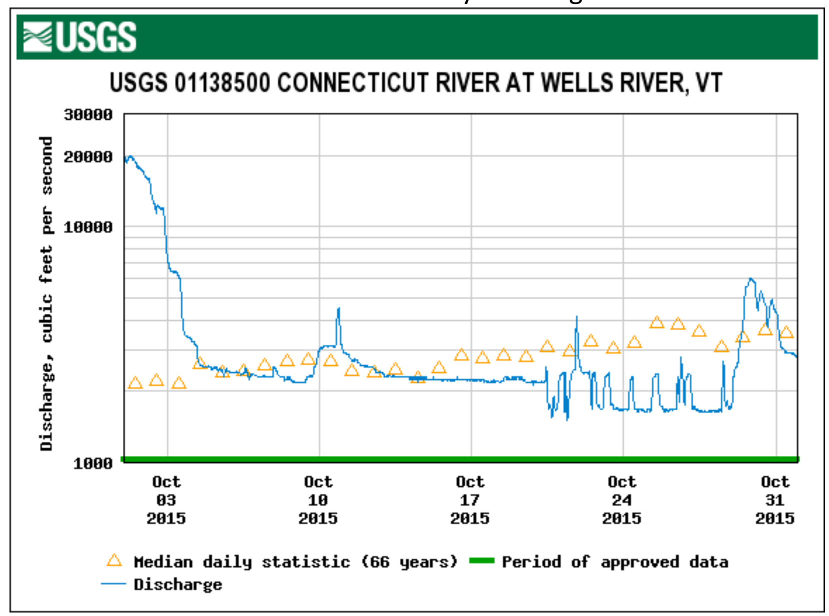
Comment #20 Additional Information:

These figures show discharge at USGS Gage # 01138500 / CONNECTICUT RIVER AT WELLS RIVER, VT which reflect mainstem conditions upstream of the Wilder Project, rather than conditions in the Wells River tributary which were included in the CRC comment letter. The graphs below display the same time periods as the comment letter.

August 2015 hourly discharge



October 2015 Hourly Discharge



Study 6 – Water Quality Study

Comment #	Source	Comment	Response
38	VANR	The report lacks a robust analysis of the potential effects of operations on [water quality] parameters…Analysis appears to be limited to graphical representations of one week of data for each parameter at one station in each reach.	We respectfully disagree that our analysis was not robust and was limited to a graphical representation of one week of data for each parameter. For clarification, we assume the commenter is referring to Figures 6.0-1 through 6.0-5 of the revised final report (filed December 15, 2016), which show the continuous water quality data along with project discharge as collected in the tailrace of each project during the ten day high temperature low flow monitoring period. These analyses consisted of an evaluation of all data collected to meet the goals and objectives of the study plan, which included an assessment of continuous water quality vertical profiles collected at each station, continuous water quality data collected at each station, and nutrient data collected from water column composite samples within each forebay, as well as tributary water temperature. The assessment included further calculations of basic summary statistics to evaluate consistency with both NH and VT surface water quality standards as well as visual examination of monthly time series figures of the entire continuous water quality dataset along with project inflows and project discharges. The entire 2015 continuous water quality dataset is presented in Appendix F.
39	VANR	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."* …Please describe how the responses to varying flows and generation levels were examined.	How water quality changes over time with respect to generation and flows was determined through visual examination of Figures 6.0-1 to 6.0-5, as well as the figures presented in Appendices F, L, and O of the revised final report. Findings are incorporated in various section of the main body of the report.
40	VANR	In comparing any effect of generation levels on water temperature and daily water temperature	Consistent with the goals and objectives of the study plan, the study determined the potential project effects on water

Comment #	Source	Comment	Response
		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.	temperature. The extent of qualification and quantification was a function of collected data. We concluded through detailed examination of the fine-scale patterns in the extensively graphed data set that the effect of generation levels on water temperature is largely indistinguishable from daily temperature fluctuations. Specifically, we concluded that at each station the continuous water temperature time-series demonstrated a single maxima and minima for each day rather than maxima and minima coincident with flow/generation/water level fluctuations. We further concluded, based on examination of the continuous water temperature time-series data, that generally there were no sharp increases in temperature within the tailrace coincident with increases or decreases in generation. Occasionally, a small effect on temperature as a result of generation within each tailrace was observed. For example, Figure 6.0-1 shows that when generation started on 9/8/2015 the temperature in the Wilder tailrace demonstrated an increase of approximately 0.5°C.

Study 9 – Instream Flow Study

Comment #	Source	Comment	Response
41	VANR	For the [Critical Reach Evaluation in Section 4.10 of the report]…the aquatic work group requested that all riffles, diverse habitats…, and sea lamprey spawning or potential spawning transects be included…The analysis in Section 5.2 groups the transects to represent the critical reaches…The agency requests that all individual 1D transects that represent the identified criteria [for critical reaches] be analyzed and presented separately.	As agreed upon during the April 14, 2017 consultation call Great River Hydro would provide results for all individual 1D transects, including critical reach transects, for all species and life stages. Examples of this output are being distributed to the aquatics working group under separate cover.
42	VANR	The report [Section 5.4 presenting AWS] 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 5.4 of the report and any related appendices will be updated to describe transect weighting and the basis for AWS results.
43	VANR	Section 5.7 Dwarf Wedgemussels and Co-occurring mussels states *"Both DWM and co-occurring display relatively flat habitat versus flow relationships for the Johnston Island 2D site indicating little effect on habitat with changes in flow."* [This] is likely 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…[see additional comments for Study 24 below].	See also response to comment #55 below under Study 24. We respectively disagree that adult mussels are not sensitive to flow. Numerous studies have indicated that hydraulic shear related variables are predictors of suitable mussel microhabitat and can affect mussel distribution and abundance (Layzer and Madison, 1995; Allen and Vaughn, 2009; Maloney et al., 2012; Parastewicz et al., 2012, to name a few). These variables are associated with changes in depth and velocity, and are also a function of substrate composition. The flat habitat versus flow relationship at Johnston Island is primarily a result of limited but persistent habitat availability at flows greater than approximately 3,000 cfs (see Study 9 final report Section 5.7, and appendices D and E). However, we agree that overall mussel abundance and habitat is also a function of flow regime. Habitat data for Tessellated Darter is in Study 9.

Literature Cited in Study 9 Responses:

Layzer, J.B., and L.M. Madison. 1995. Microhabitat use by freshwater mussels and recommendations for determining their instream flow needs. Regulated Rivers: Research and Management, Vol. 10:329-345

Allen, D.C., and C.C. Vaughn. 2010. Complex hydraulic and substrate variables limit freshwater mussel species richness and abundance. Journal of the North American Benthological Society 29(2):383-394.

Maloney, K.O., W.A. Lellis, R.M. Bennett and T.J. Waddle. 2012. Habitat persistence for sedentary organisms in managed rivers: the case for the federally endangered dwarf wedgemussel (Alasmidonta heterodon) in the Delaware River. Freshwater Biology 57:1315-1327.

Paraziewicz, P., E. Castelli, J.N. Rogers, and E. Plunkett. 2012. Multiplex modeling of physical habitat for endangered freshwater mussels. Ecological Modelling 228(2012):66-75.

Study 17 – Upstream Passage of Riverine Fish Species Assessment

Comment #	Source	Comment	Response
44	VANR	The attraction water system for the Vernon fish ladder was not operating at night during the 2015 assessment but was operational when the fish ladder was open during 2016…The agency requests that data from 2015 and 2016 be compared to determine whether there is a difference in passage rates at night…	The request for this comparison was raised at the March 30, 2017 study meeting and Great River Hydro described the reasons that this comparison between data collected in 2015 and 2016 cannot be made. This is a function of the different way Salmonsoft recording frames-per-second settings were selected in each year, along with an inherent error within the software that did not allow for capturing accurate timestamps of observations in 2016. This phenomenon is explained in detail on pages 79 - 80 of the final study report.
45	VANR	The report currently presents cumulative data plots versus time for each species at the three projects. The agency requests that [the plots be provided] for all species combined, resident species, and diadromous species for each project.	This information had been requested at the time of the initial study report, and was included in the final study report filed November 30, 2016 in Section 4.4.1 and related figures in that section.
46	VANR	The observation of [walleye and white sucker] in the [Vernon] fish ladder almost immediately upon opening of the ladder brings into question whether spawning migration is 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 stream flow and other environmental conditions.	Due to high flows in 2015 the Vernon fish ladder opened later than April 15. In 2016, the ladder opened on April 15, and while some Walleye or White Suckers were present shortly after opening, they were present in very small numbers (p. 79). We acknowledge that annual variability can affect timing and movement but based on the two years of data we conclude that the April 15 opening date does not cause undue delay or have a significant effect on these species. The report statement was made in reference to it not appearing warranted to open the fish ladder earlier than its current annual schedule for migratory species.

Study 18 – American Eel Upstream Passage Assessment

Comment #	Source	Comment	Response
47	VANR	Section 4.1 (Figure 4.1-1) – the Agency would find it helpful if the location of the temporary eel pass was included in the figure to discern where the eel pass was relative to the eel survey observations.	The location of the eel pass is described in Section 3.2 of the report supplement filed November 30, 2016. It was located in the tailrace corner at the fish ladder entrance and along the downstream wall of the powerhouse where the survey site #13 is depicted in Figure 4.1-1.

Study 19 – American Eel Downstream Passage Assessment

Comment #	Source	Comment	Response
48	NHFGD	Although the primary route of passage at each project was through the units, mortality appears to be much lower for eels that use other means of passage…[the comment goes on to make suggestions for improving survival via non-turbine passage routes and summarizes "survival" percentages based on tailrace residency times].	The final study report (filed February 28, 2017) makes clear that the radio telemetry portion of the study was not intended to inform on eel passage survival or on tailrace residency. Radio telemetry only provides information on the locations of active tags, not on the actual status of any fish once the tag has stopped moving (which could indicate a dead fish either by passage or other reasons, or a dislodged tag). However, at FERC's request, an attempt was made in Study 23 to estimate "total project survival" (report supplement filed February 28, 2017). That report supplement also describes the limitations of attempting to use radio telemetry to estimate survival.
49	VANR	Route Selection and Residency (Executive Summary and Section 5.1.3): Due to the long residency time of [some radio tagged] eels in the Vernon tailrace there is a strong likelihood that these individuals sustained serious injuries or were mortalities.	See response to Comment #48. Long residency times together with results from turbine survival could represent injury or mortality but this is not definitive for the reasons stated in the study report and the response above.
50	VANR	Turbine Survival (Executive Summary): Although the survival study showed that survival was higher through Francis turbines compared to Kaplan turbines…mortality appeared to be lower for eels that	See response to Comment #s 48 and 49.

Comment #	Source	Comment	Response
		did not pass through the units. Additionally the agency does not believe that units are an acceptable means of providing safe, effective, and timely passage.	
51	VANR	Section 4.3.6: The guidelines for major and minor injury classification in Table 4.3.6-1 underrepresent major injuries resulting in death. The Agency requests that all classifications be changed such that if a fish dies within 48 hours…it is classified as a major injury.	The classification of injuries is a standard classification developed for and used in many HI-Z tag survival studies designed to quickly classify injuries of recaptured fish by injury type. Injury classifications are independent of the survival estimates which take into account the fate of fish at 48 hours after passage (see Section 5.2.3 of the final report).
52	VANR	Section 5.1.1 - Wilder: [The radio telemetry] results support the findings of the [turbine] survival…study that the current configuration of Unit 3…has the potential to result in injury to eels. However the degree of injury could not be ascertained because individuals could not be recaptured.	Study 23 (report supplement filed February 28, 2017) found that *"Unit 3 survival was estimated using the Franke blade strike information…resulting in a predicted survival estimate of 0.0 - 46.9% at the unit's normal discharge of 700 cfs."*
53	VANR	Section 5.1.3 – Vernon: The report should clarify at what point [tailrace] residency time an eel was considered dead…Fish that are determined to be dead should be eliminated from summaries (e.g., Table 5.3-10). Not only does this reduce variability but it better illustrates the migratory behaviors of these fish once they encounter and pass a project.	Table 5.3-10 was intended to provide an overall summary of all fish that passed Vernon, regardless of their ultimate fate. The report text just above the table on p. 68 indicates that 76% of eels that entered the Vernon study area passed and departed the study area within 24 hours. As noted in response to Comment #48, there is no way to determine whether a stationary tag is a dead fish or a dislodged tag, nor whether the fish may have died as a result of passage.
54	VANR	Appendix E: the Agency notes that although the majority of eels passed the projects in less than 24 hours most of them exhibited wandering or searching behavior.	The Nearfield Movement Patterns subsections of report Sections 5.1.1, 5.1.2, and 5.1.3 report on the high percentages of eels that passed each project in less than 1 hour (74 – 76%), and in less than 8 hours (82 – 89%), suggesting these eels found downstream passage relatively quickly.

Study 24 – Dwarf Wedgemussel and Co-occurring Mussel Study

Comment #	Source	Comment	Response
55	VANR	The comment has been edited and summarized for clarity as follows: a) The study does not provide information needed to develop flow recommendations that meet Vermont water quality standards because it uses habitat suitability criteria (HSC) for adult mussels. b) Adult mussels are adapted to natural flow regimes and are not sensitive to flow, and VANR suggests that other life stages may be more sensitive to flow. c) There is a "reasonable assumption" that mussel reproduction may be more successful under certain flow conditions and VANR recommends analyzing habitat quality for host fish species near mussel beds at the time when female mussels are releasing glochidia, and this analysis may help the Agency determine a flow regime that is protective of mussels.	See also responses to comments on Study 9 above. a) The study plans (for Study 9 and Study 24) were reviewed and approved by stakeholders and FERC, and focused on life stages that are observable in the field and for which the HSC and modeling tools are most effective. The life stages included adult and juvenile mussels, for which the Delphi panelists concurred that HSC were similar. The study did not consider the parasitic larval stage of freshwater mussels for several reasons, including (but not limited to): (1) very little is known about the phenology of embryonic development and release of glochidia; (2) host-fish relationships for mussels are not fully understood; (3) the factors that influence the infection, attachment, and development of glochidia on their hosts are not understood. Furthermore, the assumption that mussel reproduction is directly related to host fish habitat under certain flows may not be viable if glochidia release is not flow dependent. b) VANR suggests that adult mussels are not sensitive to flow, and that other life stages may be more sensitive to flow. Scientific studies all concur that all life stages of mussels, and their habitat, are indeed sensitive to flow. Although planktonic larvae and newly settled juvenile mussels may be more sensitive to certain aspects of the flow regime, the degree of sensitivity is unknown, and incorporating this sensitivity into HSC to use in the habitat modeling is challenging and beyond the scope of the studies. VANR states that there is a “reasonable assumption” that mussel reproduction may be more

Comment #	Source	Comment	Response
			successful under certain flow conditions. Whether or not this assumption is "reasonable" is not clear based on current scientific understanding, as there are many aspects of mussel reproduction that remain unknown. c) VANR recommends analyzing habitat quality for host fish near mussel beds at a time when female mussels are releasing glochidia. This is a complex and challenging request, considering that: (1) several mussel species are known to occur in the Project area; (2) some of the mussel species in the Project area are very sparse and do not exist within "beds" that have been identified or mapped (example: creeper, triangle floater, dwarf wedgemussel); (3) most fish species that occur in the project areas likely serve as suitable hosts for one or more of the mussel species; and (4) the timing of glochidial release varies among species and is thought to be influenced by several environmental factors.

Study 25 – Dragonfly and Damselfly Inventory and Assessment

Comment #	Source	Comment	Response
56	VANR	Neither the report nor the analysis distinguish between species that prefer lotic habitat of the riverine sections versus those species that are generalist or select the semi-lotic habitat of the impoundment reaches… [and may underestimate project effects]…This type of analysis would [help to] determine whether project operations are having a disproportional effect on odonates using riverine sections… [see specific comments on Sections 4.2 and 5.2 of the report].	The final study report (filed December 15, 2016) distinguishes between lotic and semi-lotic species in both the literature and in the study area. Based on additional comments below, we will prepare a study report supplement that will include more description of the locations where lotic and semi-lotic species were found, and summarizes our findings relative to these species to make the information more clear.
57	VANR	The report indicates that no consistent trend was found in substrate or habitat preference… [The report should] provide information on the proportion of habitat types available below the low habitat elevation…especially for the riverine habitat where there is between 1.5 and 4 ft of substrate that was documented being used by odonates...[see specific comments on Sections 4.2, 5.2, and 6.1 of the report].	As shown in Appendix B of the final study report, we observed few eclosing odonates in the areas below the toe of slope, and sediments are uniformly fine. We will revisit the data and if possible, describe the conditions and frequency of use, and assess the potential habitat impacts of Project operations, if relevant in those areas, in the report supplement.
58	VANR	The analysis of water level rise of 8 inches over 30 minutes as a result of project operations [underestimates] project effects…This time step does not include the time for the teneral to harden and take flight…A conservative approach [should be taken] for this analysis and evaluate the water level rise over the course of one hour [see specific comments on Sections 6.1 and 6.2 of the report].	Because many tenerals were observed climbing almost immediately after eclosing, we believe 30 minutes is a reasonable timeframe to analyze, but will perform the 1-hour analysis as requested and present those results in the report supplement.
59	VANR	The report likely overestimates the vertical distance from the water surface at the time of emergence…a potential way to limit the overestimation of the distance traveled is for each sampling period at each site [to present] the mean, maximum, and minimum	The relationship between elevations estimated from exuvia and those measured from eclosing animals is discussed in section 5.3 (page 20) of the final study report. We consider this approach and resulting data to be more accurate than the weekly water level data requested in the comment. We

Comment #	Source	Comment	Response
		water level for one week prior to the survey.	will expand on this explanation in the report supplement.
60	CRC	CRC recommends that Great River Hydro consider using a longer eclosure period (e.g., 1-2 hours rather than 30 minutes).	See response to Comment #58.
61	CRC	The study should look at the height of WSE changeover the critical time period (recommended 1-2 hours) and compare that with the typical distance above water that eclosure takes place…on page 20 it states that *"The mean vertical distance from the water surface at which eclosing Stylurus spiniceps were observed was 12 inches (range of 8 – 16 inches)."* What is the likelihood that the water level would rise by 12 inches in 30 minutes, 1 hour, or 2 hours?	See response to Comment #58. Looking at an 8-inch water level rise rather than a 12-inch rise is a more conservative approach that we used in the study. The 30-minute time period is reasonable and based on study observations, but as noted in response to Comment #58, the supplemental analysis will also use 1 hour. There is no basis for looking at water level rise over longer timeframes such as 2 hours.

Study 33 – Phase II Archaeological Site Evaluation Surveys, Wilder and Vernon Projects (Vermont)

Comment #	Source	Comment	Response
62	VDHP	The VDHP concurs with the PAL recommendation that five of the six pre-contact sites evaluated as part of the Phase II investigation are eligible for the National Register of Historic Places. The VDHP also concurs with the finding that the National Register eligibility of the Site VT-WD-355, the second site evaluated in the Vernon Project, is undetermined pending verification of the stratigraphic context within the area of potential effect (APE).	We acknowledge VDHP's concurrence. As stated in the report, the National Register eligibility of Site VT-WD-355 is undetermined at this time because of the questionable integrity of the cultural context of deposits in the APE (most pre-contact cultural material recovered was found within disturbed and plowed soils layers). There is potential for intact, National Register-eligible site deposits on the upper terrace to the west and outside of the APE. No pre-contact cultural features were identified.
63	VDHP	While the VDHP is in general agreement with the further recommendation that Great River Hydro, LLC, as new owners of the Projects, take measures to preserve and protect the six pre-contact sites evaluated during this investigation, it is imperative that mitigation strategies take precedence over monitoring. All six of the sites are situated adjacent to eroding scarps and significant deposits in the National Register eligible sites extend to the top of bank, indicating there has likely been substantial data loss. Implementation of data recovery excavation efforts in actively eroding site areas should occur immediately rather than waiting for the development of the Historic Resource Management Plan (HPMP) so that there is no additional data loss from these significant historic properties.	Great River Hydro will consider and evaluate monitoring, protection, and mitigation measures recommendations within the total context of all relicensing recommendations or proposed protection, mitigation, and enhancement (PM&E) measures (some yet to be determined or proposed) in an alternative to the currently proposed and no-action alternatives in an amended FLA or during the course of FERC's post-filing environmental analysis, as appropriate. All monitoring and potential mitigation strategies for would be then be outlined in the HPMPs. Protection and mitigation measures cannot be specified in the absence of the broader context and consideration of all other project mitigation and enhancement measures that will apply to the future licenses.
64	VDHP	The positive eligibility determinations for five of the six sites subject to Phase II evaluation also underscores the necessity for continued efforts to obtain landowner permissions to complete Phase I site	As indicated above, all monitoring and continued efforts to obtain landowner permissions to complete Phase I site identification and Phase II evaluation studies in un-sampled portions of the APE within the Wilder, Vernon, and Bellows

Comment #	Source	Comment	Response
		identification and Phase II evaluation studies in un-sampled portions of the APE within the Wilder, Vernon, and Bellows Falls Projects. As first noted in the VDHP's updated Study Plan comment on July 15, 2013 almost four years ago, completion of these actions is fundamental to fully considering the Projects impacts to historic properties in compliance with the National Historic Preservation Act.	Falls Projects will be considered within the total context of all relicensing recommendations or proposed PM&E measures (some yet to be determined or proposed) in an alternative to the currently proposed and no-action alternatives in an amended FLA or during the course of FERC's post-filing environmental analysis, as appropriate. Final recommended actions or strategies to address this request for continued effort would be encompassed in the HPMPs for the Projects.

Study 33 - Cowasuck Band of the Pennacook-Abenaki People, Comment letter from Paul Pouliot dated May 9, 2017

Comment #	Source	Comment	Response
65	Cowasuck Band	1. Introductory Comments: It is not the intent of the Cowasuck Band to make any specific demands. However, the Cowasuck Band expressly reserves its Indigenous rights under 25 U.S.C. and our rights to protect ourselves from any harmful action in regard to the ILP and the future operations of GRH. We believe that the NHPA Section 106 Tribal Consultation is a negotiated multi- lateral process that provides us an opportunity to express our concerns and suggestions relevant to this ILP and the continued operations by GRH.	Great River Hydro, irrespective of FERC's statutory responsibility under NHPA Section 106 Tribal Consultation, will continue to engage and consult with Abenaki tribal leaders representing the various Abenaki tribal units within our project affected area.
66	Cowasuck Band	2. Defining Area of Potential Effect (APE): As the Area of Potential Effect (APE) is identified, the Cowasuck Band believes that this APE meets the minimum requirements. The Connecticut River and all of its associated water shed that is defined	While Great River Hydro respectfully understands the concept and vision of what may represent the APE to the Abenaki tribe, the ability of these projects to directly affect or impact that area has been identified in various studies that inform stakeholders of the capability of the projects to

Comment #	Source	Comment	Response
		as the APE may in fact be a "fluid" reality that needs continued monitoring and redefined description. It may, in a broad scope, be considered a "living ecological system" that extends both upstream and downstream of the defined APE to limits that we cannot fully understand or attempt to define.	affect, mitigate, or enhance various resource considerations. In a larger context, the continued operation of these valuable renewable energy projects significantly offsets and prevents the need for additional carbon-based and other pollutant energy resources or new hydropower development in Canada and therefore represents a positive enhancement and value to the APE as defined by this comment and perspective.
67	Cowasuck Band	3. Defining Vermont and New Hampshire State River Boundaries: Based on our historical review of the Vermont and New Hampshire border and Connecticut River boundary issues it appears to us that the vast majority of the APE is within the state of New Hampshire, with the exception of that portion that is within the Vermont Yankee Nuclear Power Plant locus. The Cowasuck Band believes that, as the Indigenous tribal entity resident in New Hampshire, we are a major stakeholder in this ILP.	See response to Comment #66 and note that this is without prejudice to location relative to one side of the Connecticut River or the other, whether in NH or VT as the projects are located in both states.
68	Cowasuck Band	4. Great River Hydro Custodial and Operational Responsibilities: We believe this is a significant custodial responsibility that requires GRH to act to responsibly protect, maintain, and potentially improve the APE in all particulars for the ensuing fifty years.	Great River Hydro acknowledges this comment and no response is required.
69	Cowasuck Band	6A. Mitigation. Archaeological Activities and Documentation: The Cowasuck Band will be seeking mitigation action to properly document all project archaeological activities, including prior historical findings, Phase 1A, Phase 1B, Phase II, and any	Sharing of information and or consultation related to Project-related archaeological activities, investigations, protection or mitigation with Abenaki Tribal leaders will be address in a Programmatic Agreement and resulting Historic Resource Management Plan

Comment #	Source	Comment	Response
		continuing project archaeological activities.	
70	Cowasuck Band	6C. Mitigation. Traditional Indigenous Fishing and River Access Sites: We suggest that GRH, study, plan, develop, and if possible construct traditional Indigenous fishing sites at locations under the control and or ownership of GRH. The goal and objective is to provide improved fishing and to reestablish a small portion of the Indigenous Traditional Cultural Property that was once in existence in the time before the Connecticut River was restricted or otherwise impacted by dams and colonial commerce. These sites could also be designed for river access, if applicable, for swimming or conveyance by canoeing but with no provisions for motor powered water craft.	A mitigation proposal such as this would be considered within the total context of all relicensing recommendations or proposed PM&E measures (some yet to be determined or proposed) in an alternative to the currently proposed and no-action alternatives in an amended FLA or during the course of FERC's post-filing environmental analysis, as appropriate. Final recommended actions or strategies to address this request would, if adopted, be encompassed in HPMPs or other land use related plans for the projects.
71	Cowasuck Band	6D: Mitigation. Aquatic Life- Fish and Aquatic Life Improvement- Dam Passage Improvements: We have reviewed the numerous reports and studies related to various aquatic, insect, and plant life, specifically the anadromous and catadromous fish species. It is obvious that dams on the river are manmade obstacles to any of the migratory species that may have historically spawned within the Connecticut River watershed. Action is needed if any of the fish runs are to survive for the next fifty years. Fish friendly safe and effective passage is required at all dams. We cannot make specific recommendations, but we believe that multiple and unique strategies are required at each dam	Great River Hydro has historically approached aquatic habitat and fish passage requirements in a responsible manner, working in concert with state and federal agencies as well as other dam owners. There is no reason to believe that that legacy will not continue within the total context of all relicensing recommendations or proposed PM&E measures and with a clear understanding of passage necessity, priorities, and site-specific designs and alternatives that affect implementation timing.

Comment #	Source	Comment	Response
		site to facilitate the up and down stream migration of the various migratory fish species. Simply stated, no one fish ladder or dam passage design for one particular species is an adequate solution for the greater good of all fish species. Furthermore, we believe that these dams are major part of a much larger issue. To make the entire Connecticut River watershed and its feeder tributaries more productive for aquatic life we need an inter-company strategy between all operating companies, the federal and state agencies, and the stakeholders to create safe fish passage at other major and tributary dams to increase available spawning habitat and success.	
72	Cowasuck Band	6E. Mitigation. Dam Operation- River Flows, Water Levels, and Water Temperature: From an operational standpoint we suggest that comprehensive testing should be conducted before making any changes to dam discharges and flow rate regimes to prove they will not harm any aquatic or plant life due to flow issues or erosion. Especially important are the operational conditions and flows that occur during peak and low river flow and the multiple migratory fish spawning time periods. We also recognize that the existing hydro-electric turbines were designed for power production in historical times when aquatic life passage issues were not a priority. We also believe that some of	Instream flow studies and fish passage studies including turbine survival studies have been undertaken and results presented to interested stakeholders and filed with FERC. All mitigation proposals put forth by various agencies, tribal leaders, and other stakeholders addressing issues identified in these studies would be considered within the total context of all relicensing recommendations or proposed PM&E measures (some yet to be determined or proposed) in an alternative to the currently proposed and no-action alternatives in an amended FLA or during the course of FERC's post-filing environmental analysis, as appropriate.

Comment #	Source	Comment	Response
		the particular hydro-electric turbine designs are more inherently destructive and lead to high fish mortality rates. Turbine design studies, possible design modifications, and operational changes should be implemented to lower these fish mortality rates.	
73	Cowasuck Band	F. River Bank Erosion Issues: Operational flow rates and water level considerations should be a high priority to protect river bank and shore line landscapes from any undue erosion. We realize that erosion remedial actions may require a: detailed action plan; inter-agency participation and permitting;and, potentially complex construction methods to stabilize areas of erosion. In the event that river bank erosion requires remedial (emergency or planned) action,GRH must be held as a responsible party, with the appropriate parties, to facilitate repairs to the riverbank landscape. If that river bank or shoreline erosion occurs and results in the exposure of an historical Indigenous site, known or newly discovered, GRH must notify the appropriate federal, state, and tribal (Cowasuck Band) authorities. In our case, the New Hampshire Department of Historical Resources (NH DHR) must be notified to take appropriate investigative action. If the NH DHR determines that this situation reveals or may potentially expose the presence of artifacts and or human remains then we would request that the	Erosion studies have been undertaken and results presented to interested stakeholders and filed with FERC. All mitigation proposals put forth by various agencies, tribal leaders and other stakeholders addressing issues identified in these studies would be considered within the total context of all relicensing recommendations or proposed PM&E measures (some yet to be determined or proposed) in an alternative to the currently proposed and no-action alternatives in an amended FLA or during the course of FERC's post-filing environmental analysis, as appropriate. Sharing of information and or consultation with Abenaki Tribal leaders as well as State Historic Preservation offices about project-related archaeological activities, investigations, discovery of artifacts, human remains, repatriation, and other protection or mitigation will be address in a Programmatic Agreement and resulting HPMPs citing, at a minimum, required statutes regulating such activities.

Comment #	Source	Comment	Response
		action be taken under the provisions of New Hampshire Title XIX Public Recreation Chapter 227-C Historic Preservation, Preservation of State Historic Resources, Section 227-C:8-A. In the execution of these actions the Cowasuck Band would provide assistance to perform traditional ceremonial repatriation services if required.	
74	Cowasuck Band	6G. Mitigation. Curation and Repatriation - Sacred Artifacts, Human Remains, Funerary Artifacts, and Artifacts of Cultural Patrimony: It is our position that if an artifact is deemed to be "sacred" or otherwise an item of "cultural patrimony" by our Cowasuck Band and, or the NH DHR, that item must be appropriately curated by the NH DHR or repatriated regardless of any perceived ownership issues. No Indigenous human remains, funerary item, or artifact should ever be removed from the State of New Hampshire or our traditional homelands for the purpose of private sale, curation, or repatriation.	See response to Comment #73.