PO Box 6219, Brattleboro, VT 05302 - 802-258-0413 - ctriver.org
Connecticut River Conservancy

Mr. Jeff Crocker
Vermont Agency of Natural Resources
Department of Environmental Conservation
Watershed Management Division
1 National Life Drive, Davis 3
Montpelier, VT 05620-3533
jeff.crocker@vermont.gov

March 16, 2025

Re: Vernon Hydroelectric Project (FERC No. 1904) draft 401 Water Quality Certification (ENB ID: PN24.0018904)

Dear Mr. Crocker:

The Connecticut River Conservancy ("CRC"), Vermont Natural Resources Council ("VNRC"), Conservation Law Foundation ("CLF"), American Rivers ("AR"), American Whitewater ("AW"), and Appalachian Mountain Club ("AMC") respectfully submit these comments to recommend that the Department of Environmental Conservation ("DEC") deny the § 401 Water Quality Certification ("WQC" or "Certification") for Great River Hydro's, LLC ("GRH") Vernon Project (FERC No. 1904).

The Connecticut River is one of Vermont's most important public and natural resources. The areas affected by these Vernon, Bellows Falls, and Wilder hydroelectric projects span approximately two-thirds of Vermont's length and impact river use and ecology in 16 towns. The FERC relicensing and § 401 Water Quality Certifications must ensure compliance with Water Quality Standards and water-quality-related requirements of state law for the next 40 years.

The Draft Certification fails to ensure this compliance. Indeed, the Draft Certification has critical shortcomings largely resulting from GRH's failure or outright refusal to provide adequate information and plans in their application. The draft WQC fails to address the adverse impacts the GRH Vernon project will have on water quality and recreation. The Draft WQC does not

ensure that the continued presence and operation of the Vernon project will comply with the State of Vermont ("Vermont") Water Quality Standards ("WQS"). These shortcomings compel denial of certification without prejudice such that GRH and DEC can fully address these critical deficiencies in a timely manner, as outlined below.

As an environmental organization dedicated to the protection and restoration of the Connecticut River and its tributaries, CRC is deeply concerned about the lack of specificity and appropriate conditions contemplated in the draft WQC. Since 1952, CRC has worked to protect and restore the Connecticut River and its tributaries. CRC represents thousands of members across four states, including several hundred in Vermont, and as the only nonprofit organization dedicated to protecting the entire Connecticut River ecosystem, our comments consider the localized impacts of the Vernon project, and the watershed-wide implications of the failure of the DEC to properly condition the § 401 certification.

American Rivers works to protect wild rivers, restore damaged rivers, and conserve clean water for people and nature. Since 1973, American Rivers has protected and restored more than 150,000 miles of rivers through educational and advocacy efforts, on-the-ground projects, and an annual America's Most Endangered Rivers campaign. Annually American Rivers engages in more than 20 hydropower relicensing across the country. American Rivers has regional programs across the country including in the Northeast, and more than 100,000 supporters, members, and volunteers nationwide. American Rivers' staff and volunteers work to enhance river flows and increase river connectivity to benefit biodiversity, protect floodplains and wetlands, and restore rivers providing climate change refugia. Members of American Rivers enjoy and are sustained by the resources of the Connecticut River including for angling, boating, swimming, hiking, and wildlife viewing.

American Whitewater is a national non-profit 501(c)(3) river conservation and recreation organization founded in 1954. With approximately 7,000 members and 85 affiliate clubs, representing tens of thousands of whitewater paddlers across the nation, American Whitewater's mission is to protect and restore our nation's whitewater resources and to enhance opportunities to enjoy them safely. American Whitewater members are primarily conservation-oriented kayakers and canoeists, many of whom live and/or engage in recreational boating in the New England region within easy proximity of the Connecticut River. American Whitewater has long been involved with the FERC licensed hydropower projects in Vermont, including hydropower projects located on the Connecticut, Green, Missisquoi, Mad, and Wells rivers.

Since 1876, the Appalachian Mountain Club ("AMC") has promoted the protection, enjoyment, and understanding of the mountains, forests, waters, and trails of the Appalachian region. AMC is the largest conservation and recreation organization in the Northeast with more than 90,000 members, supporters, and advocates, many of whom visit the Connecticut River for recreation.

Conservation Law Foundation's mission is to protect New England's environment for the benefit of all people. CLF uses the law, science, and the market to create solutions that preserve our natural resources, build healthy communities, and sustain a vibrant economy. CLF has thousands of members across New England, including hundreds who reside in Vermont. CLF has active members who live near to the Connecticut River (including upstream and downstream of the Vernon Dam) and regularly use the river for recreation and personal enjoyment including, but not limited to fishing, paddling, and wildlife viewing.

VNRC is a Vermont not-for-profit and member-supported environmental advocacy organization that has been addressing environmental issues in Vermont, including issues related to water quality, for sixty years. VNRC's mission is to protect and enhance Vermont's natural environment, vibrant communities, productive working landscapes, rural character, and unique sense of place through advocacy, collaboration, research, and education. VNRC serves to both support and hold accountable agencies that administer Vermont's environmental laws to ensure that these laws are legally and properly implemented. VNRC works specifically on environmental policy related to clean water, healthy forests and wildlife, forestry, agriculture, sustainable communities, land use, and climate change and energy. VNRC has over five thousand members who reside in Vermont.

SUMMARY

These § 401 processes are the first opportunity since 1979 to address the dams' impacts on water quality, and due to the length of FERC license cycles, will be the only opportunity for the next 40 years. We do not have a shorter cycle allowing for periodic review, updates and reasonable timeframes in which mistakes can be fixed. The 40-year FERC licensing cycle compels gathering as much information as needed for the enormous task of correcting conditions that resulted in negative impacts to water quality and fluvial processes, as well as to plan appropriately for the protection of water quality and access to the river to protect designated uses for the next 40 years.

CRC raised multiple issues related to the relicensing of this facility through FERC proceedings during the past several years and through our comments on the GRH § 401 applications for the Wilder, Bellows Falls, and Vernon projects submitted to the DEC on October 1, 2024, which comments are hereby incorporated and attached hereto. The DEC should have denied water quality certification due to the material lack of information in the application. Having issued the Draft WQC, the DEC has failed to include the appropriate mitigation provisions and conditions needed to protect Vermont's Water Quality Standards or to properly exercise and enforce Vermont's § 401 authority. We include those comments dated October 1, 2024, by reference and explicitly, as comments to be considered and addressed through this formal comment period. Those comments are attached.

The Connecticut River ("the River") is a public resource. GRH's use of, manipulation of, and profit from this public resource impedes public access to and use of the River and impacts natural hydrologic and hydraulic processes. Public access and uses must be maintained—the issuance of a federal license or § 401 certification does not transfer ownership of the River to Great River Hydro. They must coexist and exercise coextensive use of the River with the public and wildlife that relies on the river. Through outright lack of data as well as vague and contradictory statements, GRH fails to demonstrate how their project proposals meet Vermont WQS. Critically, DEC's subsequent lack of clear and enforceable conditions in the Draft WQC fails to meet the WQS because the conditions do not:

1. Address and mitigate shoreline undercutting and erosion, model impacts of changes in flows, and monitor for impacts of peak flows under new flex operations;
2. Manage sediment transport, including the protection of aquatic habitat and limiting the release of legacy nutrients;
3. Model climate change impacts on expected flows and flooding scenarios;
4. Protect rare, threatened, endangered or otherwise protected species of concern such as the shortnose sturgeon, dwarf wedge mussel, tiger beetle, Fowler's toad, and protected plants under proposed operational changes;
5. Protect water quality, aquatic habitats and species in the face of increased flooding and subsequent drawdowns;
6. Provide for appropriate and equitable public access to the river for designated recreational uses;

7. Reduce impacts on water quality and aquatic habitat by adequately managing aquatic invasive species;
8. Protect and monitor historical and archaeological resources that may be impacted by changes in erosion and sediment depositional processes;
9. Install effective fish passage upgrades in a timely manner;
10. Provide financial assurances regarding the funding of eventual decommissioning;
11. Provide real time data on flows for recreational access, improve education about and access to fish passage, communicate about recreational access areas, and provide periodic reports regarding ecological concerns.

A. Numerous Vermont Water Quality Standards Are Applicable Here

The draft WQC fails to include the following important provisions of the WQS that must be included in consideration of this § 401 application:

- § 29A-206(b)(2) which provides that "[a] water quality certification shall not be issued unless . . . there is reasonable assurance that the discharge will not result in a violation of these rules, including any applicable water quality criteria and the Antidegradation policy articulated in these rules."[1] CRC contends that both GRH's application and the draft WQC does not in fact provide reasonable assurance.

- §29A-206(c) which requires that "any certification issued by the State shall establish conditions necessary to ensure that the federally licensed or permitted activity will comply with these rules, *as well as with any other appropriate requirements of State law* . . . ."[2] While certain VT statutes are called out, the statement does not exclude all other state laws that would be applicable to this proceeding, such as where there is no consideration of potential impacts to archeological resources because of changes in erosion and deposition as a result of operational changes.[3]

[1] VERMONT AGENCY OF NAT. RES. DEP'T OF ENV'T CONSERVATION WATERSHED MGMT. DIV., VERMONT WATER QUALITY STANDARDS ENVIRONMENTAL PROTECTION RULE CHAPTER 29A 18 (2022).
[2] *Id.* (emphasis added).
[3] VT. STAT. ANN. tit. 22, § 723.

- §29A-302(2)(A) which requires that, "[i]n all waters, total phosphorus loadings shall be limited so that they will not contribute to the acceleration of eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents the full support of uses,"[4] and §29A-302 (3)(A) which requires that "[i]n all waters nitrates shall be limited so that they will not contribute to the acceleration of eutrophication, or the stimulation of the growth of aquatic biota, in a manner that prevents the full support of uses.[5] Here no consideration has been made for the potential of nutrient loading and its compliance with these WQS as a result of changes to sediment transport and depositional dynamics under the new operating flow regime and exacerbated by climate change. Furthermore, no analysis has been required, and no conditions have been put in place to understand, model for, or monitor potential increases in nutrient loading over the next 40 years.

- §29A-305(a) which provides that "[t]he Secretary shall determine whether there is full support of the aquatic habitat use through appropriate methods of evaluation, including hydrogeomorphic assessments of flow characteristics, physical habitat structure, and stream processes for rivers and streams and aquatic habitat studies for lakes, ponds, and reservoirs."[6] During the FERC Integrated Licensing Process ("ILP"), studies were done to assess benthic habitat, but they were done based on the status quo of previous peaking operations and have not been re-done to evaluate the effect of the change in operation, and subsequent changes in erosion and depositional patterns on aquatic habitat that would result from the project operations described in the application. There has been no analysis and there are no conditions to assess the potential impacts to aquatic habitat from operational changes.

Comments on Section IV. Decision and Certification

The conditions that are included in the Draft § 401 will fail to protect WQS. These conditions will fail to protect WQS because of the lack of fundamental information needed to assure WQS compliance. We address those conditions below in the order presented in the Draft § 401 WQC:

B. Flow and Water Level Management Changes Require Additional Scrutiny

[4] VERMONT AGENCY OF NAT. RES. DEP'T OF ENV'T CONSERVATION WATERSHED MGMT. DIV., *supra* note 1, at 21.
[5] *Id.* at 22.
[6] *Id.* at 27.

We are in support of the change in flow management. This change, however, addresses only limited aspects of the Connecticut River's widespread water quality problems. And while this change is a step in the right direction, it is also expected to have short and long-term impacts that are likely to violate WQS. It is irresponsible of the Department to accept this change in flow management without first having required modeling and analysis to assess and manage adverse consequences. For example, and as stated in our October 1 letter, "the change will also likely create extensive shifts in sediment transport dynamics over the coming license period. As this change in operations was not considered during the study phase of the relicensing, no meaningful analysis has been done to understand the effects of changing river flows on erosion, sediment transport, and river hydrogeomorphology."[7] These changes to sediment transport dynamics are very likely to violate WQS. Additional certification conditions may be warranted to bolster and strengthen the agreed-upon flow changes.

In addition to this, we are experiencing much more significant storms and flooding due to climate change. These storms bring with them water quality impacts due to increases in water volume that will further destabilize river systems. Planning for climate change impacts over the next 40 years must be considered in this WQC review process.

GRH chose not to develop the information needed to understand the impacts of flow changes in their actual physical context. The Draft WQC validates this complacency and proposes certification without even considering this problem.

This complacency compounds existing flaws in GRH's ILP studies. As part of their required ILP Studies 2 and 3, Great River Hydro was required to examine erosion impacts. Their HEC-RAS model evaluated sediment transport under *status quo* peaking conditions—not considering this change in operation. The failure of ILP Studies 2 and 3, which we pointed out in our comments, was that GRH chose to look at velocities and sediment size to examine sediment transport under a peaking scenario and failed to consider erosional impacts of surface water elevation changes.[8] What was not examined in these ILP studies was erosion resulting from saturation and desaturation of riverbanks under peaking, nor sediment transport changes in relation to sustained increases in velocity which will result due to GRH's proposed operations.

---

[7] CONNECTICUT RIVER CONSERVANCY, RE: WILDER (FERC NO. 1892), BELLOWS FALLS (FERC NO. 1855), AND VERNON (FERC NO. 1904) RELICENSING AND CLEAN WATER ACT §401 CERTIFICATION APPLICATIONS TO THE STATE OF VERMONT 7-10 (October 1, 2024).

[8] CONNECTICUT RIVER CONSERVANCY, CONNECTICUT RIVER CONSERVANCY COMMENTS ON GREAT RIVER HYDRO, LLC STUDY REPORTS FILED BY FEBRUARY 9, 2018; REQUEST FOR STUDY MODIFICATION TO REQUIRE COMPLIANCE WITH THE RSP (FERC NO. 20180423-5180). April 23, 2018. FERC Accession # 20180423-5180.(2018).

DEC is relying on a failed application of the HEC-RAS model to extrapolate the assertion that water quality will not be impacted by changes in operation, as that operational change was never contemplated or studied.

We agree with DEC's factual findings which state that "[d]uring flexible operations, the impoundment will fluctuate which may affect . . . potentially erosion,"[9] that "[t]here are many processes that can contribute to erosion within rivers, some include the hydraulics of river flows,"[10] and that there is some erosion that "can also be exacerbated by anthropogenic causes" such as "bank erosion" which "occurs when the various forces of erosion are stronger than the strength of the bank material."[11] CRC also agrees that "river channels seek equilibrium condition where the sediment and hydrologic regimes are in balance," and that "this process can be hindered by manmade activities and structures, including hydroelectric facilities."[12] Through these statements, DEC acknowledges that the change in operations will be yet another anthropogenic cause to further destabilize river equilibrium, importantly, yet fails to provide any condition to anticipate or respond to those potential impacts.

The draft WQC describes five locations that were examined as part of the applicant's erosion monitoring between 2013 and 2015, but discounts erosion causation because the notching is not at an elevation equal to the median water surface elevation ("WSE") range.[13] Our comments to FERC on the erosion studies pointed out that it is completely logical that there would be erosion occurring above the waterline and at the mid-section of the bank as a part of the overall erosion cycle. The issue in question as it relates to WSE changes was the erosion of the toe of the slope at and under the waterline as one aspect of the overall erosion cycle that destabilized the entire riverbank, causing slumping, overhanging banks, and notching. This cycle of erosion can only be tracked over a longer time scale. The evidence of this erosion under the current operations in addition to the potential for increased erosion further underscores the need for modeling impacts of the change in operations.

While DEC references the use of the HEC-RAS model for habitat, surface water elevation, and flow considerations below the dam, it does not seem to consider any information provided from Addendum 2 of the Erosion study which explicitly used the HEC-RAS model to

[9] Draft Water Quality Certification: Vernon Hydroelectric Project, Vermont Agency of Nat. Res. Dep't of Env't Conservation. 52 (2025).
[10] *Id.* at 53.
[11] *Id.*
[12] *Id.*
[13] *Id.* at 54-55.

evaluate erosion potential using velocities in relation to particle size in the impoundment. DEC describes an analysis comparing water surface elevation changes at multiple nodes in the Vernon impoundment.[14] While this analysis does show that there will be fewer water surface elevation changes under the new operating scenario, it misses the point of our argument entirely — namely that what needs to be examined now are the impacts of sediment transport that results from a consistently increased velocity of flows. The analysis did not examine these impacts.

Now that GRH is applying for an operational change that will increase flows throughout the projects, it would be logical to require GRH to use their HEC-RAS model, or some other modeling technique, to assess sediment transport potential based on increased sustained velocities. But while DEC has provided factual information on the use of the HEC-RAS model as it relates to dewatering aquatic habitat, it has not provided any factual information about the use of the HEC-RAS model as it relates to erosion and sediment transport as findings in the draft and sadly have not required condition(s) for GRH to even study the potential impacts of changed flow rates. Modelling this change in operation should have been required as part of the application review process. Without this requirement, the certification should be denied so that the necessary modeling can be done and proper conditions included in the WQC.

The draft WQC, additionally, attributes the lack of river equilibrium and connection to the floodplain to historic straightening, armoring, and berming,[15] but fails to consider any of the impacts that may be caused by 40 years of surface water fluctuations or 116 years of a 30 foot increase in the height of river level caused by the building of the dam.[16] In fact, the armoring mentioned may well have been needed because of the presence and historic operations of the dams and their impacts on river equilibrium. This is a misguided case of historical damage to the river from previous operations being dismissed then (and now) and the current impacts being blamed only on channelization. The impacts to the river cannot be attributed to only historical channelization while completely ignoring the hydroelectric company's multiple impacts over the past 100+ years. The draft § 401 states that "these historic changes . . . are not related to the Project"[17] when in fact they likely were and will be exacerbated by the next set of operational changes that is proposed in this application. Yes, it is likely that "the Connecticut River will

---

[14] *Id.* at 90-91.
[15] *Id.* at 89.
[16] "Vernon was an ambitious facility that required raising the river 30 feet, flooding all or parts of 150 farms." PUBLIC ARCHAEOLOGY LABORATORY: CULTURAL RESOURCE MANAGEMENT PROFESSIONALS, HISTORY OF HYDROELECTRIC DEVELOPMENT ON THE CONNECTICUT AND DEERFIELD RIVERS 3 (2000).
[17] Draft Water Quality Certification: Vernon Hydroelectric Project, *supra* note 9, at 90.

continue to adjust in an effort to achieve equilibrium condition, which is likely to continue to lead to increased scour within the channel than would be expected in an equilibrium state where the sediment and hydrologic regimes are in balance,"[18] expressly in response to these proposed operational changes. This necessitates modeling to properly condition the WQC and monitoring over time to validate expected erosional and depositional changes in the river.

As DEC points out, there are multiple natural and unnatural factors contributing to erosion. While it may not be "possible to determine which [contributing factor of erosion] is the primary cause of a particular erosion event"[19] DEC misses the point and abdicates their responsibility to require the applicant to model potential impacts of their operational change on sediment movement and the overall erosion cycle.

In addition to our comments here, we strongly encourage the DEC to consider the comments of our consultant Princeton Hydro, which are incorporated by reference and attached hereto. It is imperative that the VT DEC does not allow an unfettered ecological experiment to play out over the next 10 to 30 years as a result of the change in operations. It is contrary to law to not require modeling to assess potential impacts and properly inform needed conditions, or to allow this change without requiring monitoring to evaluate impacts of changed hydraulics over time.

D. Operations Compliance and Monitoring Plan is Required to Support Designated Uses

We support the need for an Operations Compliance and Monitoring Plan, and since it will "include a method for continuous monitoring and reporting outflow releases,"[20] this information should be used to provide real-time, transparent communication about flows to the public to support access for the designated uses of boating, swimming and angling.

E. The Water Quality Certification Does Not Ensure Timely or Effective Fish Passage

The VT DEC is not a party to the fish settlement agreement, as which was executed by the Vermont Department of Fish and Wildlife, and as a result the DEC cannot abdicate its responsibility to protect the uses identified by the State which include aquatic biota and wildlife, habitat, aesthetics, boating, fishing and primary contact recreation as required through the issuance of this § 401 WQC.

---

[18] *Id.*
[19] *Id.*
[20] *Id.* at 103.

DEC requires the development of a Fish Passage Management Plan ("FPMP") only after the approval of the new license. This makes this aspect of the WQC both meaningless and unenforceable given that details of that Plan will not be developed until well after the § 401 WQC is finalized. The only specific conditions required are the months that the fish passage facilities will be operated upon completion of enhancements contemplated in the settlement agreement. In addition, given that it has yet to be decided whether FERC will even incorporate this agreement into the license, the WQC in its current form fails utterly to protect aquatic biota and wildlife.

As we indicated in our previous comments, "CRC opposes the unnecessarily lengthy proposed timeframes for installing both upstream and downstream fish passage facilities at all three projects as the continued presence of the facilities provides an impediment to safe, timely, and effective fish passage and negatively impacts the designated uses of aquatic biota and wildlife, aquatic habitat, and the use of waters for fishing that Vermont is required to support."[21] The Fish Passage Settlement Agreement absurdly allows *at least* 7 years for downstream passage, 6 years for enhancements to the existing ladder to support more effective upstream passage of American eel and sea lamprey, 3 years to achieve *interim* upstream passage for American eel, 11 years for permanent upstream eel passage, 9 years to finalize a process to trap American shad for upstream transport, and 6 years to improve the public viewing window. These timeframes are unlawful and unacceptable. As a result of the 1979 license, the existing fish ladders were built in three years—between 1978 and 1981.[22] DEC can and must protect and support WQS by requiring needed passage upgrades under a reasonable and expedited timeframe.

We are pleased to see that DEC formally acknowledges that "[s]hortnose sturgeon is listed as endangered federally as well as in Vermont,"[23] and that "[s]hortnose sturgeon have been documented above and below the Vernon Project via video, photos, and positive detections from environmental DNA sampling."[24] However, completely absent from the draft WQC is any consideration of protective conditions, analysis of how the operational changes may impact

---

[21] CONNECTICUT RIVER CONSERVANCY, RE: WILDER (FERC NO. 1892), BELLOWS FALLS (FERC NO. 1855), AND VERNON (FERC NO. 1904) RELICENSING AND CLEAN WATER ACT §401 CERTIFICATION APPLICATIONS TO THE STATE OF VERMONT 20 (October 1, 2024).
[22] Preliminary Licensing Proposal: TransCanada Hydro Northeast Inc. Wilder Hydroelectric Project (FERC Project No. 1892-026), Bellows Falls Hydroelectric Project (FERC Project No. 1855-045), Vernon Hydroelectric Project (FERC Project No. 1904-073), FERC Nos. 1892, 1855, 1904, 2-20 (2016).
[23] Draft Water Quality Certification: Vernon Hydroelectric Project, *supra* note 9, at 71.
[24] *Id.*

habitat, or considerations of fish passage for shortnose sturgeon, whose presence in the project areas between Bellows Falls, Vernon, and Turners Falls dams has been confirmed.

DEC states that "it is believed the population is smaller than the population in the lower reach of the Connecticut River below Turners Falls."[25] The current eDNA sampling results prove presence and cannot estimate population numbers or age. This point is moot, however, because the presence of a federally and state endangered species requires consideration as to how the species and its habitat must be protected.

There is absolutely no information to suggest that the Applicant's proposal is protective of the shortnose sturgeon. The initial burden of proof to ensure protection is on the applicant and then, by proxy, the state. The § 401WQC requires compliance with state law, and as such, both the applicant and DEC must follow VT state law regarding a listed endangered species.

Regardless of whether "National Marine Fisheries Service (NMFS) is the federal agency responsible," or questions about "the number of shortnose sturgeons present,"[26] or "whether spawning is occurring,"[27] the DEC must take the most conservative approach and assume there is a breeding population that is attempting to migrate past the dams (both upstream and downstream).[28] Dam presence affects shortnose sturgeon. NOAA's 1998 shortnose sturgeon recovery plan indicates that dams are one of the major factors affecting shortnose sturgeon population recovery in the Connecticut River. Therefore, particularly when there is limited information, the assumption should be that project operations may affect shortnose sturgeon. It is incumbent on the applicant to prove otherwise, and they have not done so. There is no information provided in the application that GRH has consulted with NMFS at all regarding shortnose sturgeon, so there is also no information suggesting their proposal *is* in fact protective. The DEC has failed to acknowledge this or provide any condition(s) to require protection.

At a minimum, DEC has the authority to condition the § 401 on completion of an ESA Section 7 consultation, development of a program to assess sturgeon interactions with project components, and a handling and recovery plan should the sturgeon be adversely impacted at the facility. None of those conditions have been included. Additionally, DEC should develop action plans should the sturgeon be found to be breeding or overwintering in VT waters in order to

[25] *Id.* at 95.
[26] *Id.* at 71.
[27] *Id.* at 95.
[28] VT. STAT. ANN. TIT. 10. § 5403A.

protect that habitat and behavior through specific critical habitat designations. VT state law provides authority to designate critical habitat protections in waters under VT jurisdiction regardless of NMFS responsibility.[29] As written, the draft only kicks the can down the road, allowing for continuing impacts to this endangered fish and abdicating the DEC's responsibility to protect the species through its issuance of the WQC.

G. The Water Quality Certificate Does Not Support Public Access and Recreation

The draft § 401 does not adequately and equitably protect, much less support, adequate and appropriate public access and recreational uses. The only decision and certification related to protecting recreational uses is a requirement to develop an after-the-fact "recreation management plan providing additional details on the schedule for implementing the Applicant's proposal" summarized in this condition and in Findings 140-142.[30] The result is that the only enforceable conditions in this WQC regarding recreation is maintaining the status quo. The wording of the condition also expressly limits the proposed recreation plan to include only the limited improvements proposed by the applicant on recreation properties they currently own and that have potentially been in place for over 40 years while simultaneously cutting out public input in the process and failing to ensure the plan will comply with WQS.

Additionally, CRC's October 1 comments point out that the application provides for no consideration for swimming and, due to changes in operational flows, curtails some in-stream wading as a result of operational changes.[31] The draft WQC fails entirely to address these concerns.

In addition to the impacts to aquatic biota directly, the delay in improvements to fish passage also impacts the protected recreational use of angling. Migratory fish must pass the dams to reach appropriate habitats to procreate. The human impacts of the presence of the dams, and the delay and degradation of robust opportunities for both migratory and resident fish spawning directly impacts angling. The draft WQC allows for nearly a decade in delay before GRH is required to address these impacts by providing safe, effective and timely upstream and downstream passage. The agreed upon timelines to complete improvements to fish passage impedes the intent of the WQC and does not protect WQS for the protected use of angling.

---

[29] VT. STAT. ANN. tit. 10. § 5402a.
[30] Draft Water Quality Certification: Vernon Hydroelectric Project, supra note 9, at 104-105.
[31] CONNECTICUT RIVER CONSERVANCY, LETTER. RE: WILDER (FERC NO. 1892), BELLOWS FALLS (FERC NO. 1855), AND VERNON (FERC NO. 1904) RELICENSING AND CLEAN WATER ACT §401 CERTIFICATION APPLICATIONS TO THE STATE OF VERMONT 16 (. Dated October 1, 2024).. Page 16.

We acknowledge that the minor improvements proposed may enhance existing recreational amenities but find them woefully inadequate to protect access to the river for the protected uses of swimming, boating and angling across the project area for the next 40 years. DEC provides descriptions of several recreational facilities in the Vernon project area, but fails to indicate which ones are actually in VT.[32] DEC's jurisdiction regarding access to recreation as designated uses under the VT WQC is VT. Their responsibility within this jurisdiction is to protect access to those designated uses in response to the federal action of *this* applicant. The facilities owned by the applicant are only those that are immediately adjacent to the Vernon dam. The other facilities listed have a variety of constraints upon their use and issues that were addressed in the Study but not included in the draft § 401 WQC.[33] In addition, the Putney, Dummerston, and Old Ferry Road boat landings are owned by VT Fish and Wildlife—which based on Department procedures does not allow swimming or hand-carry boat access unless that access is being used explicitly for fishing. The Retreat Meadows boat launch amounts to a pull-off next to a state highway; and Norm's Marina is privately owned and charges fees for launching boats. Merely listing nearby recreational areas does not protect recreational uses.

No new ADA accessible recreational facilities have been considered for the five Vermont towns adjacent to the river in the Vernon project area even though four out of the five towns score high on the VT Environmental Disparity Index and Environmental Risk.[34] This lack of consideration potentially violates state law.[35] With VT DEC's decision to leave the recreation/public access plan to an after-the-fact non-public process, the Agency and GRH guarantee that the public in general and these disadvantaged communities in particular will have ***no*** say on public access and recreation. Compliance with recreational WQS is put off with the ***hope*** that an appropriate plan will be developed (without assured public input and process and without VT's authority to ensure WQS compliance) that will meet WQS[36]. This is an abdication of DEC's authority and legal responsibility. It privatizes a critically important portion of the § 401 review process.

---

[32] Draft Water Quality Certification: Vernon Hydroelectric Project, supra note 9, at 72.
[33] LOUIS BERGER AND NORMANDEAU ASSOCIATES, INC., TRANSCANADA HYDRO NORTHEAST INC. ILP STUDY 30: RECREATION FACILITY INVENTORY, USE AND NEEDS ASSESSMENT 236-38 (2016).
[34] Qing Ren and Bindu Panikkar, *Vermont Environmental Disparity Index*, UNIV. OF VERMONT, https://www.arcgis.com/apps/webappviewer/index.html?id=68a9290bde0c42529460e1b8deee8368 (last visited March 10, 2025).
[35] VT. STAT. ANN. tit. 3, § 6003 (requiring that "no segment of the population of the State should, because of its racial, cultural, or economic makeup, bear a disproportionate share of environmental burdens or be denied an equitable share of environmental benefits").
[36] 40 C.F.R. 121.7(d)(3)-(4) (2025).

DEC identifies the three Connecticut River Paddler's Trail campsites in the project area, but fails to identify that above the Wantastiquet campsite there is a 17.2 mile stretch of river before the Windyhurst campsite, or the 11.8 mile stretch of river upstream to the next site in Westminster. While CRC is grateful that GRH will be formally stewarding the Stebbins Island and Wantastiquet campsites, there is need for at least two more in the project area to fully support the designated use of muscle-powered boating.

DEC goes to great pains to outline multiple findings from the 9-year-old Recreation Study. DEC somewhat dismissively mentions a few of the comments to FERC regarding the need for a mitigation fund, better portage, and additional facilities, but fails to include the recommendations from the ILP Study 30.[37] The Recreation Study clearly outlines recommendations including that:

> these users continued to make recommendations such as a need for more boat ramps and launches, river access for shoreline fishing, parks (picnic tables and benches), and walking trails. Popular recommendations included creating more bank angling opportunities within existing sites, adding walking and hiking trails along the riverbank wherever possible, and adding more motorboat launch facilities[38]

The draft WQC indicate that the "the Applicant has proposed maintaining the call in flow number where boating conditions can be accessed by phone . . . . and "the day ahead flow forecasting will remain available."[39] GRH has used a third-party application - Waterline, which is an electronic publication that reports river flow forecasts and current water levels over the telephone and on the Web. This outdated application provides very limited real time flow information which river users have said is often inaccurate. It provides estimates based on GRH's plans for the day-ahead market. We cannot assume this antiquated system that has been in use since the 1980s is appropriate given the affordable advances in technology now in common use. GRH should be providing real time flows through more accessible methods, such as text messages or real time updates online. The Waterline website clearly states that "[f]lows will often differ from this forecast for reasons beyond the company's control" and "[a]ll

[37] Draft Water Quality Certification: Vernon Hydroelectric Project, supra note 9, at 75.
[38] LOUIS BERGER AND NORMANDEAU ASSOCIATES, INC., *supra* note 32, at 240.
[39] Draft Water Quality Certification: Vernon Hydroelectric Project, supra note 9, at 97.

published flows are approximate and forecasts are estimates only,"[40] yet GRH knows exactly what the flows are, and should be required to make that available in real time and provide access to a full history of real time flow data at Vernon for purposes of safety and ecological analysis over time. Additionally, the Waterline website can be confusing. For instance, when accessed on January 13 at 1:37 PM, the site simultaneously displayed that "At 1:21 PM Today the total flow below the dam was 5,056 CFS" and that the forecasted flow "Until 4:00 PM Today" would be "750 CFS."[41]

Other § 401 WQCs issued by VT DEC provide conditions that require specific recreation improvements that are then incorporated into the final license, but nothing of that kind has been provided here. For instance, the Barton Village WQC provides for a final plan that must be approved by the Department and updated every six years and requires specific improvements to facilities;[42] the Canaan WQC requires signage, development of the recreation plan with named parties (including the State of NH), and any modifications to the plan subject to DEC approval;[43] and the Great Falls WQC requires the construction of a new access area, signage, needs assessment, and a maintenance plan to be updated on an interval not to exceed 10 years.[44] Here, the draft § 401 WQC provides no detailed timeline for upgrades, no required standards for accessibility, and no requirements for stakeholder involvement or re-assessment over time. The EPA final § 401 rule indicates that, "for certifications with conditions, it is important to clearly indicate what information is merely background or supplementary information as opposed to the actual conditions that must be incorporated into the Federal license or permit."[45] The only clear condition in this draft § 401 WQC is that a plan should be developed (outside of the public process) maintaining the existing recreational facilities.

H. The Draft Water Quality Certificate Fails to Provide Adequate Public Access

[40] *505121 – Connecticut River at Wilder Dam, Wilder VT*, WATERLINE, http://www.h2oline.com/srcs/505121.html (last visited Jan. 13, 2025).
[41] *Id.*
[42] Water Quality Certification: Barton Village Hydroelectric Project, Vermont Agency of Nat. Res. Dep't of Env't Conservation (2003).
[43] Water Quality Certification: Canaan Hydroelectric Project, Vermont Agency of Nat. Res. Dep't of Env't Conservation (Issued Nov. 20, 2008).
[44] Water Quality Certification: Great Falls Hydroelectric Project, Vermont Agency of Nat. Res. Dep't of Env't Conservation (Issued Nov. 22, 2019).
[45] Clean Water Act Section 401 Water Quality Certification Improvement Rule, 88 Fed. Reg. 66615 (Sept. 27, 2023) (publishing EPA final 401 rule).

The DEC confirms the need for public access to the project lands to support its use as a public resource as codified in 10 V.S.A. § 1421 but fails to provide conditions that would allow the public to access those areas.

Conclusion

In conclusion, this draft § 401 certification does not ensure that the continued presence and operation of the GRH Projects will comply with Vermont Water Quality Standards. Therefore, the § 401 Water Quality Certification ("WQC") for Great River Hydro's, LLC ("GRH") Vernon Project (FERC No. 1904) should be denied.

Thank you for your consideration of our comments to this § 401 certification review process.

Sincerely,

/s/ Kathy Urffer
Director of Policy and Advocacy/ River Steward in Vermont
Connecticut River Conservancy

/s/ Rebecca Todd
Executive Director
Connecticut River Conservancy

/s/ Andrew Fisk
Northeast Regional Director
American Rivers

/s/ Bob Nasdor
Northeast Stewardship & Legal Director
American Whitewater

/s/ Mark Zakutansky
Director of Conservation Policy Engagement
Appalachian Mountain Club

/s/ Mason Overstreet
Senior Attorney
Conservation Law Foundation Vermont

/s/ Jon Groveman
Policy and Water Program Director
Vermont Natural Resources Council

Jeff Crocker
Supervising River Ecologist
Vermont Agency of Natural Resources
Department of Environmental Conservation
1 National Life Drive, Davis 3
Montpelier, VT 05620-3522

RE: Draft Vermont 401 Water Quality Certificate
Vernon Hydroelectric Project
Great River Hydro LLC.
69 Milk Street; Suite 306
Westborough, MA 01581

March 16, 2025

Dear Mr. Crocker,

On behalf of the Connecticut River Conservancy (CRC) Princeton Hydro, LLC (Princeton Hydro) is providing the following comments on this Draft VT 401 Water Quality Certification (Draft WQC) for the FERC relicensing of the above referenced project. These comments are in addition to CRC's previously submitted comments on the application and CRC's comments specifically on the draft water quality certifications for all three projects currently in application to the Vermont DEC[1].

Introduction

As will be discussed, the Draft WQC does not go far enough to protect the water quality of the Connecticut River within, and downstream of the section impounded by the Vernon Hydroelectric Project. While the CRC strongly supports the changes to river flow management (inflow equals outflow), the effects of the changes in the river system, especially compared to the antidegradation standards, and how the changes to the flow operations will, as is the goal of the VT Water Quality Standards to, not just preserve, but "protect and enhance the quality, character, and usefulness of its surface waters and to assure the public health"[2], "seek over the long term to upgrade the quality of the waters and to reduce

[1] Vernon, Bellows Falls, and Wilder Hydroelectric Projects
[2] Vermont Water Quality Standards, § 29A-103 General Policies (b)(1)

existing risks to water quality"[3], and "…conserving riparian area adjacent to surface waters for their important physical, hydrological, and ecological functions, including water temperature moderation; **sediment and nutrient filtration** and retention; large wood and organic material recruitment and retention; **streambank, shoreland, and floodplain stability**; and the provision of habitat and travelways for wide variety of species."[4] (bolds and underlines for emphasis).

Within a reasonable degree of engineering and scientific certainty, and as reflected by the Draft WQC, GRH has not provided the evidence needed to determine compliance with the VT WQS. As such, a Final WQC cannot be issued until robust modeling and analysis is developed, implemented to assess the impacts of the new flow and operations regimen.

Background and Prior Review by Princeton Hydro

Princeton Hydro was contracted by the CRC in 2016[5], 2017[6], and 2018[7] to provide a peer evaluation of Studies 2 and 3 and the modeling efforts completed by GRH and their consultants. Specifically, there was concern by CRC, and concluded by Princeton Hydro that the actual causes of erosion, bank slumping, and the associated impacts to water quality and habitat were not adequately and accurately evaluated. Our focus at the time was on the Revised Study Plan (RSP) and Integrated Licensing Process (ISP) Study 2 and 3 (Riverbank Transect and Riverbank Erosion Studies). In our initial peer review of 2016, with the 18 recommendations made in the memorandum, we found that GRH only

[3] § 29A-103 General Policies (b) (8)
[4] § 29A-103(d)
[5] Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies", prepared by Princeton Hydro, dated September 16, 2016.
[6] Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies, Supplement to Final Study Report, dated 11/15/2017", prepared by Princeton Hydro, dated May 15, 2017.
[7] Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies, Final Study Report, dated February 4, 2017", prepared by Princeton Hydro, dated March 6, 2018.

reviewed velocities of the river flows and would not concede that rapid fluctuations in water levels could lead to bank failure.

Our final report of 2018, while recognizing the improvements to the GRH's evaluation of bank stability, including the incorporation of a 2-dimensional model, we found significant gaps and that GRH did not evaluate the daily inundation of riverbanks that created conditions that left the lower river banks bare of vegetation and subject to submersion that would reduce the shear strength of the banks, thus causing the sloughing that was observed. From a concern about their oversimplification of the impacts of river flow velocities on the subject reach, they stated that "only 8 out of 21 sites show any potential for sediment entrainment[8]". We pointed out in our review that 80 of 21 sites represents over 30% (actually, 38%), which can be extrapolated to mean that nearly 40% of the river channel within the Wilder, Vernon, and Vernon Hydroelectric Projects or 37 miles of river subject to instabilities caused by these projects.

Proposed Flow Regime and Purported Benefits

These comments are specific to proposed modifications to the operations of the Great River Hydro (GRH) Vernon Hydroelectric Project between the states of Vermont and New Hampshire. The dam is located at river mile 141.9, approximately two miles upstream of the confluence with New Hampshire's Ashuelot River, and 7.4 miles downstream of the confluence with Vermont's West River.[9], which is part of a larger system of separately permitted projects, including the Bellows Falls and Wilder Hydroelectric Projects at river miles 173.7, and 217.4, respectively. The Draft Certification and relicensing proposal includes modification of the flow management operations from what is termed "Peaking Operations" as perceived demands and instructed actions occur, to an "inflow equals outflow" (IEO) wherein flow entering the impoundment are to equal flow being discharged downstream. The IEO operation is designed to reduce the frequent and rapid increasing and decreasing of water surface elevations within

[8] Entrainment is defined as the process of water flows or currents capturing and transporting sediment because of exceeding a soil's shear strength or having a velocity to be able to suspend such sediment.
[9] Vernon Draft WQC, paragraph 24.

the respective impoundments and provide more predictable and consistent water surface elevations in the impoundments and flow closer to natural conditions within the riverine reaches of the Connecticut River. This change in operations is outlined in the Memorandum of Understanding (MOU) signed on December 1, 2020.[10] It is noted, though, there are allowances for exceeding the IEO operations, albeit for very limited periods of variance, for example due to extraordinary energy demands, maintenance, and flooding events.

The potential benefits to changing operations to IEO, include the increased reduction in riverbank instability, consistent river levels and flows to improve fish passage and reduce strandings, and make the river safer for recreational use. While these modifications may improve the ecological function of the river, the modification may also create unintended consequences to the status quo initiating sediment discharges and harmful algal blooms (HABs), for example. Regarding HABs, a change in flow regime from peaking to IEO leads to several questions regarding the change in state of thermal stratifications, with future monitoring of thermal conditions, nutrient concentrations, and available oxygen at depth. On one hand the current peaking operations provides mixing of thermal layers of the water body but can release nutrient lade sediment, but with the IEO operation, stabilized water surface elevations could lead to extended periods of higher water temperatures, anoxia at depth, and the triggering of harmful algal blooms (HABs) within the impoundments.[11] It will be vitally important to understand how the changes to the operations could trigger such blooms,

[10] Memorandum of Understanding between Great River Hydro and the United States Fish and Wildlife Service, the New Hampshire Department of Environmental Services, the New Hampshire Fish and Game Department, the Vermont Department of Environmental Conservation, the Vermont Department of Fish and Wildlife, The Nature Conservancy, and the Connecticut River Conservancy; filed with Vernon Project FLA Exhibit B of Amended Final License Applications of Great River Hydro, LLC for Vernon Project, et. al. under P-1855 et. al. Accession Nos. 20201207-5219 (Public), executed on December 1, 2020

[11] Harmful algal blooms consist of blue-green algae, also known as cyanobacteria, which release cyanotoxins that can negatively affect fish and terrestrial organisms, including humans who might ingest water containing these toxins.

Pertinent Definitions and Water Quality Designation within the WQS

As stated above, with specific reasons described later, it is my professional opinion, and within a degree of engineering certainty, there is, simply, not enough evidence provided by the applicant to determine if the project will not adversely and significantly impact the "waters" that include the Connecticut River and its tributaries within the influence of these hydropower projects relative to the defined "natural condition" and "natural flow regime". To understand the context of this project and its compliance with the Vermont Water Quality Standards, I have provided definitions that are pertinent to understanding whether the 401 WQC in its current draft form complies with these standards.

The "waters" of Vermont:

"…*include all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs and all bodies of surface waters, artificial or natural, which are contained within, flow through, or border upon the State or any portion of it.*"[12]

Of course, the Connecticut River borders upon the State, and the hydropower influenced tributaries in Vermont are "…contained within..." and "…flow through…" it.

"Natural condition", as defined by the VT WQC is as follows:

"…*the range of chemical, physical, and biological characteristics of a body of water that occur with only minimal effects from human influences*."[13]

This definition speaks for itself, using the phrasing of "minimal effects from human influences". Clearly, the Wilder, Vernon, and Vernon Dams, at 59, 30, and 58 feet in height, and impounding 46, 26, and 26 miles,

[12] § 29A-102 Definitions (51) Waters
[13] § 29A-102 Definitions (27) Natural condition

respectively[14], these industrial scale energy generation projects would not be defined as having "…minimal effects from human influences".

> And "natural flow regime" as defined by the VT WQC is as follows:
>
> "…*a water's characteristic pattern of variability in flow rates and water levels, annually, seasonally, and daily, without the influence of artificial flow regulation. This pattern of variability is characterized by the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions*."[15]

For Vermont DEC to fully understand compliance with the VT WQS, comparison to "natural condition" and "natural flow regime" must be conducted. Regardless of the purported benefits of the new regime to the riverine resources and recreational opportunities, it is unknown what the impact is to the WQS, specifically to the Antidegradation policy and the damages in relation to the "natural condition" and "natural flow regime". The subject reaches of the Connecticut River, including the impounded reaches, caused by the existence of the dams, and the non-impounded sections between the dams and downstream of the lowest dam (Vernon Hydroelectric Project), are classified as B(2) waters and have specific minimum standards that are to be met, and if not, determine an understanding of how those standards fall short.

While an alternatives analysis is not required to receive a VT WQC under the VT WQS, it is important to understand whether there were other approaches to the modification of operations that may have provided more effective measures to meet the Anti-degradation requirements of the regulation. A review of Exhibit E, January 2024 Revision, the applicant discusses the no action alternative (keeping operations as is), the chosen alternative (IEO Operation), and the alternatives not considered, including a non-power

[14] Pre-Application Documents, Vernon Hydroelectric Project, Vernon Hydroelectric Project, and Vernon Hydroelectric Project (3 separate documents), TransCanada Northeast Inc., each dated October 30, 2012,

[15] § 29A-102 Definitions (28) Natural flow regime

license, federal takeover, and retirement (decommissioning) of the projects. Specific to the retirement of the projects, the applicant focuses on FERC's reasoning for not considering the alternatives in terms of cost and "clean, safe, and reliable source of renewable energy"[16]. While these two factors do come into play, the WQS are more specific, including that there "…is no practicable alternative to the proposed activity that would have a less adverse impact on waters and wetlands of the State, and provided that any proposed alternative shall not have other significant adverse human health, safety, or environmental consequences."[17] There does not appear to be any other analysis proving that the applicant has looked into other alternatives, including the completion of costs estimates. Even the US Fish & Wildlife Service, The Nature Conservancy, and Two Rivers-Ottauquechee stated that a decommissioning option was dismissed prematurely, for which their statement was dismissed.[18] While the applicant states that "[t]here would be significant costs involved with decommissioning the projects and/or removing project facilities"[19] is simply stating so enough to meet the needs of the WQS to allow approval of a WQC? The applicant, quoting FERC, further states that a more thorough analysis of decommissioning is not warranted as per The Interagency Task Force Report on NEPA Procedures in FERC Hydroelectric Licensing.[20] However, completing a "more thorough analysis" will mean that an initial analysis would have been conducted. We found no evidence in the record of such an initial analysis, and the VT WQSs require a comparison to "natural" conditions.

General Observations of the Studies Completed to Date

The studies used are dated and would not be considered statistically significant for use as representative baseline conditions. Within the Vermont Water Quality Certification applications for each of the three projects, GRH states that it is currently meeting the Vermont water quality standards and refer

[16] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-35
[17] § 29A-206 (b)(1)
[18] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-35
[19] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-35
[20] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-36

to their Exhibit E[21] sections 3.5.1.2, 3.5.2.2, 3.5.3.2, and 3.5.4.2 and the Integrated Licensing Process (ILP) Study 6 Report[22] as the basis for this claim; contrary to the statement by VTDEC in this draft WQC[23]. GRH refers to the 2016 VT WQS throughout the document and relies on two study seasons 2012 and 2015 as the basis of their observations and conclusions regarding meeting WQS. GRH repeatedly provides reference, comparisons, and documents listed in their Literature Cited section to the 2016 WQS (among other dated VT documents) throughout the document, and not the 2022 WQS. The use of two disparate years of study that occurred 9 and 12 years ago, respectively, would not provide statistically significant data to support the meeting of the WQS, and, again, is dated. As stated, while the CRC supports the change to the IEO operation, there needs to be additional modeling and future robust monitoring to determine if additional modifications to the IEO are needed.

Selected Criteria subsections within the VT WQS Discussion

§ 29A-302 Criteria Applicable to Waters Based upon Fish Habitat Designation, Use Classification, or Type of Body of Water

In their Exhibit E of the FERC application, GRH states that "…the existing thermal regime is not expected to change from existing conditions because Great River Hydro is not proposing any change in Project operations."[24] This statement contradicts the overall proposed operational change from the current process of peaking, with multiple feet of elevation change within the impoundments, to the "run-of-the-river" IEO operations, wherein the water levels will not substantially change significantly for a majority amount of time. In this author's interpretation, this statement in Exhibit should be acknowledged

[21] Within the website, Exhibit E for the VT WQC application, is dated June 7, 2023, is used, not the one labeled as revised January 2024 that is referred to in other areas of this letter.
[22] ILP Study 6, Water Quality Monitoring and Continuous Temperature Monitoring Study, Revised Final Study Report, prepared for TransCanada Hydro Northeast Inc., prepared by Louis Berger and Normandeau Associates, dated December 15, 2016.
[23] Vernon Draft WQC, paragraphs 142.
[24] Exhibit E, last revised January 2024, section 3.5.3.2, page 3-262.

and documented in the VT WQC, correcting this statement. As stated above, IEO does lead to questions regarding the change in state of thermal stratifications, with future monitoring of thermal conditions, nutrient concentrations, and available oxygen at depth. It will be vitally important to understand how the changes to the operations could trigger such HABs, with robust monitoring, analysis, and reporting to ensure compliance with the VT WQS.

HABs have been exacerbated over the years due to climate change through longer periods of elevated air temperatures that create optimal conditions for algae followed by intense rainstorms which disrupt the water columns and suspend organic sediments, accelerating the progress of these blooms.[25] There appears to be no discussion regarding the amount of sediment that has accumulated within the three impoundments, including their tributaries, and the organic content of such sediment, including phosphorus and nitrogen, nor the expected impact of releasing these nutrients due to sediment transport under the proposed change in operations. Cyanotoxins released into the water column can lead to mass fish kills and create illness and death in terrestrial mammals, including humans.

A review of ILP Study 7, which is part of the ILP studies referred to in the VT WQC application, Habitat Mapping, reveals that 76.2% of the total 3,028 acres mapped within the impoundments consist of "sand/silt/clay".[26] This equates to 2,307 acres. When compared to the surveys in the unimpounded, free flowing reaches, those substrates contained nearly 100% course-grained materials, such as sands, gravels, and cobbles.[27] This leads to Princeton Hydro's conclusion that the dominant, fine-grained substrates identified in ILP Study 7 consist of suspended sediment that settled within the impoundments because of the capture efficiencies of the reservoirs. Further, a review of the bathymetric mapping discussion within

[25] Paerl HW, Barnard MA. Mitigating the global expansion of harmful cyanobacterial blooms: Moving targets in a human- and climatically altered world. Harmful Algae. 2020 Jun;96:101845. doi: 10.1016/j.hal.2020.101845. Epub 2020 Jun 10. PMID: 32560828; PMCID: PMC7334832.
[26] ILP Study 7, Aquatic Habitat Mapping, Final Study Report, prepared for TransCanada Hydro Northeast, Inc. prepared by Normandeau Associates, Inc., dated March 2, 2015.
[27] ILP Study 8, Channel Morphology and Benthic Habitat Study, Final Study Report, prepared for TransCanada Hydro Northeast, Inc. prepared by Stantec Consulting Services Inc and Normandeau Associates, Inc., dated March 2, 2015.

ILP Study 7 did not include the collection of sediments or a determination of the overall composition and quality of sediment to determine the concentration of organic matter, including that portion that would become biologically available to aquatic organisms such as cyanobacteria, the central organism of HABs. This, in Princeton Hydro's professional opinion, does not allow for an understanding of the potential for the degradation of water quality, including the loss of dissolved oxygen, elevation of turbidity, and the potential for the triggering of HABs. GRH makes a statement that "[a]ttainment of state surface water quality standards relative to nutrients will not be affected under proposed operation because the Projects do not contribute to nutrient loading in the river."[28] However, as discussed above, promotion of accretion of organic/nutrient containing sediment is an internal source of nutrients, and thus the projects do contribute to nutrient loading.

Our conclusion is that the necessary information for VT DEC to review how the change to IEO is does not simply appear to be an improved condition, but ensure through modeling and future monitoring that the impacts associated with water quality, as compared to the "natural condition" for these B(2) waters specific to temperature, phosphorus, turbidity, and dissolved oxygen has been satisfied.

§ 29A-303 General Criteria Applicable to all Waters

As described under § 29A-302, above, a review of this subsection of the Vermont WQS has not been met, or at a minimum the data needed to make such a determination is missing. Under § 29A-303, the pertinent parameters of concern would be taste and odor, color, and toxic substances. There is a question of how the modification from peaking flows to IEO will affect the accumulation of sediment transported from smaller storms and the resuspension of these same sediments during higher flows. And, while these reservoirs are not identified as necessarily potable water sources, there are a significant number of local private potable wells within a mile of the impoundment, and have a high probability of

[28] Exhibit E, Wilder, Vernon, and Vermon Projects, June 2023 Revision, subsection 3.5.3.2, page 3-263, last paragraph of subsection.

being hydrogeologically influenced by the Vernon impoundment.[29] Cyanotoxins, a neurotoxin, in the water column resulting from HABs, in high enough doses, has been found to cause fish kills, be fatal to mammals, including dogs.[30] [31] In humans, cyanotoxins can lead to skin rashes, illness, and, sometimes, death.[32]

With algal blooms and resuspended sediments during floods and sudden changes to river flow velocities, algae and suspended sediment can create aesthetic impacts to water, as well as could also make, for example, rescues below the water surface much more difficult due to the loss of visibility/clarity.

As a result of Princton Hydro's review, the necessary information for VT DEC to assess the impacts of the preferred operational change associated with water quality, as compared to the "natural condition" specific to taste and odor, color, and toxic substances have not been satisfied.

§ 29A-304 Hydrology Criteria

As discussed above, the proposal to modify the existing operations to IEO, in concept, is a step in the right direction and appears to improve the hydrological conditions of the downstream resources, within unimpounded reaches of the river. However, the Final WQC must go further to require monitoring to ensure that riverbank stability, for example, will be mitigated except for extraordinary flows conditions via natural floods. As stated previously, "…water level fluctuations.... results in unstable/eroding stream banks upstream of the dam"[33]

---

[29] 1,265 private groundwater wells were identified within Vermont within about one mile of the impounded section of the Connecticut River, upstream of the Vernon Dam using the Vermont ANR, Natural Resources Atlas. https://anrmaps.vermont.gov/websites/anra5/, accessed on March 12, 2025.

[30] Fredrickson A, Richter A, Perri KA, Manning SR. First Confirmed Case of Canine Mortality Due to Dihydroanatoxin-a in Central Texas, USA. Toxins (Basel). 2023 Aug 1;15(8):485. doi: 10.3390/toxins15080485. PMID: 37624242; PMCID: PMC10467149.

[31] Factsheet, "Cyanobacteria in Vermont, What Veterinarians Should Know", VT DEC, Agency of Agriculture, Food, & Markets, Department of Health, July 2014, 2 pages. https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_RW_CyanobacteriaVeterinarians.pdf, accessed September 30, 2024.

[32] Webpage, "What Are the Effects of HABs", USEPA, https://www.epa.gov/habs/what-are-effects-habs#, accessed September 30, 2024.

[33] Vernon Draft WQC, paragraphs 142.

While the IEO will bring the river closer to a natural condition, it will still be subject to significant modifications to its water levels and peaking flows because of exceptions allowed in the IEO operations and still needs monitoring to ensure that this criterion is met.

What is missing from the discussion of hydrology (and hydraulics) within the available studies and is then subsequently lacking in the draft WQC, is any discussion about sediment transport, including the quantity of sediment that has accumulated within the impoundment, and how the change in operations to IEO may affect the existing distribution of sediment within the impoundment, if it will lead to redistribution and transport downstream of each of the dams, and difference in impacts between the current operation and proposed IEO related to the "natural condition" and "natural flow regime". Sediment transport is a component of the hydrology (and hydraulics of a river). Excessive sediment could have a dramatic impact on downstream resources, including the dwarf wedge mussel (DWM), as well as spawning beds for migratory and potamodromous fish species, but the draft WQC is lacking in consideration of these impacts.

As were also the topic of Princeton Hydro's comments (footnotes 19, 20, and 21, above) on ILP Study 2 and 3[34], it is important for VT DEC to understand if and how the stability of the riverbanks within the impoundment may be affected by the operation change. Princeton Hydro, in its review and prepared memorandum from 2016, was concerned about the methodologies employed by GRH's consultants, specific to the stability of the riverbanks within the impoundments of the Projects.[35] Specifically, the applicant was more focused on river flow velocities rather than the mechanisms of rapid drawdown and saturation of the banks that could lead to bank failure. Now, ironically, with the proposed change to IEO Operations, the impacts of fluctuating water levels may be somewhat alleviated, but the

[34] ILP Study 2 and 3, Riverbank Transect and Riverbank Erosion Studies, Final Study Report, prepared for TransCanada Hydro Northeast, prepared by Field Geology Services LLC and Normandeau Associates Inc., dated February 4, 2017.
[35] Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies", prepared by Princeton Hydro, dated September 16, 2016.

question of increase in velocity and its impact on sediment transport is now relevant, yet the VT DEC does not require any analysis to understand impacts. And there is no requirement to clarify how GRH will stabilize those slopes that were destabilized by nearly a half century of project operations, and how the changes in flow velocities resulting from the proposed IEO Operation will affect those slopes that may still be devoid of vegetation and undercut from previous bank sloughing.

Based on Princeton Hydro's review and current understanding of the information submitted as part of this WQC application, it appears that there is not enough information for VT DEC to compare the impacts of the hydrology of the existing and new operations to each other, as well as their relative impacts to the "natural condition" and "natural flow regime", as defined by the WQS and its Antidegradation policy. And there is nothing to compel analysis or additional data gathering.

§ 29A-305 Numeric Biological Indices and Aquatic Habitat Assessments

The definition in the WQS for "biological integrity" is as follows:

"…the ability of a body of water to support and maintain a community of organisms that has the expected species composition, diversity, and functional organization comparable to that of the water in its natural condition."[36]

Again, based on the "natural condition", it is important that the applicant confirm with modeling and monitoring that the impacts associated with the GRH projects relative to a free-flowing river and to provide information to understand the various biological indices and habitats are affected. The two years of baseline monitoring described earlier (in the years 2012 and 2015) do not provide a statistically significant understanding of the conditions over the longer term and surely do not provide relative impacts to the "biological integrity" of a "natural condition". And, based on the habitat documentation provided, GRH clearly illustrated that if 76.2% of the impoundments contain a "sand/silt/clay" substrate, as opposed to the free-flowing sections that contain coarse-grained substrate that supports the needs of

[36] § 29A-102 Definitions (8) Biological Integrity

riverine species, they would hardly support the same species composition, diversity, and functional organization of the Connecticut River in its natural condition. It is strongly recommended that the monitoring completed in the prior years be replicated moving forward to confirm that this subsection of the VT WQS has been complied with.

§ 29A-306 Use-specific Management Objectives and Criteria by Class

For all the same reasons described previously in this document, the Draft WQC does not protect against violations of the various use-specific management objectives of the WQS and class criteria. The applicant's own data illustrated that the habitat within the impoundments has been vastly altered from a sand/gravel/cobble dominated habitat substrate to efficiently trapping fine-grained, and likely organic/nutrient rich sediment that would have otherwise been transported downriver over time. Even with an increase of migratory species access with the proposed improvements for fish passage, the same access as compared to a free-flowing river has not been achieved. As a result, the relative loss of passing efficiency compared to the "natural condition" negatively impacts aquatic biota and wildlife, aquatic habitat, aesthetics, recreation, and public water sources, as described above.

Recommendations for Further Analysis and Conditions

Based on Princeton Hydro's initial review of the WQC application and documents supporting GRH's application to FERC, and the subject draft WQC, there are still a number of missing data to allow for VT DEC to have issued this draft WQC, including an understanding of the "natural condition" as the basis for the assessment of the existing operating condition, and the proposed IEO Operation under consideration. It will be vitally important for modeling, as described below, to be developed to coincide monitoring plans. And, regarding monitoring, contrary to Condition D of the Draft WQC, allowing a monitoring plan to be developed after the issuance of the Final WQC and FERC license, such conditions must be developed in the view of the public to allow scrutiny and comment on the robustness and validity of the plan. Such a plan must include provisions for specific riverbank stability monitoring, sediment surveys, and HAB development monitoring. Such monitoring is vital to understanding the validity of the

already agreed upon IEO operations, and if modifications need to be made in the future to improve water quality and riverine function. A true[37] 2-dimensional model, such as the use of the unsteady HEC-RAS[38] program must be used (which has been completed by GRH) for the river and calibrated during operations that can be used to understand circulation patterns that may affect water quality (backwater areas where HABs can develop) and flow velocities and directions that would determine the cause of a bank failure that would occur, or predict where slope failures may occur based on observed flows corroborated with the model. Additionally, continuous water monitoring stations must be included.

Our initial recommendations are as follows:

- The Draft WQC lists under Condition D that the Applicant will develop an operations compliance and monitoring plan within 180 days of the effective date of the FERC license.[39] This is not acceptable because the monitoring plan must be made part of this WQC to provide VT DEC with the ability to negotiate a plan to allow public participation.
- it will be important to require the applicant to provide modeling, field collected data, and reference data to compare the IEO operations to the "natural condition" and "natural flow regime" of the subject reaches of the Connecticut River; review the net impacts comparing the IEO, and its associated Flexible Operations to an undammed, naturally flowing condition. It is only when comparing the existing and proposed conditions of operations to no-dam conditions that VT DEC can truly understand the net impacts and make recommendations for further protections of the designated uses can be achieved. And if not protecting designated uses, what type of mitigation, either through funding or direct action to provide water quality improvements to watersheds and tributaries to the Connecticut River need to be required as conditions to this WQC.

[37] As opposed to a HEC-RAS 1-D, quasi-2 dimensional model.
[38] USACE Hydraulic Engineering Center (HEC), River Analysis System (RAS).
[39] VTDEC, Vernon draft Section 401 Water Quality Certification, Vernon Hydroelectric Project, Great River Hydro, February 12, 2025, section IV, Decision and Certification and Certification, part D, page 103 of 108.

- Volumetric quantification of accumulated sediment and sediment sampling throughout the impoundments to assess physical and analytical characteristics of accumulated sediment. Specifically, the potential for the internal nutrient loading from the sediment must be quantified and the generation of "total phosphorus".
- A true[40] 2-dimensional model, such as the use of the unsteady HEC-RAS[41] program must be developed for the river and calibrated during operations that can be used to understand circulation patterns that may affect water quality (backwater areas where HABs can develop) and flow velocities and directions that would determine the cause of a bank failure that would occur, or predict where slope failures may occur based on observed flows corroborated with the model. The model must include the total reach of the Project, from the upstream-most influence of the Wilder Hydroelectric Project to downstream of the Vernon Hydroelectric Project. The models developed must include the "natural condition" (no dams and a free-flowing Connecticut River), existing conditions (current peaking operations), and the proposed IEO Operation, including the Flexible Operations and how they would impact compliance with the WQS. Evaluations to be modeled must include 1) sediment transport, 2) temperature, 3) scour potential and impacts to the riverbanks, 4) nutrient generation and distribution throughout the impoundments. Of particular importance would be an understanding of how the change from the existing operations to the IEO Operation might initiate sediment transport of existing sediment deposits, especially in those areas of excessive deposition around tributary confluences and the potential of impacts to protected benthic species because of new patterns of sediment deposition.
- Due to the advancement and cost efficiency of LiDAR technologies for use in the monitoring of rivers and bank stability, obtaining riverbank topographic data and vegetative cover, even over

[40] As opposed to a HEC-RAS 1-D, quasi-2 dimensional model.
[41] USACE Hydraulic Engineering Center (HEC), River Analysis System (RAS).

an impoundment as long as one behind the Vernon Dam, is strongly recommended. Such data to be collected will be an initial baseline flyover via drone or helicopter survey to collect the above and below water surface slope conditions pre-change to IEO. Such data can be used to identify existing slope movements and vegetative covers. In subsequent years, say biannually, or after significant events such as flooding caused by tropical storms, nor'easters, or summer catastrophic storms such as have occurred over Vermont in the last two years a flyover LiDAR (upland and bathymetry) survey must be conducted. Subsequent years can be precisely overlain over prior years to calculated changes in slope elevations. Especially following significant flooding, the impacts between regional storm events versus bank instability caused by operations can be distinguished. In consulting with remote sensing/survey firms who conduct such services, each survey, including analysis and reporting can be completed for less than $50,000 in 2025 dollars, proving VT DEC and the public with a more comprehensive, quantitative assessment of the stability of the riverbanks and the vegetative cover that adds to river stability. Such a cost would be comparable, if not less costly than ground surveying the limited number of river sections previously completed to determine the overall stability of slopes within the subject impoundment. The surveys conducted would then be overlain with the HEC-RAS 2-dimensional models to evaluate natural and operational flows and how they may be contributing to riverbank instability. The following figures illustrate the usefulness of this technology and how it has been researched and developed for a situation such as for the Vernon Dam impoundment reach.

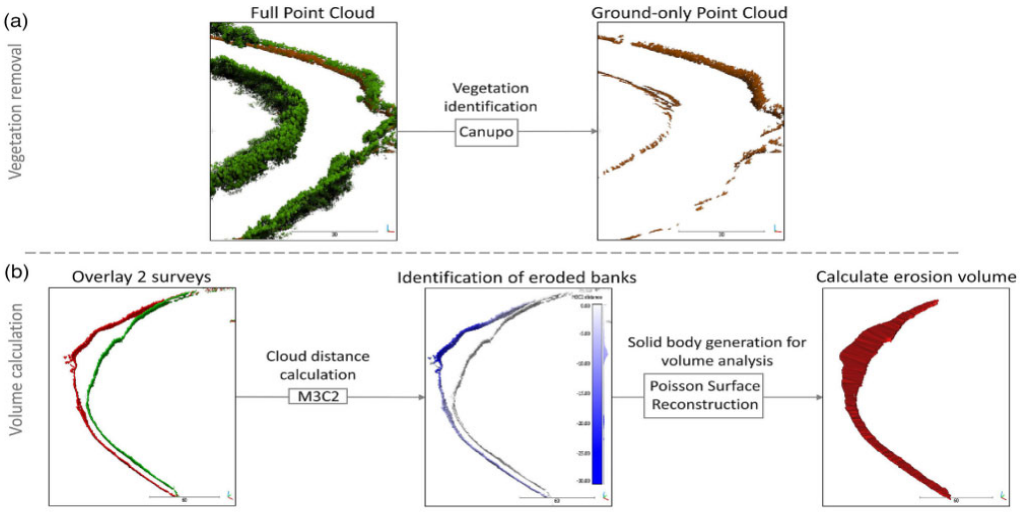


FIGURE 2 Schematic overview of the data processing workflow. Note that the bank segment shown in figure (a) (vegetation removal) differs from the bank segment shown in figure (b) (volume calculation) because areas with considerable bank erosion are generally near-vertical banks without vegetation cover—thus, different segments are best used to illustrate the two steps. [Color figure can be viewed at wileyonlinelibrary.com]

Figure 2 Illustration of the ability of the use of LiDAR to accurately assess vegetation cover and slope/volume changes of riverbanks.

Haddadchi, A., Bind, J., Hoyle, J., & Hicks, M. (2023). Quantifying the contribution of bank erosion to a suspended sediment budget using boat-mounted lidar and high-frequency suspended sediment monitoring. *Earth Surface Processes and Landforms*, 48(14), 2920–2938. https://doi.org/10.1002/esp.5667

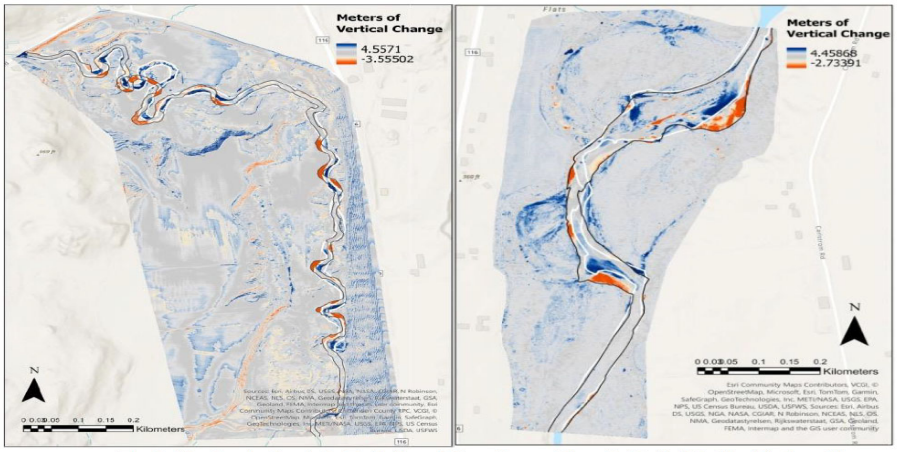


Fig 3. The Lewis Creek DoD (left) and New Haven River DoD (right). The black outline represents the 2023 stream channel boundary, and the white outline shows the older channel boundary. Polygons representing the extent of bank erosion were drawn in between the channel boundaries where the new channel was outside the older channel.

Figure 1 Another illustration of the ability of the use of LiDAR to accurately assess vegetation cover and slope/volume changes of riverbanks.

Flanzer, Zoe C., "Examining Variability in Streambank Erosion Rates in the Lake Champlain Basin, Vermont" (2024). *UVM College of Arts and Sciences College Honors Theses*. 129. https://scholarworks.uvm.edu/castheses/129

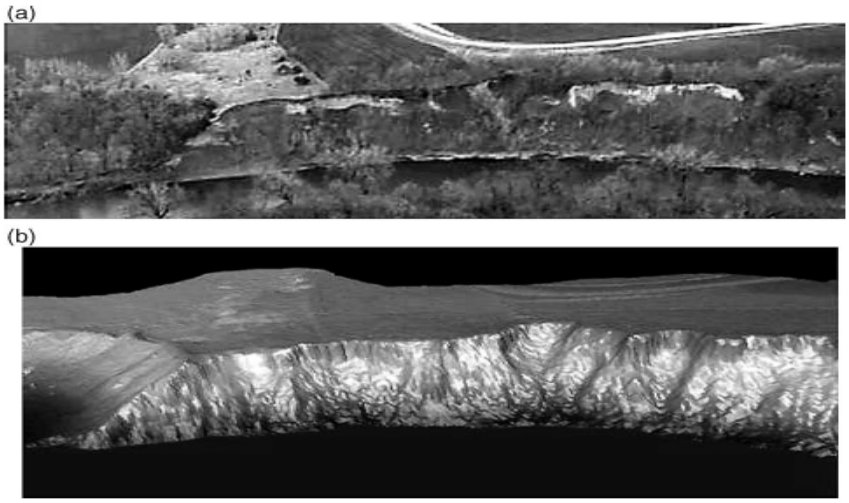


Fig. 2. (a) A severely eroded site along the Blue Earth River photographed at an oblique viewing angle from the air, and (b) rendered as a bare-earth elevation model from the LIDAR data. Vegetation was filtered and points gridded to a 1 m interval in the LIDAR image to create the model. Note gravel road passing through fallow field for scale in both figures.

Figure 3 The use of LiDAR from oblique angles to evaluate the overall stability and areas of failures on riverbanks.

Thoma, D. P., Gupta, S. C., Bauer, M. E., & Kirchoff, C. E. (2005). Airborne laser scanning for riverbank erosion assessment. *Remote Sensing of Environment, 95*(4), 493–501. https://doi.org/10.1016/j.rse.2005.01.012

- Monitoring and sampling for the potential for these impoundment systems to initiate the development of Harmful Algal Blooms (HABs), including reference reach and impoundment sampling and analysis for the existence of cyanotoxins and their relevance to the impacts to the water quality standards for "toxic substances".
- A condition that GRH will develop water quality monitoring for the life of the License to ensure that all water quality parameters can be met going forward, and the ability to enforce changes to operational process or other conditions to protect water quality, balanced with the energy generation needs.
- Require an economic analysis to compare the decommissioning of the three dams with the current and future costs for the expected lifetime of the projects, including the financial costs of the lost fisheries, recreation, and other designated uses that would otherwise contribute to the economy of Vermont.

- Development of an economic model to understand the overall losses to the designated uses of the waters of the Connecticut River, and the development of financial and/or direct implementation of ecosystem restoration efforts in the Vermont portion of the watersheds leading to the GRH projects to enhance water quality, improve habitat, and fish habitat, including contributions and/development hatcheries, for example, such as freshwater shellfish hatcheries to reestablish threatened and endangered species such as the dwarf wedge mussel and other mussel species of concern that would provide a biological approach to improving water quality and species protection[42].

Thank you for the opportunity to review and provide our comments on the Draft Vermont DEC Draft 401 Water Quality Certificate. It is strongly requested that our concerns on behalf of the Connecticut River Conservancy be addressed, with the denial of the WQC unless the monitoring plan is included, in detail, within the WQC.

Sincerely,

Geoffrey M. Goll, P.E.
President
Princeton Hydro, LLC

Enclosures:

- Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies", prepared by Princeton Hydro, dated September 16, 2016.
- Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies, Supplement to Final Study Report, dated 11/15/2017", prepared by Princeton Hydro, dated May 15, 2017.
- Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies, Final Study Report, dated February 4, 2017", prepared by Princeton Hydro, dated March 6, 2018.

[42] Freshwater Mussel Hatchery & Ecosystems Education Center, Philadelphia, PA. website: https://delawareestuary.org/hatchery/, accessed September 30, 2024.

PO Box 6219, Brattleboro, VT 05302 - 802-258-0413 - ctriver.org
Connecticut River Conservancy

October 1, 2024

Mr. Jeff Crocker
Vermont Agency of Natural Resources
Department of Environmental Conservation
Davis 3, 1 National Life Drive
Montpelier, VT 05620-3522

Re: Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) Relicensing and Clean Water Act §401 Certification Applications to the State of Vermont

Dear Mr. Crocker:

The Connecticut River Conservancy ("CRC") respectfully submits these comments in strong opposition to the applications of Great River Hydro, LLC ("GRH") for Clean Water Act §401 Water Quality Certifications for the Wilder (FERC No. 1892), Bellows Falls (FERC No. 1855), and Vernon (FERC No. 1904) hydroelectric projects. (collectively, "the GRH projects)[1]. As an environmental organization dedicated to the protection and restoration of the Connecticut River and its tributaries, CRC is deeply concerned about the significant known and potential adverse impacts the GRH Projects have on water quality and recreation. GRH's §401 applications do not ensure that the continued presence and operation of the GRH Projects will comply with the State of Vermont ("Vermont") Water Quality Standards ("WQS"). The applications fail to provide important information that will allow for informed public comment and are lacking in comprehensive recreation, river access and monitoring details that limit the

[1] *See* Great River Hydro, LLC; Application for Section §401 Water Quality Certifications for the Wilder Project FERC No. 1892, Bellows Falls Project FERC No. 1855 and Vernon Project FERC No. 1904 (submitted to VT Department of Environmental Conservation., April 18, 2024) (hereinafter "GRH §401 Application").

ability of Vermont to meaningfully enforce WQS. Simply put, the applications do not demonstrate that the GRH Projects will comply with WQS.

Under Section §401 of the Clean Water Act ("CWA"), any applicant seeking a federal license or permit for activities that may result in discharges into navigable waters must obtain a water quality certification from the state in which the discharge originates. This certification is intended to ensure that the proposed activity will comply with state water quality standards and other relevant requirements of state law.[2] §401 certification process empowers states to play a critical role in maintaining the integrity of their waters by imposing conditions or denying certification if the project does not meet water quality standards.[3]

Since 1952, CRC has worked to protect and restore the Connecticut River and its tributaries. CRC represents thousands of members across four states, including several hundred in Vermont, and as the only nonprofit organization dedicated to protecting the entire Connecticut River ecosystem, our comments consider not only the localized impacts of the projects, but also the watershed-wide implications of potential §401 certification by the Department of Environmental Conservation ("DEC").

CRC has raised many of the issues contained in this comment through the FERC proceeding over the past several years and most recently in comments on the entire Final License Application,[4] which comments we encourage DEC to review. (CRC will incorporate those earlier communications by reference herein.) GRH has not provided sufficient information to determine if the GRH Projects meet the Vermont WQS; on this basis alone Vermont must decline to issue a water quality certification.[5] As GRH has provided insufficient information for

---

[2] 33 U.S.C. 1341.

[3] *See generally* Christopher J. Eggert, *The Scope of State Authority Under Section §401 of the Clean Water Act After PUD No. 1 Washington Department of Ecology,* 31 WILLAMETTE L. REV. 851, 856–57 (1995) (describing the power states retain to block or allow certain local hydroelectric projects under Section §401 of the CWA); *see also* Daniel Pollak, *Annual Review of Environmental and Natural Resources Law: S.D. Warren and the Erosion of Federal Preeminence in Hydropower Regulation*, 34 ECOLOGY L. Q. 763, 793–94 (2007) (discussing how states have broad latitude under Section §401) ("state courts have upheld certification requirements that imposed land use restrictions… stream flow requirements based on aesthetic goals… and recreational improvements such as access improvements for fishermen and boaters").

[4] FERC Accession Number 20240522-5202. Comments of Connecticut River Conservancy on Great River Hydro, LLC's amended final license applications re the Bellows Falls Hydro Project, et al. under P-1855, et al.

[5] Vermont Agency of Natural Resources. Department of Environmental Conservation. Section §401 Water Quality Certification Practice. See V.(b)(2)(G) which states, "If an application is technically incomplete, at the Department's sole discretion, no further processing of the application will take place until the information requested is received and determined to be technically complete. If the requested information is not provided within the timeframe provided by the Department, the application may be denied without prejudice and the applicant may reapply at any time."

CRC to be able to meaningfully comment on the compliance of GRH Projects with Vermont WQS, if additional information is provided, CRC reserves the right to amend these comments.

SUMMARY

Through outright lack of data as well as vague and contradictory statements, GRH has failed to demonstrate how their project proposals meet Vermont WQSs in the following critical ways:

1. Improve shoreline undercutting and erosion; monitor for impacts of peak flows under new flex operations; and manage sediment transport, including the protection of aquatic habitat and limiting the release of legacy nutrients;

2. Protect rare, threatened, endangered or otherwise protected species of concern such as shortnose sturgeon, dwarf wedge mussels, tiger beetles, Fowler's toad, and protected plants under proposed operational changes;

3. Protect water quality, aquatic habitats and species in the face of increased flooding and subsequent drawdowns;

4. Provide for appropriate and equitable access to the river for designated recreational uses;

5. Reduce impacts to water quality and aquatic habitat by managing aquatic invasive species;

6. Protect and monitor historical and archaeological resources;

7. Timely install fish passage upgrades;

8. Provide financial assurances regarding the funding of eventual decommissioning;

9. Provide real time data on flows for recreational access, improve education about and access to fish passage, communicate about recreational access areas, and provide periodic reports regarding ecological concerns; and

10. Address numerous local concerns regarding erosion, access, aesthetics, habitat, and aquatic invasive species.

Because the applications are woefully incomplete as well as vague and contradictory, GRH provides no assurance that the projects will comply with Vermont's water quality standards, and the applications for certifications must therefore be denied.

CWA §401 CERTIFICATION

The CWA's §401 water quality certification process is a critical regulatory mechanism that empowers states to protect their water resources.[6] While the certification can include conditions necessary to ensure compliance, states have full authority to deny certification if the project fails to meet the state's water quality standards or poses significant risks to water resources.

The Vermont WQS are designed to secure the benefits of the CWA and to advance the policy of the State of Vermont to "prevent, abate, or control all activities harmful to water quality; assure the maintenance of water quality necessary to sustain existing aquatic communities; provide clear, consistent, and enforceable standards for the permitting and management of discharges; seek over the long term to upgrade the quality of waters and to reduce existing risks to water quality."[7]

Uses identified by the state, including aquatic biota and wildlife, habitat, aesthetics, boating, fishing and primary contact recreation, and use of public water sources, must be protected and restored. To maintain a water body's uses, Vermont has established specific criteria for water quality, including limits to temperature changes, pH levels, and dissolved

[6] 33 U.S.C. § 1341(a)(1).
[7] *See* § 29A-103 General Policies. Vermont Water Quality Standards. Environmental Protection Rule Chapter 29A. Effective November 15, 2022 and 10 V.S.A. § 1250.

oxygen minimums, among concentrations for other specific pollutants.[8] These standards are crucial for maintaining the ecological health of water bodies, protecting fish and wildlife habitats, and ensuring the water is safe for recreational activities and aesthetic purposes, in other words, supporting the designated uses for the river.

Water quality certification requires that the GRH Projects which are subject to relicensing under FERC comply with Vermont's WQS.[9] Because the GRH Projects seek renewed federal licenses that may last for the next half-century,[10] this §401 certification process will have effects on the health of the river for decades. Moreover, given the significant modifications the GRH Projects will continue to impose on the natural flow and ecological dynamics of the Connecticut River (even under their proposed preferred alternative operating conditions), CRC is concerned about whether and how the designated uses for the river will be protected under these conditions, particularly in the face of increasing climate change impacts. In assessing whether these hydroelectric activities comply with the state's broadly protective WQS -- a process vital for protecting the Connecticut River now and for future generations -- given the weather perturbations exacerbated by the changing climate DEC should apply the precautionary principle. The precautionary principle is the best path to "seek over the long term to upgrade the quality of waters and to reduce existing risks to water quality."[11]

COMPLIANCE WITH VERMONT WATER QUALITY STANDARDS

The GRH Projects will discharge into waters of the United States. Thus, under §401water quality certification and Vermont WQS, all waters must be managed to support their designated and existing uses.[12]

[8] See Sub Chapter 3 Water Quality Criteria. Vermont Water Quality Standards. Environmental Protection Rule Chapter 29A. Effective November 15, 2022.
[9] 33 U.S.C. § 1341.
[10] 16 U.S.C. § 808(e) ("any license issued by the [Federal Power Commission] under this section shall be for a term which the [Federal Power Commission] determines to be in the public interest but not less than 30 years, nor more than 50 years, from the date on which the license is issued").
[11] See § 29A-103 General Policies. Vermont Water Quality Standards. Environmental Protection Rule Chapter 29A. Effective November 15, 2022 and 10 V.S.A. § 1250.
[12] Nov. 15, 2022 VWQS § 29A-104(b); see also 40 C.F.R. § 131.10(a).

The party applying for a §401 certification bears the burden of demonstrating that the proposed project complies with the Vermont WQS.[13] Putting the burden of proof and persuasion on the applicant is consistent with other regulatory permitting procedures in Vermont.[14] Unfortunately, GRH has not met its burden here. They have not demonstrated that their proposal will protect water quality in the face of operational changes, protect endangered aquatic species, protect recreational access to the Connecticut River for all designated uses, protect aquatic habitat, and protect aesthetic qualities in the Bellows Falls canal or bypassed reach.

The Connecticut River is classified as B(2), under Appendix F, subsection (c) for all uses.[15] Multiple sections of the Connecticut River within the project boundaries are listed as altered under Part F of the Vermont Priority Waters List:[16]

- VT11-07 Retreat Meadows for AH (Aquatic habitat to support aquatic biota, wildlife, or plant life) and RB (The use of waters for boating and related recreational uses):
- VT13-01 CT River, Wilder Dam to Ascutney Village for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT13-02 Upper Mid-Southern Connecticut River for AES (The use of waters for the enjoyment of aesthetic conditions) and ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT13-02 Connecticut River Above Bellow Falls Dam in Springfield for AES (The use of waters for the enjoyment of aesthetic conditions) and ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT13-02 Connecticut River Above Bellows Falls Dam to Hoyt's Landing Area for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT13-02 CT River, Hoyt's Landing for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT13-03 CT River, Below Bellows Falls Dam for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT13-04 Vernon Impoundment for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)

---

[13] VWQS § 29A-104(b) ("A water quality certification shall not be issued unless the applicant demonstrates all of the following . . .").

[14] See: E.g. In re Entergy Nuclear Vermont Yankee Discharge Permit 3-1199, 2009 VT 124, ¶ 9, 187 Vt. 142 (referencing trial court review of whether applicant "met its burden of showing that the requested permit amendment should be approved"); In re Bjerke Zoning Permit Denial, 2014 VT 13, ¶ 18, 195 Vt. 586 (burden is on applicant to prove zoning permit application "actually complied with the ordinance").

[15] See § 29A-307 Classification of Waters and Appendix F. Vermont Water Quality Standards. Environmental Protection Rule Chapter 29A. Effective November 15, 2022.

[16] State of Vermont, 2022 List of Priority Surface Waters. Part F. Surface Waters Altered By Flow Regulation. July 6, 2022. "*Waters appearing in Part F of the Vermont Priority Waters List are assessed as "altered." Alterations arise from flow fluctuation, obstructions, or other manipulations of water levels that originate from hydroelectric facilities, dam operations or water withdrawals for industrial or municipal water supply or snowmaking purposes. These waters correspond to Category 4c of EPA's Consolidated Assessment Listing Methodology*."

- VT13-05 Lower Connecticut River, Below Vernon Dam for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)
- VT16-07 Connecticut River, Above Wilder Dam to Bradford for ALS (Aquatic biota and wildlife that may utilize or are present in the waters)

GRH's proposal does not adequately address the impacts from current and proposed operation on these altered river reaches. Indeed, while generally supportive of the new operational change, CRC has concerns about its impact as well as monitoring of its impact. Thus, CRC retained Princeton Hydro to undertake an independent analysis of potential water quality issues related to the anticipated operational change. Those comments are incorporated by reference and attached hereto.

I. GRH HAS FAILED TO ADEQUATELY ADDRESS EROSION, SEDIMENT TRANSPORT, AND NUTRIENT LOADING

A. Erosion

The Wilder, Bellows Falls, and Vernon impoundments have been experiencing significant surface water elevation fluctuations for over 40 years, leading to severe undercutting and shoreline erosion. Historical data and studies, including reports by the Army Corps of Engineers and confirmed by experts retained by CRC, confirm that the surface water elevation changes directly managed by peaking operations at the hydro facilities contributed to and are a significant cause of the erosion. While changes in operation will potentially address some impacts from erosion caused by surface water elevation changes, the proposed change in operation will disrupt the already existing instability. GRH has provided no data as to how the future flow regime will impact the already unstable condition and CRC has no confidence that WQSs will be met under the new regime.

CRC has commented repeatedly in the FERC docket on the inadequacy of the erosion studies conducted by the applicant.[17] Erosion continues to be widespread in the project areas and worsens year by year. The applicant is proposing a major operational change from peaking to

[17] See FERC docket: Accession Number 20180423-5180. Connecticut River Conservancy Comments on Great River Hydro, LLC Study Reports filed by February 9, 2018; Request for Study Modification to Require Compliance with the RSP.

inflow equals outflow with limited "flexible" peaking. While CRC is supportive of many of the anticipated benefits of the operational change, the change will also likely create extensive shifts in sediment transport dynamics over the coming license period. As this change in operations was not considered during the study phase of the relicensing, no meaningful analysis has been done to understand the effects of changing river flows on erosion, sediment transport, and river hydrogeomorphology. Therefore, GRH has not demonstrated that its projects are or will be in compliance with WQS.

A naturally flowing river trends toward equilibrium between erosion, transport, and deposition, with erosive effects balanced by sediment inputs from upstream[18]. The presence of dams and control of flow by hydro operations interrupts these processes, with dams trapping sediment and starving downstream reaches. The new operational change may further destabilize any equilibrium that was potentially (however unlikely) reached over the last license term. GRH's operational change will provide higher flows on a more consistent basis throughout the year[19]. As velocity of river flow increases under the new preferred operational scenario, we can expect more sediment movement throughout the projects.

While we are hopeful over time that the river may trend towards a more natural balance between erosion and aggradation, this relicensing process cannot be a case where we just hope for the best and assume that the changes will be beneficial. GRH has not provided the information needed to support their burden of proof that the operational change will not violate Vermont WQS. Rather, with no proof from the applicant that conditions will be put in place to monitor and address the actual impact of changes to project operations on erosion rates and sediment transport in real time, or any meaningful solutions to address those impacts, DEC must deny the request for certification.

GRH should have proposed a multi-decade longitudinal study inclusive of all the impoundments, riverine reaches, and sections of river in between to monitor changes in sediment transport, erosion rates, and erosive forces that will impact the stability of the river and riverbanks due to the new operational change. The magnitude of this change in operation requires an adaptive management process to monitor and respond to potential issues that may arise. Such a process should include periodic reporting, third-party verification, and, most

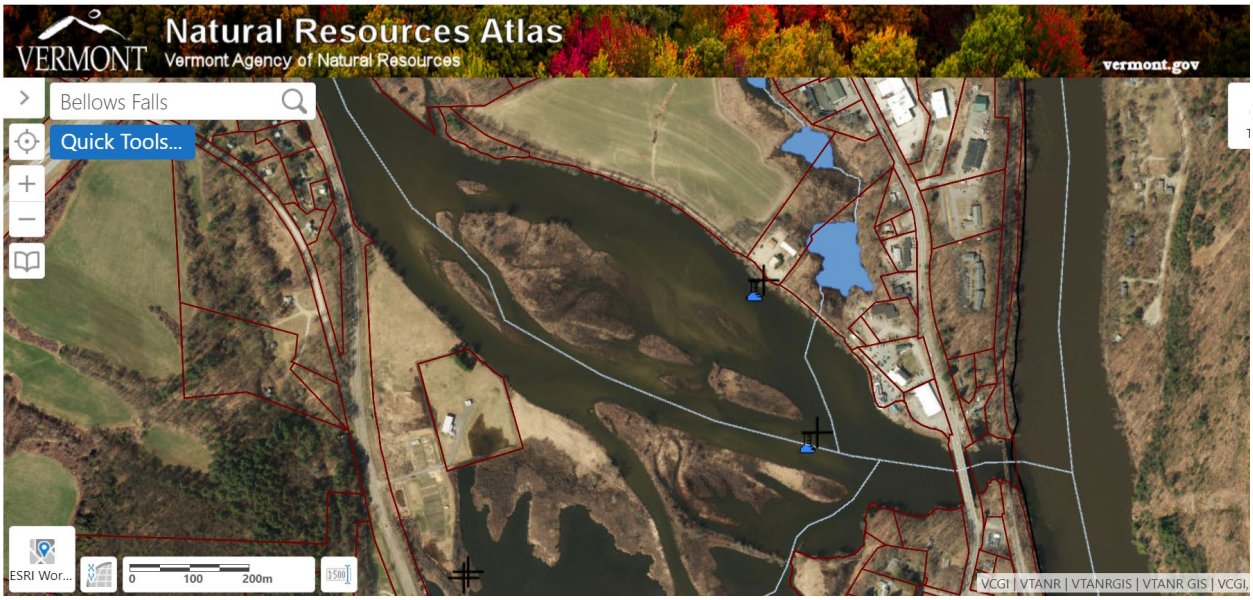
[18] e.g. Hoover Mackin, J. (1948). Concept of the graded river. Geological Society of America Bulletin, 59(5), 463-512.
[19] As evidenced by hydrographs shared with stakeholders during flow discussion in 2020.

importantly, an action plan to immediately mitigate using nature-based solutions any impacts to water quality or private property that may result from the operational change.

B. Unnatural Sediment Deposition

Because of many decades of peaking operations, the Wilder, Bellows Falls, and Vernon impoundments have been functioning essentially as lakes, with long stretches of low flows during much of the day. Consequently, tributaries that empty into each of those impoundments have a sediment wedge at the confluence of the Connecticut River. This is clearly visible on the Vermont Agency of Natural Resources ("ANR") Atlas, such as the example in Figure 1 from the West River.

Figure 1: West River confluence with the Connecticut River. ANR Natural Resources Atlas



CRC staff have personal experience attempting to recreate at this location in Brattleboro and can attest to sediment buildup at the mouth of the West River that reaches up to 1.3 miles upstream. The sediment load is so high, that when GRH is moving water through the Vernon facility and reducing the surface water level of the Vernon impoundment, it can be too shallow to boat in this area. Additionally, below is an image, taken on May 1, 2019, during a drawdown of

the Vernon impoundment, that shows the excessive, unnatural sediment buildup at this confluence.

Sediment deposition: View from 42.868306, -72.558639, facing south across the West River. Taken by Kathy Urffer on May 1, 2019.

And similar sediment build-up can be seen in this photo of the confluence of an unnamed brook adjacent to the Bellows Falls Pine Street Portage take-out in the Bellows Falls impoundment:

Sediment deposition: View from 43.142000, -72.454889, facing east across the Connecticut River. Taken by Kathy Urffer on August 2, 2023.

C. Concerns about Sediment Movement Downstream and Impacts to Aquatic Habitat

While we expect that the change in operations will begin to move more sediment out of these confluences, possibly providing better aquatic habitat in tributary streams, GRH has provided no data regarding sediment deposition further downstream. Also missing is data regarding whether the bulk of the sediment is going to get trapped behind the next downstream dam, thus decreasing the head and storage of the impoundment and continuing to sediment starve areas immediately downstream of the dams.

GRH was required to develop bathymetry data as part of Study 7: Aquatic Habitat Mapping ("Study 7"). Study 7 indicates that "sand/silt/clay" habitat type makes up 72.5%, 83.9%, and 76.2%[20] of the aquatic habitat available in the Vernon, Bellows Falls, and Wilder impoundments respectively. The prevalence of smaller particles is logical given that upstream areas of dams typically develop a sediment wedge as water slows down and drops fines. CRC staff observe that sediment has built up in sections of the river where the riverine section of one dam meets the top of the impoundment of the downstream dam. A good example of this is the stretch of the Connecticut River close to the Cornish-Windsor bridge, which is particularly shallow. As the riverine reaches and the impoundment reaches begin to flow together more consistently, and at a greater velocity, this sediment will likely begin to move through the system and be redeposited downstream. Study 7 has provided baseline aquatic mapping, and to evaluate changes in aquatic habitat in the impoundments due to changes in flows, GRH should have included measures to repeat this study at regular intervals to understand impacts of operational changes as a condition of the §401 certification. GRH's failure to evaluate the impacts of the changing flow regime provides no assurances that GRH will be in compliance with WQSs.

More importantly, there are multiple endangered species of freshwater mussels in the Connecticut River. The dwarf-wedge mussel, which is listed as endangered in Vermont and federally, occupies sections of the River in the GRH Project areas. GRH has not met their burden of proof as they have not disclosed whether there will be additional sediment deposition in mussel beds once flows are increased and sediment begins to move. Certification must be denied

[20] Accession Number 20150302-5358. TransCanada Hydro Northeast Inc. ILP Study 7. Aquatic Habitat Mapping Final Study Report. Normandeau Associates, Inc. March 2, 2015.

as there are no data provided, nor any data-driven assessments undertaken or anticipated that would verify that habitat is not degraded or eliminated by shifting sediment transport dynamics.

D. Concerns about Nutrient Loading Resulting from Sediment Movement

In addition to continued or possible increases in erosion of sediment along agricultural areas under this proposed new license GRH has not provided any data regarding how much phosphorus is bound up with the sediment already in the river and what that may mean for phosphorus loads released into the river column because of higher and more continuous flows. There is a long history of phosphorus use as a result of animal husbandry and past USDA policy.[21] Legacy phosphorus is very likely bound up with sediment that has eroded from Connecticut River drainages, similar to that found in Lake Champlain[22].

With additional phosphorus released from sediment movement in the water column, increases in turbidity due to more frequent flooding, and higher water temperatures over the coming decades due to climate change, there may be harmful cyanobacteria and algal blooms in the backwater and wetland riparian edges of the Connecticut River. DEC should not countenance the failure to address the potential for phosphorus loading and its impact on water quality.

VT DEC should require a condition to assess in real time the effect of operational changes on riverbank erosion, sediment transport, and related transport of nutrients and contaminants must be included, with a mandate that mitigation must be implemented should negative impacts on designated uses and water quality criteria occur because of this preferred change

II. GRH HAS FAILED TO ADEQUATELY ADDRESS FLOODING AND DRAWDOWNS

[21] K. Ashley, D. Cordell, D. Mavinic, A brief history of phosphorus: From the philosopher's stone to nutrient recovery and reuse, Chemosphere, Volume 84, Issue 6, 2011, Pages 737-746, ISSN 0045-6535, https://doi.org/10.1016/j.chemosphere.2011.03.001.
(https://www.sciencedirect.com/science/article/pii/S0045653511002499)

[22] See: https://www.nrcs.usda.gov/ceap/usda-legacy-phosphorus-assessment-project. And Kleinman, P.J.A., A.N. Sharpley, A.R. Buda, R.W. McDowell, and A.L. Allen. 2011. Soil controls of phosphorus runoff: management barriers and opportunities. Canad. J. Soil Sci. 91: 329-338. https://doi.org/10.4141/cjss09106.

In July of 2023, and again in July of 2024, drainages in the Connecticut River watershed in Vermont were inundated with catastrophic floods. We fully expect more occurrences of this type of catastrophic flooding in the area due to climate change and increased localized storms.

During the 2023 flooding, the stanchion flashboards at Bellows Falls dam broke, and Great River Hydro needed to draw down the impoundment for repairs. As Matthew Cole from GRH stated in an email to stakeholders, as of August 1, 2023, they began

> drawing down the impoundment upstream of Bellows Falls dam as part of the necessary restoration of the spillway following the July 10 – 11 high flows event on the Connecticut River. GRH will slowly lower the impoundment, conduct the necessary post-flood restoration work, and then gradually refill the impoundment to normal operating levels. The entire process will take approximately 3 days.

The email goes on to indicate that "visitors to Connecticut River will see exposed riparian areas upstream of Bellows Falls dam, most visible closest to the Bellows Falls dam."[23] CRC staff visited the backwater areas of Herrick's Cove during the drawdown and documented aquatic species that were killed by desiccation because of this event.

Dewatered wetlands at Herrick's Cove: View from 43.176400, -72.448400, facing southwest across the Williams River backwater area. Taken by Kathy Urffer on August 2, 2023.

[23] Email from Matthew Cole. August 1, 2023.

Desiccated mussel, snail, and sea lamprey at Herrick's Cove: View from 43.176400, -72.448400, facing southwest across the Williams River backwater area. Taken by Kathy Urffer on August 2, 2023.

We can expect that GRH will need to do more of these types of drawdowns in the face of extreme changes in precipitation patterns, with more intense localized storms causing floods. And drawdowns are clearly a violative of Vermont's WQSs. However, GRH has provided no data to suggest how repeated impacts to aquatic vegetation and organisms like these will be addressed. Will there be a requirement to understand the impacts to aquatic organisms because of this and requirements for mitigation or protection as conditions of the §401 certification? How can ecologically sensitive areas be protected, either through slower drawdown rates or limiting drawdowns to certain periods of time? Additionally, what will be the mechanism for GRH staff, or perhaps volunteers and fisheries agencies to save stranded creatures as has been done, for example, during the annual maintenance of the Turners Falls canal?[24]

[24] See: https://www.ctriver.org/post/sea-lamprey-rescue-2024

III. GRH DOES NOT ADEQUATELY SUPPORT RECREATIONAL USES

Because the §401 certification applications do not demonstrate that the three GRH Projects appropriately and equitably[25] support designated recreational uses, the applications must be denied.

A. Regulatory background

The Connecticut River in the projects areas is Class B(2), under Appendix F, subsection (c) of the Vermont WQS. Designated recreational uses include the use of waters for boating and related recreational uses; fishing and related recreational uses; and swimming and other primary contact recreation.[26]

In order to meet its burden, GRH must have documented that its proposed operation of the three projects supports these designated recreational uses throughout the project areas. The project areas encompass and are collectively adjacent to sixteen Vermont towns, many of which have been identified as environmental justice communities.[27] In order to protect designated uses, and comply with the Environmental Justice Law, the public must have reasonable equitable access.[28]

Specifically, the waters must be managed to achieve and maintain a level of water quality compatible with good quality boating, good quality fishing, and, where sustained direct contact with the water occurs, a level of water quality compatible with good quality swimming and other primary contact recreation with negligible risk of illness or injury from conditions that are a result of human activities.[29]

B. GRH's §401 Certification Applications for the Wilder, Bellows Falls, and Vernon Hydroelectric Projects Fail to Meet the Burden of Proof for Recreational Uses

[25] See 3 V.S.A. § 6003 which requires, "no segment of the population of the State should, because of its racial, cultural, or economic makeup, bear a disproportionate share of environmental burdens or be denied an equitable share of environmental benefits."
[26] VWQS § 29A-104.
[27] See: https://www.uvm.edu/news/rsenr/new-mapping-tool-identifies-vermonts-environmentally-vulnerable-populations, and https://ahs-vt.maps.arcgis.com/apps/MapSeries/index.html?appid=9478be15d6d4410f8eef8d420711310b.
[28] 3 V.S.A. § 6003
[29] VWQS § 29A-306(d)-(f).

The §401 certification applications do not demonstrate that the proposed operation of the three projects supports designated recreational uses, in three separate ways:

1. The applications provide no details about how recreational uses will be supported, and rather suggest that they will restrict in-stream recreational opportunities. For example, the application for the Vernon project provides two scant paragraphs to recreational use. The application vaguely states that river access "will be maintained or enhanced through the capital improvements to the boat launches, improved portage and general recreation area access and parking." There are no details provided. The applications for Wilder and Bellows Falls similarly state that capital improvements will be made, with no details provided.

The three applications also state "[t]here are several locations where anglers are known to wade into the river to fish, or to reach exposed sandbars from which to fish. Safe opportunity for in-stream wading will likely be restricted to the riverbank." The "several locations" are not identified. Moreover, an undefined "restriction" on in-stream wading curtails rather than supports recreational uses. Shockingly, neither swimming nor any other primary contact recreation is mentioned in any of the applications.

The §401 certification applications reference the license application filed with the Federal Energy Regulatory Commission (FERC) for these projects. Attachment F to the FERC application, which is Exhibit E as revised January 2024[30], provides additional information on recreation. Most of this information is dedicated to describing existing recreational resources. Exhibit E, Section 3.9. Section 3.9.2.2 then provides a very brief proposal regarding recreation. Essentially the proposal is to make no changes, except to incorporate three existing primitive campsites into the formal project area.

For GRH Projects that cover 124 miles of river, the curtailing of in-stream wading, the addition of three primitive campsites, and some entirely undefined "capital improvements" simply do not support Vermont WQS regarding recreation.

2. The information regarding proposed recreational enhancements provided by GRH is conflicting.

[30] https://elibrary.ferc.gov/eLibrary/filelist?accession_num=202§40131-5575

GRH's FERC application proposes to make no changes in its support of recreational uses of the river. This is in direct conflict with the §401 certification applications, which say that GRH will make some undefined "capital improvements" to recreational resources. "Capital improvements" are also referenced in GRH responses to information requests filed with FERC dated March 29, 2021.[31] Several spreadsheets are attached to the cover letter of this response showing "Recreation Resource Enhancement Measures." These measures include several line items for capital improvements. Because only very limited descriptions are included with these line items, it is not clear what exactly these proposed expenditures would entail.

In addition to actually curtailing recreational activity, these contradictory and vague proposals regarding recreational activity do not document compliance with Vermont WQS and the water quality certification must be denied.

3. The recreation proposals are also not clear enough to be enforceable.

For example, capital improvements may or may not be proposed. But it is not clear what these capital improvements are. It is therefore not possible for a regulatory agency to determine what capital improvements will be done to comply with the WQS.

The proposal to make no changes to recreational resources, or to make minimal capital improvements, also fails to meet a broad set of needs identified in study reports and surveys. GRH ignores the results of their own studies[32] that clearly indicate the need for additional recreational amenities throughout the project area(s). Additional needs were identified in other filings as well. These include the Connecticut River Conservancy Recreation Survey and Public Meetings Report from 2018[33], the July 2019 CRC AMC recreation recommendations comment[34], the ILP Study 30 Recreation Facility Inventory and Use & Needs Assessment Supplement to Study Report[35], the Connecticut River Watershed Council report dated May 2016[36], and the Study 31 on Whitewater Boating[37].

[31] https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20210330-5038&optimized=false
[32] Accession Number 20160301-5331TransCanada Hydro Northeast Inc. ILP Study 30 Recreation Facility Inventory. Use and Needs Assessment Study Report. Prepared by Louis Berger and Normandeau Associates, Inc. March 1, 2016. Page 240.
[33] https://elibrary.ferc.gov/eLibrary/idmws/file_list.asp?accession_num=20181024-5050
[34] https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20190730-5077&optimized=false
[35] https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20161215-5280&optimized=false
[36] https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20160505-5135&optimized=false
[37] https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20160301-5331&optimized=false

These filings recommended multiple additional recreational amenities and specific improvements to existing amenities, such as consideration of appropriate flows for whitewater boaters, additional motor boat access areas throughout the projects, additional access provided for swimming, specific appropriate designated SCUBA access with a ladder or beach to support underwater rescue training, separate access for hand launch and motorized boat launches to reduce conflict, improvements to public viewing at fish ladders, improvements to all portages, better signage and communication about access information, and more comprehensive public information about flows.

While it is not possible to list them all here, we provide some specific examples for each project area further below in our comments.

It is worth noting that the vagueness of GRH's treatment of recreational resources contrasts sharply with other projects in the region which have put forward much more robust provisions to ensure designated recreational uses are supported. For example, the owner of the Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485) recently submitted with its FERC relicensing application a highly specific and comprehensive Recreation Settlement Agreement to address nearly all recreation issues associated with those projects.[38]

Because GRH has not met its burden on the recreational requirements, the water quality certification must be denied.

IV. GRH HAS PROVIDED NO PLAN TO ADDRESS AQUATIC INVASIVE SPECIES

Aquatic invasive species ("AIS") need to be considered comprehensively throughout the Project areas. The presence of AIS, impact on water resources of these invasives, and the interaction with project operations were not adequately addressed in the application. Invasives were mentioned under terrestrial resources but no plan for management or detection of aquatic invasive species was listed under the GRH proposal, despite a brief mention indicating that AIS might expand ranges under the new operation.[39]

[38] Document Accession #: 20230612-5219 Filed Date: 06/12/2023

[39] Accession number 202§40131-5575. Revised Amended Final License Application, January 2024, Exhibit E. Page Page 3-503 – 3-504.

Increasing vigilance and education around transport and spread of aquatic invasive species is critical, particularly given concerns about the Connecticut River strain of hydrilla in the lower watershed.[40] An annual required survey by GRH for highly aggressive AIS will prevent the rapid spread of these species by coordinating monitoring and control. This work should be done in collaboration with resource agencies and the Northeast Aquatic Nuisance Species Panel to ensure best practices and a coordinated regional approach to AIS. Furthermore, a rotating monitoring approach of segments throughout the Projects' waters coupled with regular baseline surveys of the entire affected stretch will result in comprehensive survey data to address AIS. All GRH-owned access points and facilities should have boat cleaning CD3 type units to prevent the spread of AIS and display signage educating visitors about AIS prevention and particular species of concern.

Unfortunately, however, GRH has provided no consideration of these potential impacts to water quality or habitat in their application, and therefore the proposals fail to show how they will meet Vermont WQS. Conditions should be put into place to monitor and mitigate for the spread of aquatic invasive species throughout the project areas.

V. GRH HAS NOT ADEQUATELY CONSIDERED IMPACTS TO CULTURAL RESOURCES

Preservation of cultural resources may also play a role in the evaluation process for §401 certification under the CWA. Section §401 empowers states to assess and certify that any proposed activity requiring a federal license or permit complies with state water quality standards and *any other appropriate requirement of State law*.[41] Applicable here, The Vermont Historic Preservation Act was established in 1975 by the Vermont Legislature and requires that state agencies take measures to preserve any historic and archeological resources.[42] Thus, while §401 of the CWA primarily focuses on water quality, 401(d)'s inclusion of the "*any other appropriate requirement of State law*" provision allows DEC to also consider threats to archaeological and Indigenous resources due to changes in operation.

[40] See: https://www.nae.usace.army.mil/Missions/Projects-Topics/Connecticut-River-Hydrilla/ for more information.
[41] 33 U.S.C. § 1341(d).
[42] *See* 22 VSA 14 and https://accd.vermont.gov/historic-preservation.

It is within DEC's authority under CWA §401(d) to consider the articulated harms to archaeological and Indigenous artifacts and sites that may occur as a result of changes in operation. As already stated, CRC is concerned that changes in operation will potentially exacerbate erosion or change sediment deposition, potentially impacting archeological artifacts in riparian and riverbank areas.

VI. GRH HAS PROPOSED INADEQUATE AND UNTIMELY FISH PASSAGE MEASURES

CRC opposes the unnecessarily lengthy proposed timeframes for installing both upstream and downstream fish passage facilities at all three projects as the continued presence of the facilities provides an impediment to safe, timely, and effective fish passage and negatively impacts the designated uses of aquatic biota and wildlife, aquatic habitat, and the use of waters for fishing that Vermont is required to support. There is no dispute that dams and hydro operations are bad for migratory fish populations, that the current fish passage facilities were not designed for the species which are currently using them, and that goals in diadromous fish recovery plans will not be reached as long as the fish continue to be stressed and impeded by inadequate passage facilities along with concurrent negative impacts of dams on spawning and feeding habitats, climate change, and other human caused survival issues. Vermont can protect and support the WQS by requiring needed passage upgrades under an expedited timeframe. As noted in our comments to FERC[43] regarding this subject, this is particularly important for downstream passage of eels, which will continue to utilize the turbines as the most likely route of passage without implementation of dedicated downstream passage. In our opinion, GRH has not provided adequate justification as to why a shorter timeline of passage improvements resulting in a less sustained adverse impact on the river's ability to support fish, fish habitat, and fishing is not practicable.

We will also note that CRC has provided preliminary evidence through an ongoing environmental DNA study that federally endangered shortnose sturgeon are present in Vermont and New Hampshire waters below both the Vernon and Bellows Falls dams, a subject that has been a point of community concern for some time. We call the evidence preliminary only because our study is not yet completed; the data indicating sturgeon DNA presence in the water

[43] FERC Accession Number 20240522-5202. Comments of Connecticut River Conservancy on Great River Hydro, LLC's amended final license applications re the Bellows Falls Hydro Project, et al. under P-1855, et al.

samples will not change. We had previously requested that a community approach to fish passage be considered, and these findings underscore the need to consider additional species in the passage designs for all three projects and how changing flow regimes may impact important habitat for this and other species of concern. While the expectation is that shifting to the IEO/flex operation (a shift that CRC supports) will yield positive benefits for biota and habitat, it is unconscionable to wait until the next license renewal to ensure that this is actually true, and Vermont would be abdicating its duty to uphold WQS if it does not implement proactive protections. The VT certification should condition facility operation on ensuring that impacts of operational changes are regularly monitored and mitigated (if negative) within the license term and passage upgrades are completed as soon as possible.

An additional concern which we addressed in our comments to FERC, and which we reiterate here due to its direct relation to Vermont WQS is the intersection between the proposed "low-flow" turbine in the Bellows Falls dam, the "salmon dam" further downstream in the bypassed reach, and the intended alterations and installations of fish passage facilities. The settlement in the FERC record[44] indicates that the salmon dam may be removed, but only after the installation of the new turbine and the hydraulic studies informing design for fishway upgrades. Given that the salmon dam provides an impediment to flow through the bypassed reach, thereby negatively impacting habitat connectivity, aquatic species movement (including species which may be more inclined to enter the reach through the new turbine), sediment transport, and altering downstream hydraulics, it is in the best interest of supporting designated uses and upholding WQS to require the removal of the salmon dam prior to any other work or studies that either alter flow dynamics and reach accessibility (e.g. the new turbine) or inform fishway design and attraction flows. The presence of the salmon dam directly affects aquatic biota, habitat, aesthetics, and recreation opportunities. GRH has provided no evidence that leaving the dam in place beyond the installation of the new turbine and the design and initiation of hydraulic studies would provide any meaningful environmental benefit or support WQS. The installation of a minimum flow turbine at the Bellows Falls dam necessitates both upstream and downstream eel passage measures at the spillway as it does at the powerhouse.

Vermont should condition the §401 certifications to ensure adequate passage is established in a timely fashion (ideally 10 years or less) given the information contained above

[44] Accession Number 20220803-5124. GRH Settlement Agreement for Fish Passage. Section 2.5

and in the FERC record, and the fact that shad, lamprey, eel, and resident fish are restricted in their movements and experience habitat degradation by ongoing and future project operations. This also negatively impacts recreational fishing opportunities, thereby violating WQS in a manner that can be minimized through quicker implementation of planned passage upgrades.

VII. GRH PROPOSES NO FINANCIAL ASSURANCES FOR DECOMMISSIONING AND DAM REMOVAL

Any §401 certification must include provisions mandating decommissioning plans and financial assurances from GRH for when the facilities are ready for retirement and removal. This measure is crucial to prevent further water quality degradation and ensure that Vermont taxpayers do not bear the financial burden of decommissioning. The Great River Hydro Projects will be more than a century old when their next FERC licenses are set to expire. Requiring financial assurances now is necessary to ensure the money is available in the future to completely and effectively decommission and remove these projects and restore the Connecticut River to a natural flow regime that will protect existing and designated uses into the future.

VIII. GRH PROVIDES NO PUBLIC ACCESS TO DATA

Over the terms of the next license, there will be considerable changes in the conditions and operations of these projects —changes that will fall well outside the conditions that were studied in preparation for the license. It is important that the impact on the environment be well-monitored and understood. Changing conditions will directly result from the change in operation but will also include ongoing climate change; the environmental improvements put in place by this license; and changing electric grids, policies, and markets. Additionally, there is a need for transparent immediate data of the flows released from the hydropower facilities to inform potential boaters and other river users. The United States Geological Survey (USGS) gauges are limited and affected by multiple other inputs and are not always good predictors of sudden unexpected changes in flow and level. DEC should require additional, publicly available data and analyses in the context of §401 certification, including:

1. Expected and Real-time data on the flows released from the hydropower facilities,
2. Regular monitoring and publicly available data of macroinvertebrate populations in various reaches throughout the project areas, as macroinvertebrates provide one of the best ways to assess stream ecosystem quality.

3. Monitoring of, and public data on, populations and passage of non-fish species that provide important ecosystem services, including native mussels and riparian species.
4. Annual reports on the benefit to and impact on the environment and recreation. CRC also requests that these annual reports be sent to State and Federal officials.

IX. SPECIFIC CONCERNS REGARDING AREAS IMPACTED BY THE WILDER, BELLOWS FALLS AND VERNON PROJECTS

A. Wilder Project

1. Proposed Operational Changes Could Exacerbate Erosion at the Upper End of the Wilder Impoundment

The applicant explains that "Banks of the upper Wilder impoundment are composed (almost exclusively) of sand…" and "loam and sand banks are also prevalent in the lower impoundment."[45] Given the nature of bank composition, it is no wonder that erosion rates are higher in that area and will likely be additionally impacted by changes in flows interacting with the already unstable banks. GRH states, "While the impoundment upstream of Wilder dam extends upstream to Haverhill, New Hampshire, and Newbury, Vermont, WSE [water surface elevation] fluctuations in the upper impoundment are more significantly impacted by inflows from upstream" and that "an analysis of georeferenced historical aerial photographs indicates that the rate of erosion has increased slightly at some locations in upper Wilder impoundment…[46]" This indicates clear impacts of erosion due to inflows from upstream dams on an area of the river that is prone to erosion due to sandy substrate.

In addition, Figure 1 below provides an example illustrating the difference between surface water elevation changes in the Wilder impoundment during current operations at different distances upstream of the dam. There is greater magnitude of surface water elevation changes in the upper ends of the impoundments due to a delayed wave flow effect as well as peaking flows being passed down from 15 Mile Falls.

[45] Accession Number 202§40131-5575. Revised Amended Final License Application, January 2024, Exhibit E. Page 3-66.
[46] Accession Number 202§40131-5575. Revised Amended Final License Application, January 2024, Exhibit E. Page 3-68.

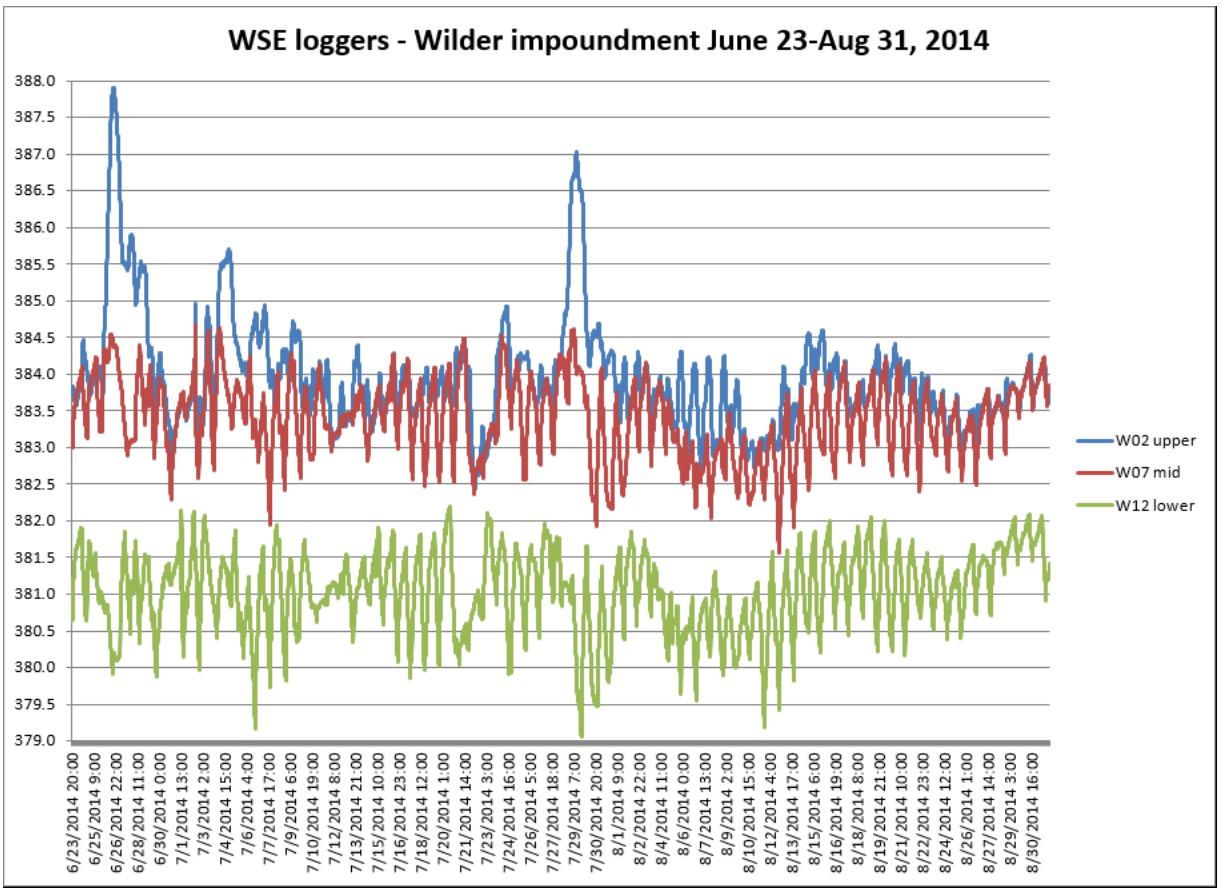


Figure 1: Water Surface Elevation as measured in the lower, middle, and upper Wilder impoundment in 2014, demonstrating peaking frequency as well as the higher water level and greater magnitude of fluctuation in relation to distance upstream from the dam.

Given the specific influence of peaking flows from the Fifteen Miles Falls projects that impact the upper end of Wilder impoundment, and the lack of analysis in regard to the preferred operation under the new license, GRH must be required to support an ongoing multi-decade monitoring program to assess any ongoing potential impacts of changes in operation on the banks of the Wilder impoundment and in changes in sediment deposition throughout the project area, and subsequently take responsibility for mitigation required to address those impacts.

2. Improvements in River Access are Needed in the Wilder Area

GRH's study indicated that user suggestions for improvements at the Wilder project was dominated by request for more access, boat launches, and campsites and specific requests for

swimming access.[47] Additionally, there was an average of 55% of respondents who indicated they were not satisfied to only slightly satisfied with the number, type and location of public recreation areas above and below the Wilder project, with an average of only 5.5% indicating moderate to extreme satisfaction.[48]

Comments from CRC's recreation survey[49] for the Wilder impoundment area consistently indicate that boat launches are too silted in to be useful, that signage and parking access needs to be improved, and that access areas lack both bathroom facilities and areas to swim. Issues related to the GRH owned Kilowatt Park North and South included concerns about prohibition for parking in the North, the loss of a swimming dock, needed enhancements to trails, and erosion control, clarity on parking areas to access Kilowatt South, needs for improved signage and upgrades to the pitch of the dock to make it more usable. GRH seems to imply that they will make improvements to the portage around the Wilder dam[50], but it is unclear what those will consist of.

There are limited recreation access areas across the Wilder impoundment project area. CRC provides some examples from a few of the towns, but this is not an exhaustive list of needs. For instance, comments from the Town of Norwich to FERC indicate that, "Areas such as Patchen's Point, which is a popular picnicking area and the only public camping area along the river in Norwich, have seen significant erosion… erosion reduces the available recreation resources" and that, "Norwich seeks to encourage recreation in and along the river."[51] There is a cartop only boat launch in Norwich that could be upgraded to allow for motor boats.

While there is a primitive campsite, there is no other river access in the town of Fairlee at all.

The Town of Newbury commented to FERC[52] that while there are conservation easements providing recreational access along the river, "actually accessing the river for boating or fishing is problematic because of the degraded banks," and that, "Two specific needs

[47] Accession Number 20160301-5331TransCanada Hydro Northeast Inc. ILP Study 30 Recreation Facility Inventory. Use and Needs Assessment Study Report. Prepared by Louis Berger and Normandeau Associates, Inc. March 1, 2016. Page 202-204.
[48] Ibid. Page 212-213.
[49] https://elibrary.ferc.gov/eLibrary/idmws/file_list.asp?accession_num=20181024-5050
[50] See GRH response to FERC Additional Information Request, Table D-1 for Wilder: https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20210330-5038&optimized=false
[51] https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20240411-5115&optimized=false
[52] Accession Number 20240522-5128

identified by the Newbury Conservation Commission are more 'car-top' boat access points for canoes and kayaks and areas set aside and properly maintained for primitive camping."

The Town of Thetford commented to FERC[53] that, "access to the Connecticut River for the 2,775 citizens of Thetford is limited. The only public access point is the North Thetford boat launch where access is limited to boaters and anglers…" and that "currently no public access for swimming in the river is provided…" and "residents are very interested in improving swimming access."

Finally, CRC would draw your attention to the comments of the Town of Hartford[54], and the surprising lease arrangement that *requires the Town to maintain Kilowatt Park at the taxpayers' expense* [emphasis added] property owned by GRH which ostensibly is serving as mitigation under their current license. The Town of Hartford outlines several specific requests related to improving recreational access to the river such as needed ADA improvements to docks, bathroom facilities, parking, roadways, pedestrian and bike access.

3. Multiple WQS Considerations in the Town of Hartland

While there are numerous potential impacts regarding whitewater recreation, dwarf wedge mussels, cobblestone tiger beetles, and endangered plants in the Hartland area, and multiple studies were done to assess those impacts, the Town of Hartland is not formally in the project area. CRC argued in our comments that the movement of flows between the facilities is coordinated based on water volume and operational need. Those areas left out of the project boundary encompass towns and shorelines of the river that are being acted on and impacted by the operation of the facilities as the river increases or decreases in flow, floods, or recedes because of operations.

Hartland's comments in response to the REA[55] state that, "Sumner Falls is the only public access point between Hartford and Springfield that does not charge a fee for entry" and that "there are ten 'significant species' near Sumners Falls" occurring in or along the banks of the river. They describe needed improvements to access the whitewater area and improvements for portage for boaters who would prefer to pass the falls, as well as the importance of the area as a cultural and historical site. CRC encourages Vermont to pay special attention to

[53] Accession Number 20240415-5303
[54] Accession Number 20240506-5060
[55] Accession number 20240520-5024

implementation of conditions to enforce water quality standards for multiple issues of concern in the Hartland area.

B. Bellows Falls

1. Herrick's Cove and Roundy's Cove Outstanding Resource Waters Petition

Vermont DEC should know that CRC and the Windham Regional Commission are working with the Rockingham Conservation Commission to petition the State to designate both Herrick's Cove and Roundy's Cove as Outstanding Resource Waters for multiple features including significant communities; Rare, Threatened and Endangered species; fish and migratory bird habitat; water storage for flood waters; and accessibility of the waters for recreational, educational, and research purposes.

Located between these two Coves and adjacent to the river, the State of Vermont manages the Missing Link Wildlife Management Area to protect Bald Eagle habitat, provide recreational access, protect Connecticut River riparian habitat corridor areas, and prime agricultural soils.[56] The interim management plan indicates that it is a crucial connector between the conserved lands (Herrick's and Roundy's Coves) owned by Great River Hydro.

The Town of Rockingham[57] and multiple other parties submitted comments to FERC supporting efforts to protect both Herrick's and Roundy's Cove and documents their importance to grassland and wetland birds as ecological, habitat and recreational assets. GRH's management decisions on these company owned lands - such as frequency of impoundment drawdowns, leases for haying or other access to agriculture, management and maintenance of recreational access facilities, use of herbicides or pesticides, etc. - could have significant deleterious effects for multiple WQS designated uses.

[56] See: https://fpr.vermont.gov/missing-link-wildlife-management-area
[57] Accession number 20240521-5033

2. Invasive Species Concerns in Albee's Cove

Windham Natural Resources Conservation District (WNRCD) has been spending considerable time and energy trying to address invasive species – namely water chestnut that has taken over a setback area called Albee's Cove[58]. Between 2020 and 2023, aquatic biologist Laurie Callahan along with staff and volunteers from the WNRCD made approximately 50 trips to collect over 19,000 water chestnut rosettes from the east and west sides of Albee's Cove. There is extensive water chestnut still present among other aquatic plants in the Cove, as seen in the photograph below.

Water chestnut in Albee's Cove. 43.152722, -72.456556. Photo by Isabel Bowman

[58] As described by Laurie Callahan in her 2023 report: These 2 sites at Albees Cove, setback areas along the CT River in Rockingham (VT), are just to the north of the Joy Wah restaurant. One of the two sites is on the west side of the railroad tracks (Albees Cove-west) and the other Trapa site is on the east side of the railroad tracks (Albees Cove-east). There is a small underpass that allows water to pass from the main stem of the river into, and out of, the setback area. The Bellows Falls dam on the CT River is just below the site and the water levels in the setback area probably see broad fluctuations over the aquatic plant growing season, spring to late fall. The Trapa found at the site known as Albees Cove–west was reported and confirmed in October 2020. The second site, known as Albees Cove–east, was detected and verified in June 2021, when survey and control efforts were beginning at the Albees Cove–west site.

3. Improvements in River Access Are Needed in the Bellows Falls Area

GRH's study indicated that user suggestions for improvements at the Bellows Falls project was dominated by request for more improvements to boat launches, more boat and fishing access locations, more campsites, and specific requests for swimming access.[59] Additionally, there was an average of 48% of respondents who indicated they were not satisfied to only slightly satisfied with the number, type and location of public recreation areas above and below the Bellows Falls project, with an average of only 12% indicating moderate to extreme satisfaction.[60]

Comments from CRC's recreation survey[61] for the Bellows Falls impoundment area consistently indicate that access areas need to be improved – launches are muddy, access is steep, and roads need repair. Additionally, there were repeated comments that more access sites were needed between White River Junction and Putney. The only boat access areas in the Bellows Falls project area in Vermont are at Wilgus State Park (for car-top boats only) in Weathersfield, Hoyt's Landing in Springfield, and Herrick's Cove in Rockingham. There is no access to the river in the Town of Windsor, or anywhere between Sumners Falls and Wilgus State Park – approximately 14 miles of river. Similarly, to the south, there is no boat access between Herrick's Cove and the Putney boat landing – almost 21 miles of river (with no access at all in the Town of Westminster).

GRH seems to imply that they will make improvements to the portage around the Bellows Falls dam, possibly providing a shuttle service[62], but there is a notable lack of information related to how that will work, timing, and whether there will be a cost or not. Moreover, the need for equitable access should dictate a walkable portage that provides access to amenities in downtown Bellows Falls.

---

[59] Accession Number 20160301-5331TransCanada Hydro Northeast Inc. ILP Study 30 Recreation Facility Inventory. Use and Needs Assessment Study Report. Prepared by Louis Berger and Normandeau Associates, Inc. March 1, 2016. Page 202-204.
[60] Ibid. Page 212-213.
[61] https://elibrary.ferc.gov/eLibrary/idmws/file_list.asp?accession_num=20181024-5050
[62] See GRH response to FERC Additional Information Request, Table D-1 for Wilder: https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20210330-5038&optimized=false

In their comments to FERC, the Town of Rockingham[63] indicated that they are interested in improved access to Herrick's Cove including better maintenance of the road to the boat launch, the installation of vault toilets, additional appropriate signage, primitive camping sites, enhanced erosion mitigation, and the installation of a boardwalk and platform blind for birders. They also asked for Village access directly to the River from Rockingham Street north of the Arch Bridge with a canoe and kayak conveyance. The town is planning to widen the sidewalks in this area and include a promenade for all to enjoy the vistas along the river. The Town is also hoping to improve a recreational pathway and river access below the dam between Adams Grist Mill and the confluence of the Saxtons River, which would enable connections to efforts being planned by the Saxtons River Trails Initiative[64] and the popular fishing and swimming hole at confluence of the Saxtons River and the Connecticut River.

4. Bellows Falls Canal Aesthetics, Aquatic Habitat, and Fishing Access

Vermont WQS that apply to the historic canal in downtown Bellows Falls include the protection of "aquatic biota and wildlife that may utilize or are present in the waters," the "use of waters for the enjoyment of aesthetic conditions," and the "use of waters for fishing and related recreational uses."[65]

There are recreational access and aesthetic considerations related to multiple places in the downtown area where community members can access the canal. Sidewalks on both Depot Street and Bridge Street bridges spanning the canal could be improved for fishing access. Numerous public areas could be improved for access to enjoy the aesthetics of the flowing water in the canal and its historic importance to the town. For instance, here is a parcel owned by GRH along the canal that is one block from the main street in Bellows Falls which is badly in need of aesthetic and access improvements:

[63] Accession number 20240521-5033
[64] See: https://www.reformer.com/community-news/saxtons-river-valley-trails-initiative-receives-nps-grant/article_4b12add9-5444-525c-8acc-a87c9b1a12c5.html and https://www.facebook.com/saxtonsrivervalleytrails
[65] VWQS § 29A-104(d)

Picture from Google map viewing the canal from 10 Bridge Street. Accessed 9/26/24.

There are additional spots along the canal, including directly in front of the Chamber of Commerce Welcome Center, which is also one of the Waypoint Visitor Centers for the Connecticut River ByWay[66]. Both the Canal and the Waypoint Visitor Center are listed on the Great Falls Region Chamber of Commerce site as a tourist attraction.[67] In their comments to FERC, the Town of Rockingham indicates that it is interested in "easements granted for a canal walk with lighting to match the Downtown, and approval for light shows over the canal," "design enhancements to the aesthetics of the canal wall," and "completion of [black iron] fencing on both sides of the canal" as was done along the northern portion.[68]

The aesthetics of, and access to the Bellows Falls Canal is an important designated use that needs to be protected. Currently, there are "No Trespassing" signs along the canal in front of the Visitor Center. While there is significant safety concerns related to entering the canal, it is important to both educate the public about safety concerns, while also welcoming them to engage with the canal in a safe way. Failing to do so fails to preserve these designated uses.

[66] See: https://vermontvacation.com/things-to-do/trip-ideas-itineraries/scenic-drives/vermont-byways/
[67] See: https://www.gfrcc.org/attractions/
[68] Accession number 20240521-5033

Fish moving through the fish ladder enter the canal on their way upstream and pass through the upper end of the canal, which then opens into the river. Given this, resident and migratory fish have access to the entire length of the canal. Therefore, the water and aquatic habitat in the canal must be protected through the Vermont WQSs. GRH will likely need to draw the canal down for maintenance multiple times over the next license period, so it is important that a process is put in place to manage that drawdown to protect aquatic species. CRC currently partners with the hydro owner, the USFWS and USGS to support a sea lamprey rescue in the Turners Falls canal[69] drawn down regularly for maintenance. Operational procedures to reduce impact to aquatic species, as well as a rescue program should be required as a condition of the §401 certification to protect those designated uses and aquatic wildlife in the canal.

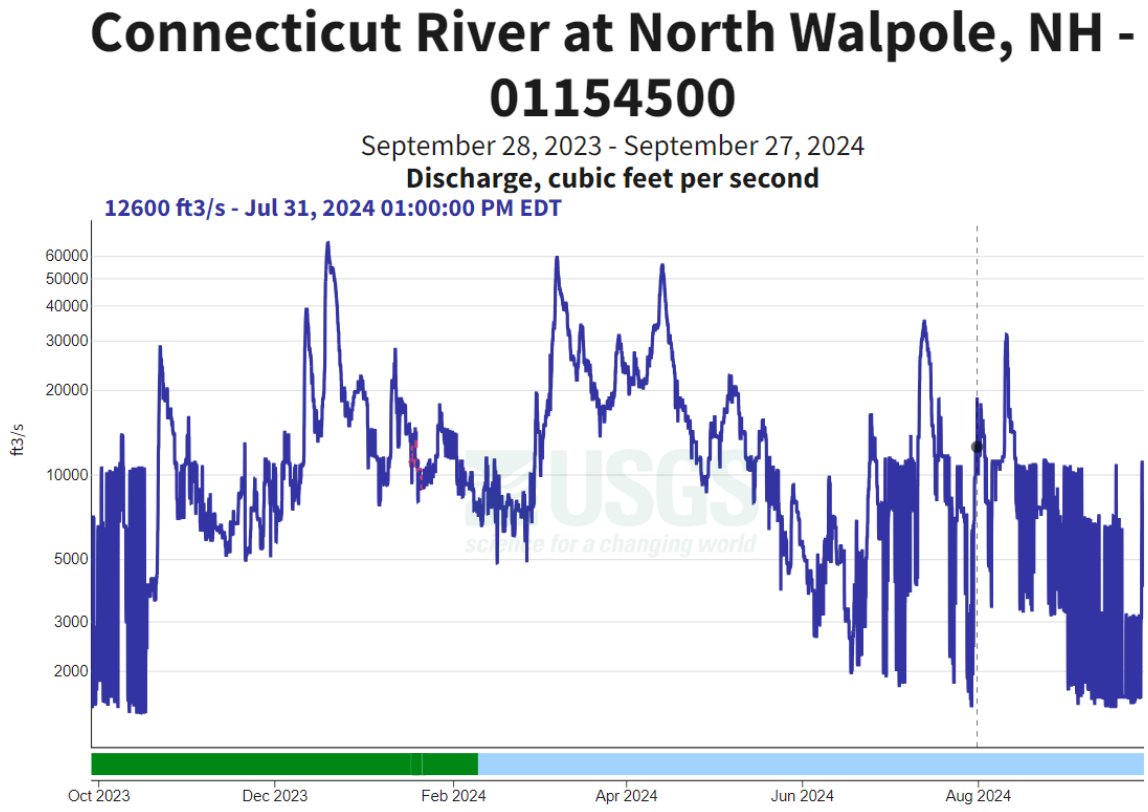
5. Bellows Falls Bypassed Reach Aquatic Habitat and Cultural Importance

It is critically important to remove the salmon dam in the so called "bypassed reach" of the river. GRH's application proposes adding a fish friendly minimum flow turbine to the dam to pass 300 cfs into the bypass reach, while also acknowledging that the bypass receives "significant amounts through spill during periods when flows exceed station capacity[70]" which is 11,010 cfs.

The USGS stream gauge at Walpole shows significant numbers of weeks when discharge was above station capacity. Here is an example from 2023-2024:

[69] See: https://www.ctriver.org/post/sea-lamprey-rescue-2024 and https://www.recorder.com/Annual-Turners-Falls-effort-protects-sea-lampreys-while-providing-education-57098622

[70] Amended Final Application for New License for Major Waterpower Project—Existing Dam. Bellows Falls Project (FERC No. 1855). Exhibit A: Project Description. June 2023 Revision. Page A-5.



USGS Stream gage cfs flows at North Walpole: September 29, 2023 to September 27, 2024.

While 2024 may have been a wet year, climate models predict and lived experience confirms that there is more precipitation in winter falling as rain. Vermont is experiencing a consistently reduced snowpack resulting in more water running off the land, and we should expect increases in more intense localized storms throughout our region. Given that, the hydrograph above may more appropriately reflect the future, and we can expect more flows passing into the bypassed reach.

Subsequently, it is critical to protect any available habitat in the bypass reach and provide for fish passage. By installing a fish friendly turbine, GRH acknowledges that American eel and other species will be passing downstream into the bypassed reach. The obsolete salmon dam must be removed to provide the free flow of available water and easy passage.

Photo 26[71]. Bellows Falls Bypassed Reach showing the Salmon dam; looking upstream right channel toward fish barrier from Vilas Bridge.

The Bellows Falls Petroglyph Site (designated through the National Register of Historic Places as Site VT-WD-8) is in the bypass reach. According to a presentation done for the New Hampshire Archeological Society,

> The Kchi Pôntegok Petroglyph Project, funded through the National Park Service's Underrepresented Communities Grant program, is attempting to address this lack of Indigenous cultural nuance by recontextualizing the Kchi Pôntegok/Bellows Falls site (VT-WD-008) within the wider landscape of the Middle Connecticut River watershed and its resources, connections and stories, as well as the regions' Indigenous and historic archaeological sites.[72]

Section §401 empowers states to assess and certify that any proposed activity requiring a federal license or permit complies with state water quality standards and *any other appropriate requirement of State law*,[73] such as the Vermont Historic Preservation Act. Given the cultural

[71] Accession Number 20150302-5358. TransCanada Hydro Northeast Inc. ILP Study 7. Aquatic Habitat Mapping Final Study Report. Normandeau Associates, Inc. March 2, 2015. C-13.
[72] See: https://www.nhas.org/post/petroglyphs-at-bellows-falls; https://www.commonsnews.org/issue/763/763petrogylphs_grnt; https://vtdigger.org/2022/05/30/federal-grant-approved-for-study-of-abenaki-carvings-in-bellows-falls/
[73] 33 U.S.C. § 1341(d).

and historic importance, beauty of the falls, and presence of the petroglyphs, the bypassed reach is a good candidate to nominate for Outstanding Resource Waters and should be protected.

Additionally, in their comments to FERC on the REA[74], the Town of Rockingham made it clear that they are interested in the development of a Riverfront Trail with river overlooks – a recreation trail that would allow views into the bypassed reach - that is outlined in their Area Wide Plan[75] in order to provide an unobtrusive method to view the petroglyphs and falls and provide a recreation pathway along the Connecticut River. The Town of Rockingham highlights in their comments the cultural and historic importance of the falls as a gathering place for Abenaki peoples.

While CRC is a signatory to, and supportive of, the MOU regarding the preferred operational change, which includes a minimum flow of 300 cfs into the bypassed reach, the Town of Rockingham and American Whitewater are not. Both entities have commented in the FERC docket about aesthetic and flow considerations in the bypass reach, and it is incumbent upon the State to recognize the importance of the bypassed reach and condition the WQC to protect designated uses for that area.

C. Vernon

1. Improvements in River Access Are Needed in the Vernon Project Area

As GRH's own study regarding the Vernon project indicated, users requested improved access areas, more boat and fishing access locations, and swimming access.[76] Additionally, there was an average of 43% of respondents who indicated they were not satisfied to only slightly satisfied with the number, type and location of public recreation areas above and below the Vernon project, with an average of only 9.5% indicating moderate to extreme satisfaction.[77]

Comments from CRC's recreation survey[78] for the Vernon impoundment area consistently indicate that access areas need improvements to parking and launches, including the

[74] Accession number 20240521-5033
[75] See: https://www.rockinghamvt.org/bellows-falls-area-wide-plan
[76] Accession Number 20160301-5331TransCanada Hydro Northeast Inc. ILP Study 30 Recreation Facility Inventory. Use and Needs Assessment Study Report. Prepared by Louis Berger and Normandeau Associates, Inc. March 1, 2016. Page 204.
[77] Ibid. Page 212-213.
[78] https://elibrary.ferc.gov/eLibrary/idmws/file_list.asp?accession_num=20181024-5050

addition of docks, improved signage, and access for swimming. The only boat access areas in the Vernon project area in Vermont are the Vermont Fish and Wildlife Putney and Dummerston boat landings (both accessible from the same road and within .46 of a mile from each other with no access for swimming), the Vermont Fish and Wildlife Old Ferry Boat landing in Brattleboro (also unavailable for swimming), the Retreat Meadows cartop boat launch in Brattleboro, the West River Marina in Brattleboro, and the Governor Hunt Recreation area below the Vernon Dam, which does not have an improved boat launch (boats are launched from a sandy beach). There is no other public boat, fishing, or swimming access to the river for 17 miles between the Putney boat landing north to just below the Bellows Falls dam, which includes no access at all for the entire town of Westminster.

In their comments to FERC, the Town of Putney states, "Residents have only one public access to the river: Vermont Fish and Wildlife's Putney Landing. Residents also use the Dummerston Landing, located a half mile south in the next town. Vermont Fish and Wildlife allow only boat launching/landing and fishing on these lands. There is no public area along the river for swimming or other recreational activities. Steep drop-offs caused by past erosion hinder recreational access in some locations."[79] They also share that, "The Vermont Council on Rural Development coordinated a town wide… report and action plan called Our Future Putney in February 2023… The final VCRD report highlighted 'Improving River Access' as a key opportunity for the town."

The Town of Dummerston indicates that, "Dummerston residents do not have adequate recreational access to the river. The one public access boat launch is not able to accommodate boats over the size of a common canoe due to awkward orientation on a heavily silted tributary to the main river."[80] Neither the Putney nor Dummerston boat landing have bathroom facilities, but both are heavily used. Additionally, these sites are also impacted by encampments of unhoused people who are using wooded areas as latrines.[81]

With the construction of a new bridge over the Connecticut River connecting Brattleboro to Hinsdale, both towns have been collaborating on visioning recreational and ecological improvements to Hinsdale Island, in the middle of the river. According to Exhibit G maps provided by GRH, they own this island. Brattleboro's comments to FERC include their hopes in

[79] Accession number 20240520-5203
[80] Accession number 20240418-5019
[81] CRC staff personal experience as of September 29, 2024.

using this island to access the Connecticut River for recreation, and call for recreational amenities in the Brattleboro-Hinsdale Plan which feature, "a boardwalk, boat dock, walking paths, a beach and landing for non-motorized boats, and a small amphitheater…"[82]

The Meadows is an approximately 100-acre wetland complex at the confluence of the West and Connecticut Rivers and is fully included in the formal project area for the Vernon facility.[83] Brattleboro additionally requests to "improve the existing informal boat access to the Retreat Meadows to enhance safety… and reduce run-off and sedimentation flowing directly into the Retreat Meadows"[84] which also is supported by the requests of the Retreat Farm which states that, "permanent flooding of this farmland has established outstanding wildlife habitat and a year-round water resource for water- and land-based recreation by kayakers, hikers, fisherfolk (including ice-fishing) ice-skaters, and birders. The Meadows is cited in the [Brattleboro] Town Plan as a 'four-season water destination and major open space amenity for the community'.[85]"

The Town of Vernon specifically asks for the improvements to existing facilities and implementation of a number of additional recreational facilities, "particularly because the commitments made by the owner under the previous license in 1979 have been largely unfulfilled."[86] In their comments, Vernon points out several new Town Plans that integrate recreational aspects – including the redevelopment of the Vermont Yankee site.[87] They request specific comprehensive upgrades to the existing recreation facilities that include permanent restrooms, working boat launch pads above and below the dam, improvements to portage, upgrades to the fish ladder viewing area with universal access and trained naturalists – something that is comparable in quality to the Bellows Falls Fish Ladder, and regular maintenance for these facilities. In addition, Vernon is interested in more access to areas above the dam from the Vermont Yankee site.

This is not an exhaustive list of possible projects that would provide equitable access to the river to protect our boating, fishing and primary contact designated uses, as expressly provided for in the WQSs. The FERC docket has many more comments expressing the need for

[82] Accession number 20240418-5230
[83] See Accession Number 20201204-5120. Amended Final Application for New License for Major Water Power Project – Existing Dam. December 2020. Exhibit G. Sheet 7.
[84] Accession number 20240418-5230
[85] Accession number 20240514-5117
[86] Accession number 20221101-0009
[87] See: https://vernonvt.org/vermont-yankee-site-redevelopment/ https://vernonvt.org/town-plans-and-town-plan-maps/, and https://vernonvt.org/village-center-conceptual-master-plan/

additional access to the Connecticut River in the project areas. The lack of information and detail regarding recreation, river access and monitoring details provided by GRH in their applications is fatal. There is simply insufficient information regarding specific recreational enhancements to provide access to the river, for all designated uses, equitably across the 124 miles that the projects impact.

6. Invasive Species Concerns in Hinsdale setbacks

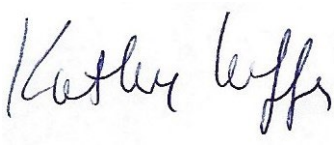
Like concerns about the presence of water chestnut in Albee's Cove, the setback areas of the river above the Vernon dam along the Hinsdale shore have infestations of water chestnut which have been managed by volunteers since 2013, including a newly located area that was discovered in 2023. As Laurie Callahan reports,

> Between late September to late October [2023] four Trapa search & manual harvest sessions occurred at this "new" site. Twelve people participated in those sessions and manually harvested 3,394 Trapa rosettes. During those four sessions, all of the Trapa present was not removed.

There is a very limited effort attempting to identify locations of and eradicate AIS such as water chestnut in the Connecticut River. Small surveys that attempt to identify AIS in various areas of the river are done by Amy Smagula (NH DES) and Kim Jensen (VT DEC) with some support from the WNRCD. More expansive efforts are needed to proactively prevent AISs from moving into the Connecticut River. GRH has not addressed this threat to water quality and aquatic habitat at all in their proposal.

The above comments outline the fatal flaws in Great River Hydro's current applications for §401 water quality certifications. Great River Hydro's §401 certification applications do not ensure that the continued presence and operation of the GRH Projects will comply with Vermont Water Quality Standards. The Vermont DEC should therefore deny the applications for their failure to meet WQSs.

Thank you for the opportunity to comment on this §401 certification process. Should you have any questions, or for further information about what specific conditions in a §401 certification CRC believes would comply with WQSs, please contact Kathy Urffer, Director of Policy and Advocacy and Vermont River Steward at kurffer@ctriver.org or 802-258-0413.



Kathy Urffer

Director of Policy and Advocacy/ River Steward in Vermont
Connecticut River Conservancy

Rebecca Todd

Executive Director
Connecticut River Conservancy

Kathy Urffer
Director of Policy and Advocacy/ Vermont River Steward
Connecticut River Conservancy
PO Box 6219
Brattleboro, VT 05302

RE: Recommendations for Conditions
Pending Vermont 401 Water Quality Certificate
Great River Hydro
Wilder Hydroelectric Project - FERC Project No. 1892-026
Bellows Falls Hydroelectric - Project FERC Project No. 1855-045
Vernon Hydroelectric Project - ERC Project No. 1904-073

October 1, 2024

Dear Ms. Urffer,

Princeton Hydro, LLC (Princeton Hydro) has been contracted to review the proposed modification to the operations of the Great River Hydro (GRH) project, which comprises of three (3) hydroelectric facilities, including their dams, located on the Connecticut River, between the states of Vermont and New Hampshire. The dams are spread out on the river, with the Wilder, Bellows Falls, and Vernon Hydroelectric Projects at river miles 217.4, 173.7, and 141.9, respectively. As we understand, the proposed relicensing of the project will include, in the most basic terms, a modification to the flow management operations from what is termed "Peaking Operations" as perceived demands and instructed actions occur, to an "inflow equals outflow" (IEO) wherein flow entering the impoundment are to equal flow being discharged downstream. The idea of the IEO operation is to reduce the frequent and rapid increasing and decreasing of water surface elevations within the respective impoundments and provide more predictable and consistent water surface elevations in the impoundments and flows closer to natural conditions within the riverine reaches of the Connecticut River. This change in operations is outlined in the Memorandum of Understanding (MOU) signed on December 1, 2020.[1]

[1] Memorandum of Understanding between Great River Hydro and the United States Fish and Wildlife Service, the New Hampshire Department of Environmental Services, the New Hampshire Fish and Game

The comments in this letter have been prepared within the context and regulatory boundaries of the Vermont Water Quality Standards, Environmental Protection Rule Chapter 29A, effective November 15, 2022 ("WQS").[2]. As stated under the Antidegradation Policy, § 29A-105(a), "…All waters shall be managed in accordance with these rules to protect, maintain, and improve water quality", and under § 29A-105(b) Existing Uses shall be protected. In addition, as per § 29A-206 Water Quality Certifications Issued Pursuant to § 401 of the Clean Water Act, under § 29A-206(b) states that a water quality certification shall not be issued unless the applicant demonstrates that, paraphrased, 1) there is no practicable alternative to the proposed activity that would have less adverse impact on waters and wetlands of the State, 2) there is reasonable assurance that the discharge will not result in a violation of the water quality rules, including water quality criteria and the Antidegradation policy.[3] And, under § 29A-206(c), also paraphrased, any certification issued by Vermont shall establish conditions necessary to ensure that, in this case, a federally licensed activity (i.e. FERC regulated hydropower projects) will comply with the WQS.

To be discussed herein, this application has still not met the standard of care required to ensure that the designated uses of the subject sections of the Connecticut River's "natural condition" and "natural flow regime" (as described below) will be protected in relationship to the Antidegradation policy and that there is no evaluation for every practicable alternative. And there is a question of whether the currently proposed operational change ("inflow equals outflow") will be enough, relative to the current activity of significant rapid changes of water elevations and flows, to not violate the water quality criteria and Antidegradation policy.

Department, the Vermont Department of Environmental Conservation, the Vermont Department of Fish and Wildlife, The Nature Conservancy, and the Connecticut River Conservancy; filed with Bellows Falls Project FLA Exhibit B of Amended Final License Applications of Great River Hydro, LLC for Bellows Falls Project, et. al. under P-1855 et. al. Accession Nos. 20201207-5219 (Public), executed on December 1, 2020

[2] Vermont Water Quality Standards, Environmental Protection Rule Chapter 29A (§29A), Effective November 15, 2022.

[3] §29A-206 Water Quality Certifications Issued Pursuant to § 401 of the Clean Water Act.

Pertinent Definitions and Water Quality Designation within the WQS

As stated above, it is my professional opinion, and within a degree of engineering certainty, there is, simply, not enough evidence provided by the applicant to determine if the project will not adversely and significantly impact the "waters" that include the Connecticut River and its tributaries within the influence of these hydropower projects relative to the defined "natural condition" and "natural flow regime".

The "waters" of Vermont:

"…*include all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs and all bodies of surface waters, artificial or natural, which are contained within, flow through, or border upon the State or any portion of it.*"[4]

Of course, the Connecticut River borders upon the State, and the hydropower influenced tributaries in Vermont are "…contained within..." and "…flow through…" it.

"Natural condition", as defined by the VT WQC is as follows:

"…*the range of chemical, physical, and biological characteristics of a body of water that occur with only minimal effects from human influences*."[5]

This definition speaks for itself, using the phrasing of "minimal effects from human influences". Clearly, the Wilder, Bellows Falls, and Vernon Dams, at 59, 30, and 58 feet in height, and impounding 46, 26, and 26 miles, respectively[6], these industrial scale energy generation projects would not be defined as having "…minimal effects from human influences".

[4] § 29A-102 Definitions (51) Waters
[5] § 29A-102 Definitions (27) Natural condition
[6] Pre-Application Documents, Vernon Hydroelectric Project, Bellows Falls Hydroelectric Project, and Vernon Hydroelectric Project (3 separate documents), TransCanada Northeast Inc., each dated October 30, 2012,

And "natural flow regime" as defined by the VT WQC is as follows:

"…*a water's characteristic pattern of variability in flow rates and water levels, annually, seasonally, and daily, without the influence of artificial flow regulation. This pattern of variability is characterized by the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions*."[7]

Regarding this definition, as with the definition of natural condition, these projects do not qualify being "…without the influence of artificial flow regulations". Even as the IEO approach to flows is an attempt to get closer to a "natural flow regime", the flows are still artificially regulated, and in fact, even with the IEO plan, an impounded reach of river is an artificial flow condition, and the "Flexible Operations" portion of the IEO plan will further regulate flow.

It is further noted that even GRH's FERC License Manager, Mr. John Ragonese recognizes that the flow regulation will be much improved with the IEO operations, but also states that "…I grant you it's not natural, and it's not perfect…but if you saw natural flows, you would probably see lower flows in much of the times of the years. The river is still managed, and it is augmented…"[8] He agrees that this system is a highly managed and manipulated system, even with the change of operations to IEO.

The takeaway that VT DEC is strongly urged to consider, is to review the project, not comparing the changing flow regulations from the current practice to the IEO operations; it is comparing the proposed IEO, with its Flexible Operations to the "natural condition" as defined by WQS. It is not enough to simply admit it is not "natural conditions", it will be important to require the applicant to provide modeling, field collected data, and reference data to compare the IEO operations to the "natural condition" and "natural flow regime" of the subject reaches of the Connecticut River; review the net

[7] § 29A-102 Definitions (28) Natural flow regime
[8] CT River Public Information Meetings discussing the VT Water Quality Certificate review process, Bellows Falls, August 8, 2024. Mr. Ragonese speaking during the public question and comment portion of the meeting, between 58 min; 6 sec and 61 min; 19 sec.

impacts comparing the IEO, and its associated Flexible Operations to an undammed, naturally flowing condition. It is only when comparing the existing and proposed conditions of operations to no-dam condition that VT DEC can truly understand the net impacts, and make recommendations for further protections of the designated uses of this section can be achieved, and if not, what type of mitigation, either through funding of, or direct action to provide water quality improvements to watersheds and tributaries to the Connecticut River.

Alternatives Analysis Completed for FERC is not Applicable to the VT Water Quality Standards

A review of Exhibit E, January 2024 Revision, the applicant discusses the no action alternative (keeping operations as is), the chosen alternative (IEO Operation), and the alternatives not considered, including a non-power license, federal takeover, and retirement (decommissioning) of the projects. Specific to the retirement of the projects, the applicant focuses on FERC's reasoning for not considering the alternatives in terms of cost and "clean, safe, and reliable source of renewable energy"[9]. While these two factors do come into play, the WQS are more specific, including that there "…is no practicable alternative to the proposed activity that would have a less adverse impact on waters and wetlands of the State, and provided that any proposed alternative shall not have other significant adverse human health, safety, or environmental consequences."[10] There does not appear to be any other analysis proving that the applicant has looked into other alternatives, including the completion of costs estimates. Even the US Fish & Wildlife Service, The Nature Conservancy, and Two Rivers-Ottauquechee stated that a decommissioning option was dismissed prematurely, for which their statement was dismissed.[11] While the applicant states that "[t]here would be significant costs involved with decommissioning the projects and/or removing project facilities"[12] is simply stating so enough to meet the needs of the WQS to allow

[9] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-35
[10] § 29A-206 (b)(1)
[11] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-35
[12] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-35

approval of a WQC? The applicant, quoting FERC, further states that a more thorough analysis of decommissioning is not warranted as per The Interagency Task Force Report on NEPA Procedures in FERC Hydroelectric Licensing.[13] However, completing a "more thorough analysis" will mean that an initial analysis would have been conducted. We found no evidence in the record of such an initial analysis.

Background and Prior Review by Princeton Hydro

Princeton Hydro was contracted by the CRC in 2016 to provide a peer evaluation of the modeling efforts completed by GRH and their consultants.[14] Specifically, there was concern by CRC, and concluded by Princeton Hydro that the actual causes of erosion, bank slumping, and the associated impacts to water quality and habitat was not adequately and accurately evaluated. Our focus at the time was on the Revised Study Plan (RSP) and Integrated Licensing Process (ISP) Study 2 and 3 (Riverbank Transect and Riverbank Erosion Studies). In our peer review, with the 18 recommendations made in the memorandum, we found that GRH only reviewed velocities of the river flows and would not concede that rapid fluctuations in water levels could lead to bank failure.

While there were other factors that led to the Memorandum of Understanding (December 1, 2020), a major decision to change operations to the proposed IEO was to reduce fluctuations in water levels was likely, in part, of our concern of the impacts of rapid drawdown, a known cause of slumping of the riverbank.[15]

[13] Exhibit E of the letter from GRH to FERC, January 2024 Revision, subsection 2.3.3, Page 3-36
[14] Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies", prepared by Princeton Hydro, dated September 16, 2016.
[15] Xiaoping Chen, Jingwu Huang, Stability analysis of bank slope under conditions of reservoir impounding and rapid drawdown, Journal of Rock Mechanics and Geotechnical Engineering, Volume 3, Supplement 1, 2011, Pages 429-437, ISSN 1674-7755, https://doi.org/10.3724/SP.J.1235.2011.00429.

Proposed Inflow Equals Outflow (IEO) and its Purported Benefits

GRH is proposing a substantial modification to their current operations for all three (3) hydropower projects under review for this 401 WQC application. All three (3) projects are proposing essentially an identical modification of operation to what they have termed "Inflow Equals Outflow" (IEO). IEO is defined as holding the water surface elevation of each dam at a "Target WSE[16] Bandwidth" (TWSEB) of +/- 0.5 feet to account for varying inflows at the dam. The Target WSE for all three dams is 0.5 feet below the spillway elevation of each dam. The following table is included in Exhibit E of the letter from GRH to FERC, dated January 31, 2024[17] that illustrates the proposed IEO targets.

Table 2.2-1. Target WSEs and Target WSE Bandwidths for each Project (elevations are m.s.l., NGVD29)

	Wilder Project	Bellows Falls Project	Vernon Project
Target WSE	384.5 ft *	291.1 ft *	219.63 ft
Target WSE Bandwidth	Between 385.0 and 384.0 ft, representing 0.5 ft above and below the Target WSE	Between 291.6 and 290.6 ft, representing 0.5 ft above and below the Target WSE	Between 220.13 and 219.13 ft, representing 0.5 ft above and below the Target WSE

* Except during DWM pre-winter habitat protection operation period, triggered and maintained as water temperatures drop from 15° Celsius (°C) to10° C within identified DWM habitats within the Projects.

While they term this management operation as "run-of-the-river" flows, there will still be an impoundment that extends to the distances upstream of each dam as identified above, totaling 98 miles[18]. There are exceptions to the IEO operations where GRH will deviate from the TWSEBs, labeled as "Flexible Operations"

[16] Water surface elevation

[17] Letter referenced "Great River Hydro, LLC; FERC Project Nos. 1855-050, 1892-030 and 1904-078, Response to Bellows Falls Application Deficiencies and Requests for Additional Information, authored by John L. Rangonese, FERC License Manager, Great River Hydro, addressed to Debbie-Anne Reese, Acting Secretary, FERC, January 31, 2024.

[18] The 98 miles of impounded section of the Connecticut River represents over 41% of the total river miles, of 238, that border the State of Vermont.

which "are conducted at the Licensee's discretion and deviate from operation at IEO and stable pond"[19] (underlined for emphasis), are initiated based on requirements of the needs of ISO-B NE, Highwater Operations, Transition Operation, Emergencies, System Operation Requirements, and Maintenance[20]. While these operations are a discretionary action, there are limits to the Flexible Operation, depending on the time of the year as follows:

- *December, January, February, March: no more than 65 hours in each month; this represents an average of 9 percent of hours in each month.*
- *April, May, June: no more than 10 hours in each month; this represents an average of 1.4 percent of the hours in each month.*
- *July: A total of 20 hours with no more than 10 hours from July 1 through July 15; this represents 2.7 percent of the hours in July.*
- *August, September, October: a total of no more than 20 hours in each month; this represents an average of 2.7 percent of the hours in each month.*
- *November: a total of 42 hours with no more than 10 hours from November 1 through 15; this represents 5.8 percent of the hours in November.* [21]

Once a Flexible Operation event occurs, there are also ramping down/refilling time requirements to reduce surges of flow downstream and rapid drawdown within the impoundment. The benefits for the new operations include the minimization of elevation fluctuations within the impoundment, protection of downstream targeted species of concern, and recreational access.

It is recognized that the change in operations *may (or may not)* be an improvement to the quality of the Connecticut River, however, the proposed IEO Operation must be compared to the "natural condition", "natural flow regime", and comply with the Antidegradation policy.

[19] Exhibit E of the letter from GRH to FERC, January 2024 Revision, Proposed Action and Alternatives, Page 2-28
[20] "Amended Final Application for New License for Major Water Power Project – Existing Dam, Bellows Falls Project (FERC No. 1855), Exhibit B: Project Operations and Resource Utilization, January 2024 Revision.
[21] Exhibit E of the letter from GRH to FERC, January 2024 Revision, Proposed Action and Alternatives, Page 2-28

Comparison to Vermont Water Quality Standards

Regardless of the purported benefits to the riverine resources and recreational opportunities, it is not clear what the impact is to the WQS, specifically to the Antidegradation policy and the damages in relation to the "natural condition" and "natural flow regime". The subject reaches of the Connecticut River, including the impounded reaches, caused by the existence of the dams, and the non-impounded sections between the dams and downstream of the lowest dam (Vernon Hydroelectric Project), are classified as B(2) waters and have specific minimum standards that are to be met, and if not, determine an understanding of how those standards fall short.

General Observations of the Studies Completed to Date

Within the Vermont Water Quality Certification applications for each of the three projects, GRH states that they are currently meeting the Vermont water quality standards and refer to their Exhibit E[22] sections 3.5.1.2, 3.5.2.2, 3.5.3.2, and 3.5.4.2 and the Integrated Licensing Process (ILP) Study 6 Report[23] as the basis for this claim. As a general note, both the listed sections above and the ILP Study 6 are somewhat dated. Specifically, GRH refers to the 2016 VT WQS throughout the document and relies on two study seasons 2012 and 2015 as the basis of their observations and conclusions regarding meeting WQS. GRH repeatedly provides reference, comparisons, and documents listed in their Literature Cited section to the 2016 WQS (among other dated VT documents) throughout the document, and not the 2022 WQS.[24] Also, the use of two, disparate years of study that occurred 9 and 12 years ago, respectively, would not provide statistically significant data to support the meeting of the WQS, and is, frankly, dated.

[22] Within the website, Exhibit E for the VT WQC application, is dated June 7, 2023, is used, not the one labeled as revised January 2024 that is referred to in other areas of this letter.
[23] ILP Study 6, Water Quality Monitoring and Continuous Temperature Monitoring Study, Revised Final Study Report, prepared for TransCanada Hydro Northeast Inc., prepared by Louis Berger and Normandeau Associates, dated December 15, 2016.
[24] Exhibit E, Wilder, Bellows Falls, and Vernon Projects, June 2023 Revision.

§ 29A-302 Criteria Applicable to Waters Based upon Fish Habitat Designation, Use Classification, or Type of Body of Water

In their report, GRH states that "…the existing thermal regime is not expected to change from existing conditions because Great River Hydro is not proposing any change in Project operations."[25] This statement contradicts the overall proposed operational change from the current process of peaking, with multiple feet of elevation change within the impoundments, to the "run-of-the-river" IEO operations, wherein the water levels will not substantially change significantly for a majority amount of time. Such a change leads to several questions regarding the change in state of thermal stratifications. On one hand the current peaking operations could trigger mixing of the water body, but with the IEO operation, stabilized water surface elevations could lead to extended periods of higher water temperatures within the impoundments. Such periods of stratifications would also promote anoxia in the hypolimnion, leading to the releasing of phosphorus into the water column, triggering algal blooms and, of more concern, harmful algal blooms (HABs)[26]. It will be vitally important to understand how the changes to the operations could trigger such blooms.

HABs have been exacerbated over the years due to climate change, through longer periods of elevated air temperatures that create optimal conditions for algae, followed by intense rainstorms which disrupt the water columns and suspend organic sediments, accelerating the progress of these blooms.[27] There appears to be no discussion regarding the amount of sediment that has accumulated within the three impoundments, including their tributaries, and the organic content of such sediment, including

[25] Exhibit E, last revised January 2024, section 3.5.3.2, page 3-262.
[26] Harmful algal blooms consist of blue-green algae, also known as cyanobacteria, which release cyanotoxins that can negatively affect fish and terrestrial organisms, including humans who might ingest water containing these toxins.
[27] Paerl HW, Barnard MA. Mitigating the global expansion of harmful cyanobacterial blooms: Moving targets in a human- and climatically-altered world. Harmful Algae. 2020 Jun;96:101845. doi: 10.1016/j.hal.2020.101845. Epub 2020 Jun 10. PMID: 32560828; PMCID: PMC7334832.

phosphorus and nitrogen. Cyanotoxins released into the water column can lead to mass fish kills and create illness and death in terrestrial mammals, including humans.

A review of ILP Study 7, Habitat Mapping, reveals that 76.2% of the total 3,028 acres mapped within the impoundments consist of "sand/silt/clay".[28] This equates to 2,307 acres. When compared to the surveys in the unimpounded, free flowing reaches, those substrates contained nearly 100% course-grained materials, such as sands, gravels, and cobbles.[29] This leads to Princeton Hydro's conclusion that the dominant, fine-grained substrates identified in ILP Study 7 consist of suspended sediment that settled within the impoundments because of the capture efficiencies of the reservoirs. Further, a review of the bathymetric mapping discussion within ILP Study 7 did not include the collection of sediment or a determination of the overall composition and quality of sediment to determine the concentration of organic matter, including that portion that would become biologically available to aquatic organisms such as algae. This, in Princeton Hydro's professional opinion, does not allow for an understanding of the potential for the degradation of water quality, including the loss of dissolved oxygen, elevation of turbidity, and the potential for the triggering of HABs. GRH makes a statement that "[a]ttainment of state surface water quality standards relative to nutrients will not be affected under proposed operation because the Projects do not contribute to nutrient loading in the river."[30] However, as discussed above, the existence of the dams and promotion of accretion of organic/nutrient containing sediment is an internal source of nutrients, and thus the projects do contribute to nutrient loading.

[28] ILP Study 7, Aquatic Habitat Mapping, Final Study Report, prepared for TransCanada Hydro Northeast, Inc. prepared by Normandeau Associates, Inc., dated March 2, 2015.
[29] ILP Study 8, Channel Morphology and Benthic Habitat Study, Final Study Report, prepared for TransCanada Hydro Northeast, Inc. prepared by Stantec Consulting Services Inc and Normandeau Associates, Inc., dated March 2, 2015.
[30] Exhibit E, Wilder, Bellows Falls, and Vermon Projects, June 2023 Revision, subsection 3.5.3.2, page 3-263, last paragraph of subsection.

Our conclusion is that the necessary information for VT DEC to review the impacts associated with water quality, as compared to the "natural condition" for these B(2) waters specific to temperature, phosphorus, turbidity, and dissolved oxygen has not been satisfied.

§ 29A-303 General Criteria Applicable to all Waters

As described under § 29A-302, above, a review of this subsection of the Vermont WQS has not been met, or at a minimum the data needed to make such a determination is missing. Under § 29A-303, the pertinent parameters of concern would be taste and odor, color, and toxic substances. Due to the significant presences of accumulated, fine-grained, with likely high concentrations of organics, including biologically available phosphorus, these parameters would be negatively impacted. And, while these reservoirs are not identified as necessarily potable water sources, there are likely many local private potable wells within the hydrogeologic influence of these impoundments that may be affected. Cyanotoxins, a neurotoxin, in the water column resulting from HABs, in high enough doses, has been found to cause fish kills, be fatal to mammals, including dogs.[3132] In humans, cyanotoxins can lead to skin rashes, illness, and, sometimes, death.[33]

With algal blooms and resuspended sediments during floods and sudden changes to river flow velocities, algae and suspended sediment can create aesthetic impacts to water, as well as could also make, for example, rescues below the water surface much more difficult due to the loss of visibility/clarity.

[31] Fredrickson A, Richter A, Perri KA, Manning SR. First Confirmed Case of Canine Mortality Due to Dihydroanatoxin-a in Central Texas, USA. Toxins (Basel). 2023 Aug 1;15(8):485. doi: 10.3390/toxins15080485. PMID: 37624242; PMCID: PMC10467149.
[32] Factsheet, "Cyanobacteria in Vermont, What Veterinarians Should Know", VT DEC, Agency of Agriculture, Food, & Markets, Department of Health, July 2014, 2 pages. https://www.healthvermont.gov/sites/default/files/documents/pdf/ENV_RW_CyanobacteriaVeterinarians.pdf, accessed September 30, 2024.
[33] Webpage, "What Are the Effects of HABs", USEPA, https://www.epa.gov/habs/what-are-effects-habs#, accessed September 30, 2024.

As a result of Princton Hydro's review, the necessary information for VT DEC to assess the impacts associated with water quality, as compared to the "natural condition" specific to taste and odor, color, and toxic substances have not been satisfied.

§ 29A-304 Hydrology Criteria

As discussed above, the proposal to modify the existing operations to IEO, in concept, appears to improve the hydrological conditions of the downstream resources, within unimpounded reaches of the river. It is interesting to note that the ILP Study 8, Channel Morphology and Benthic Habitat Study states that there are larger coarse particles, for example, immediately below the Wilder Dam (sample site 08-M01) contained larger cobble substrate, while the reach downstream from the Bellows Falls Dam consisted of primarily sand (08-M15).[34] The claim that the rock below Wilder Dam could have been from the remains of construction could also be explained as a sediment starved reach due to the capture efficiency of the Wilder Dam's reservoir, while at Bellows Falls Dam, the existence of sand is likely due to the over widened section of the river at that location, promoting the settlement of what little sand makes it through the Bellows Falls impoundment, as well as contributions from the Saxtons River in the vicinity of the sampling location.

The predominantly of sand/silt/clay composition within the impoundments of the dams, versus the coarse-grained riverbed material in the free-flowing reaches clearly illustrates the way in which these three dams have drastically segregated out fine-grained sediment via settlement within the impoundments.

What is missing from the discussion of hydrology (and hydraulics) within the available studies is any discussion about sediment transport, including the quantity of sediment that has accumulated within the impoundment, and how the change in operations to IEO may affect the existing distribution of sediment

[34] ILP Study 8, Channel Morphology and Benthic Habitat Study, Final Study Report, prepared for TransCanada Hydro Northeast, Inc. prepared by Stantec Consulting Services Inc and Normandeau Associates, Inc., dated March 2, 2015, page

within the impoundment, if it will lead to redistribution and transport downstream of each of the dams, and difference in impacts between the current operation and proposed IEO related to the "natural condition" and "natural flow regime". Sediment transport is a component of the hydrology (and hydraulics of a river). Excessive sediment could have a dramatic impact on downstream resources, including the dwarf wedge mussel (DWM), as well as spawning beds for migratory and potamodromous fish species.

As was also a topic of Princeton Hydro's comments on ILP Study 2 and 3[35], it is important for VT DEC to understand if and how the stability of the riverbanks within the impoundment may be affected by the operation change. Princeton Hydro, in its review and prepared memorandum from 2016, was concerned about the methodologies employed by GRH's consultants, specific to the stability of the riverbanks within the impoundments of the Projects.[36] Specifically, the applicant was more focused on river flow velocities rather than the mechanisms of rapid drawdown and saturation of the banks that could lead to bank failure. Now with the changing to IEO Operations, the impacts of fluctuating water levels may be somewhat alleviated, but the question arises as to how GRH will stabilize those slopes that were destabilized, and how the changes in flow velocities resulting from the proposed IEO Operation will affect those slopes that may still be devoid of vegetation and undercut from previous bank sloughing.

Based on Princeton Hydro's review and current understanding of the information submitted as part of this WQC application, it appears that there is not enough information for VT DEC to compare the impacts of the hydrology of the existing and new operations to each other, as well as their relative impacts

[35] ILP Study 2 and 3, Riverbank Transect and Riverbank Erosion Studies, Final Study Report, prepared for TransCanada Hydro Northeast, prepared by Field Geology Services LLC and Normandeau Associates Inc., dated February 4, 2017.
[36] Memorandum referenced "FERC Re-Licensing Process for TransCanada Hydro Northeast Inc. Peer-Review of ILP Study 2 and Study 3 Riverbank Transect and Riverbank Erosion Studies", prepared by Princeton Hydro, dated September 16, 2016.

to the "natural condition" and "natural flow regime", as defined by the WQS and its Antidegradation policy.

§ 29A-305 Numeric Biological Indices and Aquatic Habitat Assessments

The definition in the WQS for "biological integrity" is as follows:

"…the ability of a body of water to support and maintain a community of organisms that has the expected species composition, diversity, and functional organization comparable to that of the water in its natural condition."[37]

Again, based on the "natural condition", it is important that the applicant demonstrate that the impacts associated with the GRH projects relative to a free-flowing river and to provide information to understand the various biological indices and habitats are affected. The two years of baseline monitoring described earlier (in the years 2012 and 2015) do not provide a statistically significant understanding of the conditions over the longer term, and surely do not provide relative impacts to the "biological integrity" of a "natural condition". And, based on the habitat documentation provided, GRH clearly illustrated that if 76.2% of the impoundments contain a "sand/silt/clay" substrate, as opposed to the free-flowing sections that contain coarse-grained substrate that supports the needs of riverine species, they would hardly support the same species composition, diversity, and functional organization of the Connecticut River in its natural condition.

Based on Princeton Hydro's review and current understanding of the information submitted as part of this WQC application, it appears that there is not enough information provided for VT DEC to compare the impacts of the biological and habitat integrity of the existing and proposed operations, to each other, as well as their relative impacts to the "natural condition" and "natural flow regime", as defined by the WQS and its Antidegradation policy.

[37] § 29A-102 Definitions (8) Biological Integrity

§ 29A-306 Use-specific Management Objectives and Criteria by Class

For all the same reasons described previously in this document, the applicant has not met the standard of care of the WQS, which leads to violations of the various use-specific management objectives of the WQS and class criteria. The applicant's own data illustrated that the habitat within the impoundments has been vastly altered from a sand/gravel/cobble dominated habitat substrate to efficiently trapping fine-grained, and likely organic/nutrient rich sediment that would have otherwise been transported downriver over time. Even with an increase of migratory species access with the proposed improvements for fish passage, the same access as compared to a free-flowing river has not been achieved. As a result, the relative loss of passing efficiency compared to the "natural condition" negatively impacts aquatic biota and wildlife, aquatic habitat, aesthetics, recreation, and public water sources, as described above.

Recommendations for Further Analysis and Conditions

Based on Princeton Hydro's initial review of the WQC application and documents supporting GRH's application to FERC, there are still a number of missing data to allow for VT DEC to draft a WQC, including an understanding of the "natural condition" as the basis for the assessment of the existing operating condition, and the proposed IEO Operation under consideration. Our initial recommendations are as follows:

- Volumetric quantification of accumulated sediment and sediment sampling throughout the impoundments to assess physical and analytical characteristics of accumulated sediment. Specifically, the potential for the internal nutrient loading from the sediment must be quantified and the generation of "total phosphorus".
- The development and completion of a 2- or 3-dimensional hydrodynamic model of the total reach of the Project, from the upstream most influence of the Wilder Hydroelectric Project to downstream of the Vernon Hydroelectric Project. The models developed must include the

"natural condition" (no dams and a free-flowing Connecticut River), existing conditions (current peaking operations), and the proposed IEO Operation, including the Flexible Operations and how they would impact compliance with the WQS. Evaluations to be modeled must include 1) sediment transport, 2) temperature, 3) scour potential and impacts to the riverbanks, 4) nutrient generation and distribution throughout the impoundments. Of particular importance would be an understanding of how the change from the existing operations to the IEO Operation might initiate sediment transport of existing sediment deposits, especially in those areas of excessive deposition around tributary confluences.

- Monitoring and sampling for the potential for these impoundment systems to initiate the development of Harmful Algal Blooms (HABs), including reference reach and impoundment sampling and analysis for the existence of cyanotoxins and their relevance to the impacts to the water quality standards for "toxic substances".
- A condition that GRH will develop water quality monitoring in perpetuity to ensure that all water quality parameters can be met going forward, and the ability to enforce changes to operational process to protect water quality, balanced with the energy generation needs.
- Require an economic analysis to compare the decommissioning of the three dams with the current and future costs for the expected lifetime of the projects, including the financial costs of the lost fisheries, recreation, and other designated uses that would otherwise contribute to the economy of Vermont.
- Development of an economic model to understand the overall losses to the designated uses of the waters of the Connecticut River, and the development of financial and/or direct implementation of ecosystem restoration efforts in the Vermont portion of the watersheds leading to the GRH projects to enhance water quality, improve habitat, and fish habitat, including contributions and/development hatcheries, for example, such as freshwater shellfish hatcheries to

reestablish threatened and endangered species such as the dwarf wedge mussel and other mussel species of concern that would provide a biological approach to improving water quality and species protection[38].

Thank you for the opportunity to review and provide our comments and recommendations for the forthcoming Vermont DEC draft 401 Water Quality Certificate. Once the draft WQC is issued, we will provide a more detailed and comprehensive review of the application materials to assess the GRH hydropower projects impacts to the VT WQS and Connecticut River.

Sincerely,

Geoffrey M. Goll, P.E
President
Princeton Hydro, LLC

[38] Freshwater Mussel Hatchery & Ecosystems Education Center, Philadelphia, PA. website: https://delawareestuary.org/hatchery/, accessed September 30, 2024.

Scientists, Engineers & Environmental Planners Designing Innovative Solutions for Water, Wetland and Soil Resource Management

September 30, 2016

MEMORANDUM

To: Andrea Donlon, CRWC
David Deen, CRWC

From: Laura Wildman, P.E., Princeton Hydro, LLC
Paul Woodworth, Fluvial Geomorphologist, Princeton Hydro, LLC
Melinda Daniels, PhD, Fluvial Geomorphologist, Stroud Water Research Center

Re: FERC Re-Licensing Process for TransCanada Hydro Northeast Inc.
Peer-Review of ILP Study 2 and Study 3
Riverbank Transect and Riverbank Erosion Studies

The Connecticut River Watershed Council (CRWC) is a stakeholder and participant in the re-licensing process of the Federal Energy Regulatory Commission (FERC) for the three hydropower facilities owned by TransCanada Hydro Northeast Inc. on the Connecticut River, Wilder Dam, Bellows Falls Dam, and Vernon Dam. Princeton Hydro, with the Stroud Water Research Center, was retained by CRWC to complete peer-review of technical erosion studies, specifically Integrated Licensing Process (ILP) Study 2 and Study 3: Riverbank Transect and Riverbank Erosion Studies. ILP Study 1: Historical Riverbank Position and Erosion Study was reviewed for background data, as was the study plan laid out in the Revised Study Plan (RSP), dated August 14, 2013, and as revised in Appendix B: Staff's Recommendations on Proposed and Requested Study Modifications And Studies Requested, dated September 13, 2013[1]. This memorandum is a critical review of ILP Study 2 and Study 3 and aims to address the following questio*ns* as defined in 18 CFR § 5.15 Conduct of studies (d) Criteria for modification of approved study, and the RSP:

- Were the studies completed as per the Revised Study Plan?
  - Were the objectives set in the RSP met?
    a. If not, is additional data collection or analysis warranted?
  - Were the methods described in the RSP utilized?

[1] Our review was limited to the RSP, Study 1, and the Study 2 and Study 3 Report, as well as their associated Appendixes. No field work was conducted as part of our review, so we are not able to comment on if the observations stated in the studies accurately reflect field conditions within the project reach. In addition, we did not review, in any detail, the numerous other studies submitted to FERC as part of TransCanada's recent submittal.

- Was the analysis described in the RSP conducted?
- Was the Study conducted in a manner consistent with generally accepted scientific practice?
    a. Was the methodology utilized consistent with generally accepted scientific practice?
        i. If not, is additional analysis or a different type of analysis warranted to meet the RSP goals of conducting the study in a manner consistent with generally accepted scientific practice?
    b. Were the conclusions of the study consistent with the scientific evidence presented?
- Were the deliverables promised in the RSP included in the final study report submittal?

FRAMEWORK FOR THIS PEER REVIEW

For ease of review of this memorandum we have italicized, placed in quotes, and referenced page numbers for any text taken directly from the Revised Study Plan (RSP) or the combined Study 2 and Study 3 Report. Our comments have been structured as per the Integrated Licensing Process (ILP) regulations 18 CFR § 5.15(d)(1) regarding conduct of studies, and have been subcategorized to reflect the structure of the subsections taken from the Revised Study Plan, dated August 14, 2013, pages 19-36, and additionally revised September 13, 2013.

The Revised Study Plan was organized into 14 sections, including:

RELEVANT STUDY REQUESTS
STUDY GOALS AND OBJECTIVES
RELEVANT JURISDICTIONAL AGENCY RESOURCE MANAGEMENT GOALS
ASSOCIATION WITH OTHER STUDIES
EXISTING INFORMATION AND NEED FOR ADDITIONAL INFORMATION
PROJECT NEXUS
STUDY AREA AND STUDY SITES
METHODS
ANALYSIS
CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE
DELIVERABLES
SCHEDULE
LEVEL OF EFFORT AND COST
REFERENCES

We have organized our review to comment on only those sections of the Study 2 and Study 3 Report that we felt were not conducted as provided for in the Revised Study Plan, as per the ILP regulations 18 CFR § 5.15(d)(1) regarding conduct of studies. The sections we commented on relating to their consistency with the RSP are:

STUDY GOALS AND OBJECTIVES

METHODS
ANALYSIS
CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE
DELIVERABLES

All of our comments fall under the ILP regulations 18 CFR § 5.15(d)(1), which asks if "approved studies were not conducted as provided for in the approved study plan."

Each section of our review starts by including the exact statement from the Study 2 and Study 3 Report that we are commenting on, and then follows with our peer review comment and our recommendation.

STUDY GOALS AND OBJECTIVES

This section includes our comments on the "Study Goals and Objectives" as described in the RSP. We have specifically commented on the objectives from the RSP that we feel were not met or not conducted as provided for in the RSP.

Objective from RSP, under Study Goals and Objectives: *"Observed water-level fluctuations and shear stresses from nonproject-related factors will also be investigated."* (Page 19, RSP Study 2)

"Hydraulic modeling (Study 4) will be integrated into the study after field sampling ends to analyze the relationship between shear stress and bank erosion." (Page 25, RSP Study 2)

"Analyze hydraulic modeling data to provide information on flow velocity, stage (water surface elevation or WSE), and shear stress impacting riverbanks in the study area." (Page 5, Study 2 and Study 3 Report)

Peer Review Comment: No hydraulic modeling results, including shear stress impacting riverbanks in the study area, were analyzed or discussed in the Study Report. Without this analysis, a key part of the study as proposed in the RSP is missing and a fundamental driver in the erosion process (i.e. shear stress) has gone unassessed.

Recommendation #1: TransCanada should incorporate hydraulic modeling results from Study 4 into Study 2 and Study 3, and analyze the results to assess the relationship between shear stress and river bank erosion, as proposed in the RSP.

Objective from RSP, under Study Goals and Objectives: *"The objectives of this study are to: Ascertain the likely causes of erosion (e.g., high flows, groundwater seeps, eddies, and water-level fluctuations related to project operations)."* (Page 27, RSP Study 3)

"This study will ascertain the relative importance of water-level fluctuations associated with project operations in the erosion process relative to other contributing factors and how the importance of water-level fluctuations in the erosion process varies with soil type and geomorphic setting." (Page 21, RSP Study 2)

Peer Review Comment: The third objective of Study 3, to "*ascertain the likely causes of erosion" (page 27, RSP Study 3)*, has not been completed, nor has the study ascertained *"the relative importance of water-level fluctuations associated with project operations in the erosion process relative to other contributing factors"* (page 21, RSP Study 2). The Study 2 and Study 3 Report characterizes the cyclical processes of bank erosion but concludes that, *"Trying to distinguish specific effects of normal project operations among the panoply of potential controls on bank erosion in any given location is not possible"* (page 108, Study 2 and Study 3), and states, *"Attempting to identify a single cause for erosion fails to recognize that multiple processes operate collectively to effect change on the riverbanks through space and time"* (ES-3, Study 2 and Study 3 Report). The fact that there are multiple causes of bank erosion is a generally accepted assertion; the intent of the study was not to determine if project operation were the single cause for erosion but to ascertain the likely causes of erosion, in other words to ascertain which causes are more dominant than others and thus, to *"facilitate conclusions as to the association and effect of project operations on active erosion"* (page 13, RSP Study 1). The RSP's Project Nexus for Study 2, page 21, states that, *"This study will ascertain the relative importance of water-level fluctuations associated with project operations in the erosion process relative to other contributing factors*". The study fails to *"ascertain the relative importance"* of the project operations (i.e., WSE fluctuation) in relation to other contributing factors (e.g. high flows, groundwater seeps, eddies), because it uses a methodology that cannot accomplish this study objective, referred to in the study as *"the erosion ratio" (first described on page* 82, Study 2 and Study 3 Report), and which was not proposed in the RSP. Please see our comment under the section on "CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE" in this peer review.

In addition, no data was collected to ascertain groundwater seeps associated with water fluctuation as a likely cause of erosion. An investigation of groundwater seeps would have required identifying the elevation of groundwater adjacent to the banks with respect to the varying water surface elevation in the channel. The report states, *"the magnitude of water surface fluctuations in the study area is less than 2.0 ft for 75% of the study area's length so hydraulic gradients between groundwater levels in the bank and the adjacent river level are likely small"* (page 111, Executive Summary, Study 2 and Study 3 Report); however, no groundwater data was collected to affirm that statement, nor to assess the remaining 25% of the study area.

The Revised Study Plan provides a simple list of causes of erosion, *"e.g., high flows, groundwater seeps, eddies, and water-level fluctuations related to project operations,"* (page 27, RSP Study 3) that were considered at the outset of the project. However, the Study does not consider adjacent land use as a factor (other than the presence or absence of riparian vegetation at the top of bank), and yet numerous peer-reviewed research studies have investigated and confirmed that adjacent land use has a strong role in bank stability and erosion. In addition, the study does not consider the impact that daily WSE fluctuations may have on limiting vegetative growth at the toe of the river banks, although the study itself acknowledges the important role that vegetation can have on increasing bank resistance to erosion.

Recommendation #2: TransCanada should re-evaluate the existing data, or if necessary gather additional data, with respect to these important factors (i.e., methodology used, groundwater elevations, and surrounding land use) to "*ascertain the relative importance of water-level fluctuations associated with project operations in the erosion process relative to other contributing factors*" as per the RSP (page 21, RSP Study 2).

Objective from RSP, under Study Goals and Objectives: *"Identify the effects of shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat)."* (Page 27, RSP Study 3)

Peer Review Comment: The fourth objective of Study 3, *"to identify the effects of shoreline erosion on other resources"* (page 27, RSP Study 3) has not been completed. In the final section of the Study 2 and Study 3 Report, the Assessment of Project Effects makes brief references to other studies (page 112, Study 2 and Study 3 Report); however, these studies do not assess shoreline erosion project effects and in most cases these additional studies were not intended to do so. Specifically:

A. With regard to Water Quality, reference is made to Study 6 - Water Quality Monitoring Study (Louis Berger Group and Normandeau, 2016a), which *"found that the Wilder, Bellows Falls, and Vernon projects had negligible to no effect on turbidity"* (page 112, Study 2 and Study 3); however, the following statement, *"the few recorded spikes in turbidity were found to occur in response to high flows resulting from heavy rain events,"* (page 112, Study 2 and Study 3) fails to distinguish if bank erosion is a contributing factor in the turbidity peaks. Thus, the project effects on water quality remain unassessed and its conclusion that project operations had negligible effect on turbidity are unfounded.

B. With regard to Aquatic Habitat, reference is made to Study 8 – Channel Morphology and Benthic Habitat Study (Stantec and Normandeau, 2016), but acknowledges that the study did not quantify the effect of fine-grained riverbank materials on increased embeddedness of coarse-grained spawning substrates. Another reference is made to Studies 14/15 – Resident Fish Spawning in Impoundments and Riverine Sections Studies

(Normandeau, 2016a), Study 16 – Sea Lamprey Spawning (Normandeau, 2016b), and Study 21 – American Shad Telemetry Study – Vernon (Normandeau, 2016c) (page 112, Study 2 and Study 3); however, none of these studies had the objective of assessing the impacts of bank erosion on aquatic habitats. Thus, the project effects on aquatic habitat remain unassessed.

C. With regard to Rare Animal Populations, reference is made to Study 24 – Dwarf Wedgemussel and Co-Occurring Mussel Study (Biodrawversity et al., 2014; 2015, Study 25 – Dragonfly and Damsel Fly Inventory and Assessment (Normandeau, 2016d), Study 26 – Cobblestone and Puritan Tiger Beetle Survey (Normandeau, 2016e), Study 28 – Fowler's Toad Survey (Normandeau, 2016f), and Study 29 – Northeastern Bulrush Survey (Normandeau, 2016g) and they *"did not identify erosion resulting from normal project operations water level fluctuations as a potential factor"* (page 113, Study 2 and Study 3). However, none of these studies had the objective of assessing the impacts of bank erosion on rare animal populations, both direct (i.e. WSE fluctuation) and indirect (i.e. bank collapse impacts). Thus, the project effects on these rare animal populations remain unassessed.

Recommendation #3: TransCanada should revise the Study 2 and Study 3 Report to identify the effects of shoreline erosion on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat, as stated in the RSP.

Objective from RSP revision of Sept. 13, 2013: "*The study's analysis will include a correlation of visible indicators of erosion with project-caused water-level fluctuations at the 21 transect locations established in the Riverbank Transect Study (Study 2)."* (Page 1 Study 2 and Study 3)

Peer Review Comment: This objective is not accomplished because the *"erosion ratio"* metric (page 82, Study 2 and Study 3) employed to attempt to identify correlation is not a generally accepted scientific practice. It lacks the rigor of other accepted statistical analysis techniques. For additional discussion on this topic please see our comments relating to "CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE" later in this memorandum.

The RSP notes on page 32 the importance stratigraphy can play in bank erosion: *"the layering of sediments within the banks can play an instrumental role in bank stability with contacts between permeable sand above impermeable clay providing a zone along which water can preferentially seep out of the bank. Consequently, identification of the various sedimentary layers within a bank is critical to understanding the distribution and causes of erosion."* In addition, the RSP states on page 29 that, *"Detailed information to be collected as part of this study on bank stratigraphy, depth to sand-clay interfaces, and their relationship to past water-level fluctuations is needed to confirm whether project operations are causing reductions in bank instability."*

While stratigraphic data were collected and provided in the appendices, these data were only referenced in general statements in the study and not analyzed or discussed, such that the relationship between WSE fluctuations and bank instability were unassessed. The Study 2 and Study 3 Report states:

- "*Banks composed of non-cohesive sediments and interlayered cohesive and non-cohesive sediments are the most susceptible to erosion.*" (page 10, Study 2 and Study 3 Report)
- *"Normal project operations result in daily or sub-daily fluctuating water levels. At many sites, the position of those daily fluctuations on the bank aligns with the location of notching at the base of the bank"(page 53, Study 2 and Study 3 Report)*. Figure 5.4.2-6, below, from the Study 2 and Study 3 Report illustrates this observation, with the location where the WSE fluctuation based on normal operating range intersects with the notch in the river bank, circled in red.

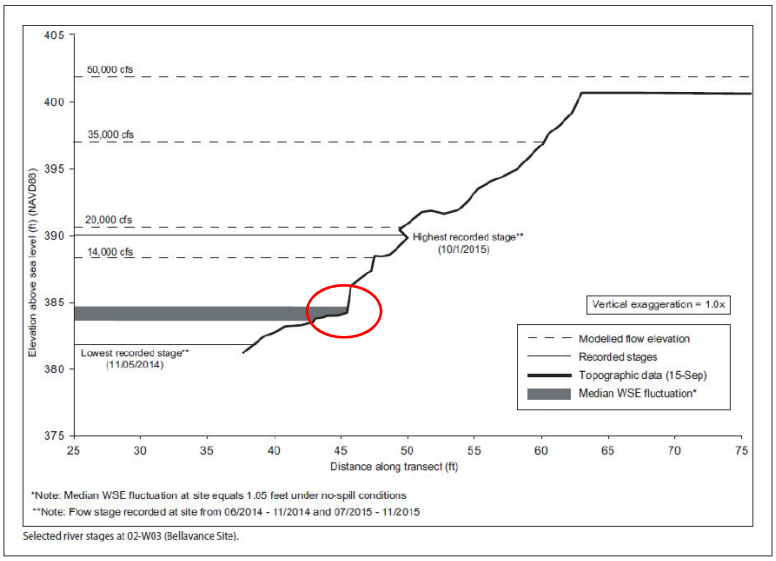


Figure 5.4.2-6. Position on bank of normal operating range aligns with location of notching at 02-W03 (Bellevance Site).

- *"Fluctuations in WSE related to normal project operations under no-spill conditions are consistent with notching and overhangs observed at the base of 8 of the 21 monitored banks at some point during the two-year monitoring period (Appendix A). Erosion can result from seepage forces generated by WSE fluctuations (Budhu and Gobin, 1995) with overhangs developing when seepage is focused along a single layer (Fox and Wilson, 2010)."* (page 111, Study 2 and Study 3)
- *"The character of sediments in the study area creates banks with limited resistance to erosion. The bank sediments at the monitoring sites, representative of the study area as a whole, are nearly ubiquitously comprised of fine-grained and unconsolidated floodplain or glaciogenic sediments particularly prone to erosion (see Appendix A stratigraphic columns). Frequently observed inter-beds of permeable sand and less*

> *permeable silt can further reduce the resisting force of floodplain sediments by creating horizontal surfaces along which groundwater can preferentially move, potentially increasing seepage forces acting on the bank."* (page 109, Study 2 and Study 3)

A more detailed discussion and analysis of these site conditions is warranted in order to determine "*their relationship to past water-level fluctuations" and "confirm whether project operations are causing reductions in bank instability"* as per the plan set forth in the RSP.

The study concludes that, "Trying to distinguish specific effects of normal project operations among the panoply of potential controls on bank erosion in any given location is not possible," (page 108). We suggest that a statistical method such as an Analysis of Variance (ANOVA), Multivariate Analysis of Variance (MANOVA), or Principal Component Analysis (PCA) would be consistent with generally accepted scientific practice and would yield more conclusive results. This is further discussed in our comments under "CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE" that follow in this memorandum. In addition to a statistical method, a modeling method, such as Bank Toe Erosion Model (BSTEM), coupled with a sensitivity analysis of the input variables, would assist in distinguishing the degree to which WSE fluctuation impacts bank stability versus other erosive mechanisms. The input variables in a bank stability model such as BSTEM typically include geotechnical and vegetation data, such as surface erodibility, critical shear stress, geotechnical strength, bulk unit weight, riverbank sediment particle-size distribution, maximum rooting depth of vegetation, and riparian species distribution. This type of bank stability model has the ability to run with various parameters either included or not included, in order to better assess the likely causation of erosion.

Recommendation #4: TransCanada should utilize the existing data to further assess the potentially "instrumental role" that WSE fluctuation may have on initiating the erosion cycle, by directly comparing the elevations where notching is observed and where the normal operational WSE fluctuations occur, and incorporate their data, relating to the "layering of sediments within the banks" and the stratification of permeable and less permeable zones, into this assessment. In addition, TransCanada should utilize a more rigorous statistical method to analyze the significant amount of data collected.

METHODS

This section includes our comments on the "Methods" as described in the RSP. We have only included comments on the sections of the "Methods" from the RSP that we feel were not conducted as provided for in the RSP.

Repeat Surveys

Statement from RSP: *"TransCanada will consult with the erosion working group during the 2-year monitoring period to discuss the need for, and locations of, increased sampling frequency based on the initial monitoring results and any information gleaned from the historical data research in Study 1 (Historical Riverbank Position and Erosion) that supports the need for more periodic monitoring based on significant erosion rates. The need for, and extent of, additional monitoring approaches (e.g., groundwater-level monitoring) could also be discussed in consultation."* (Page 23 RSP Study 2)

Peer Review Comment: TransCanada did not consult with the Erosion Working Group[2] during the 2-year monitoring period as described on page 23 of the RSP. The Erosion Working Group participated in choosing the transect locations, but was allowed only to review the study after the 2-years of monitoring were completed and the Study 2 and Study 3 Report were submitted.

This interim consultation appears to have been added to the RSP to justify the reduction in the number of monitoring sites from 30, requested by FERC (10 for each project), to 20 (page 21 RSP Study 2, an additional cross section was added later) and from a biweekly monitoring frequency, requested by NHDES, NHFG, and VANR, to "*at least four times per year for 2 years" (page 23 RSP Study 2),* and yet this consultation and interim reporting did not take place.

Recommendation #5: TransCanada should formally meet with the erosion working group as necessary to consider its comments and revise the Study 2 and Study 3 Report to reflect those comments, as proposed in the RSP.

Hydraulic Modeling

Statement from RSP: *"For this study, two-dimensional (2-D) modeling at up to six sites using River2D may be necessary to understand complex sites where HEC-RAS modeling does not adequately describe eddy flows that might develop, for example, upstream of valley constrictions or flow deflection that might occur, for example, around a mid-channel bar or island."* (Page 33 RSP Study 3)

[2] **TransCanada organized stakeholders into working groups to discuss study plans and study details. CRWC is or was a member of the Erosion Working Group.**

Peer Review Comment: The RSP stated that 2D modeling "may be necessary to understand the complex sites". No 2D modeling was prepared, nor was its use or reasons for not using it discussed in the Study.

Recommendation #6: TransCanada should add a discussion to the Study 2 and Study 3 Report that explains why 2D modeling was not completed and that the 1D modeling provided in Study 4 was adequate to analyze the more complex sites.

ANALYSIS

This section includes our comments on the "Analysis" as described in the RSP. We have only included comments where we felt that the Study Report was not conducted as provided for in the RSP.

Statement from RSP: *"TransCanada will consult with the erosion working group periodically to solicit comments to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the 2-year study period."* (Page 35 RSP Study 3)

Peer Review Comment: TransCanada did not consult with the Erosion Working Group periodically to solicit comments to strengthen data collection procedures, analysis of erosion causes, and continuing studies during the 2-year study period for Study 3, as stated in the RSP.

Recommendation #7: FERC should consider the August 1, 2016 Study 2 and Study 3 Report to be the interim report and that the Erosion Working Group's current review of Study 2 and Study 3 Report be integrated into a revised study that the Erosion Working Group is then able to review as the final study as proposed in the RSP.

CONSISTENCY WITH GENERALLY ACCEPTED SCIENTIFIC PRACTICE

This section includes our comments on the Study 2 and Study 3 Report in relation to its "Consistency with Generally Accepted Scientific Practice" as described in the RSP. We have only included comments on the methods used and conclusions drawn that we feel were not conducted as provided for in the RSP. We have broken our comments down into two sections, to respond to the Study's consistency with generally accepted scientific practice, as stated below:

"The various methods to be used for this study conform to generally accept scientific practice" (Page 24 RSP Study 2), and *"The various methods to be used in the Riverbank Erosion Study conform to generally accepted scientific practice as detailed in the Methods section above"* (Page 35 RSP Study 3).

The first section relates to comments on how the methodology used in Study 2 and Study 3 is consistent with generally accepted scientific practice (i.e., cross section selection and the erosion ratio method utilized), the second relates to comments on whether the Study's conclusions are supported by the evidence given.

1. Consistency of Methodology with Generally Accepted Scientific Practice

Cross Section Selection for Monitoring

While we believe that the study selected the cross section monitoring sites in accordance with the RSP, the study extrapolates observations regarding bank erosion, on a project-wide basis, from monitoring sites that were "*selected so a range of"* conditions *"are incorporated into the analysis"* (page 22 RSP Study 2). Because the sites were not selected to reflect statistical occurrence along the project-wide reach, any extrapolation on a project-wide basis may not be well supported.

> **Recommendation #8:** TransCanada should revise the report to omit extrapolations to the entire study area based on the monitored cross sections unless a statistically based method is used to link cross-section observations with their likely occurrence frequency over the entire study reach.

Erosion Ratio

The primary metric relied upon for *"identifying the propensity of erosion to occur in association with certain conditions"* (Page 34 RSP Study 3) is the *"erosion ratio"* (Page 82, Study 2 and Study 3). This approach is not a generally accepted scientific practice and is not included in the RSP. It was presumably used to accomplish the objective of including a *"correlation of visible indicators of erosion with project-caused water-level fluctuations at the 21 transect locations"* (Page 1, Study 2 and Study 3). No citation or reference is provided for this metric, and the metric is not used, to our knowledge, in the extant fluvial geomorphic scientific literature. The Study does not demonstrate that the method *"conforms to generally accepted scientific practice"* (page 24, RSP Study 2 and Page 35 RSP Study 3).

The erosion ratio is too simplistic for attempting to ascertain the likely causes of erosion, when there are multiple known causes. It is defined as the ratio of two percentages: *"the percentage of bank erosion in the study site that is present within a specified feature divided by the percentage of bank length occupied by that feature"* (page 82, Study 2 and Study 3). According to the report, a value greater than 1.0 represents a propensity (or *"more likely to occur"*), and a value less than 1.0 indicates no propensity (i.e. *"less likely to occur"*).

Generally accepted scientific practices for analyzing processes with multiple causative variables rely on statistical analyses more sophisticated and robust than simple ratios. Such statistical methods that may be applied in these Studies, depending on the type and structure of the collected data, include Analysis of Variance (ANOVA), Multivariate Analysis of Variance (MANOVA), or Principal Component Analysis (PCA).

As much of the data is geographic in nature (e.g. the location of bank instability) and managed within a GIS, more rigorous spatial statistical methods should be employed to ascertain spatial autocorrelation or spatial regression, particularly to analyze *"correlation of visible indicators of erosion with the project-caused water-level fluctuations"* (page 1, Study 2 and Study 3).

For example, the data set that categorizes all banks within the study area into one of six classes: eroding, vegetated eroding, failing armor, stable, healed erosion, and armored (page 79, Section 5.6.4 Mapping Results, Study 2 and Study 3) should be re-analyzed through one of these multi-variate methods with respect to the various contributing factors such as bank height, WSE fluctuation, riparian vegetation, bend geometry, etc. It also should be noted that the classes *"healed erosion"* and *"armored"* are essentially banks that were eroding in the past but are not anymore, and those previously eroding banks may also have been due to project operations. Including those two classes in the larger *"stable"* category may lead to overlooking past impacts associated with project operations and could significantly change the findings in Section 5.3 Analysis of Historical Aerial Photography (page 23). For example, in Figures 5.3-1a, b, c, (Pages 25, 27, and 29, Study 2 and Study 3, respectively) it is unclear whether the decrease in bank erosion through time was influenced by bank armoring which may have arrested the process in some areas, while the source of the problem continued to exist.

In addition, the data set derived from the review of aerial photographs at 0.5-mile increments (Page 23, Section 5.3 Analysis of Historical Aerial Photography, Study 2 and Study 3) should also be re-analyzed with multi-variate methods with respect to the bank classification data mentioned above or with respect to the various contributing factors such as bank height, WSE fluctuation, riparian vegetation, bend geometry, etc. Further, the data set related to the 21 transects (Page 30, Section 5.4 Erosion Monitoring, Study 2 and Study 3) should be re-analyzed through a multi-variate method with respect to the erosion at the top, upper, mid, lower and toe of bank (Table 5.4.2-1, page 44) and to the median WSE fluctuation.

The erosion ratio appears to have limitations and be subject to biases. In discussing the erosion ratio associated with WSE fluctuations in the Vernon impoundment in Section 5.6.5 of Study 2 and 3, page 97, an abnormally high value is dismissed because the WSE range in question exists for such short lengths, which indicates that the erosion value can be easily skewed. To avoid 'interpreting results potentially skewed by short lengths', the analysis deliberately disregards any bank lengths that are less than 10% of the study area. This is problematic for two reasons. First, it overlooks banks that, albeit short, may be severely impacted by project operations. Second, multiple classes of 0.5-foot increment WSE fluctuations, which may fall below the arbitrary 10% threshold individually, collectively add up to a significant proportion, likely over 25%. Thus, in attempting to circumvent allegedly skewed results, the analysis dispenses with data that could otherwise be informative.

Recommendation #9: TransCanada should re-analyze the data in Study 2 and Study 3 Report according to generally accepted scientific practice, as specified in the RSP. The data set that categorizes all banks within the study area into one of six classes (i.e. eroding, vegetated

eroding, failing armor, stable, healed erosion, and armored (Page 79, Section 5.6.4 Mapping Results, Study 2 and Study 3)), should be re-analyzed through a multi-variate statistical method with respect to the various contributing factors such as bank height, WSE fluctuation, riparian vegetation, bend geometry, etc. In addition, the data set derived from the review of aerial photographs at 0.5-mile increments (Page 23, Section 5.3 Analysis of Historical Aerial Photography, Study 2 and Study 3) should also be re-analyzed with multi-variate methods with respect to the bank classification data mentioned above or with respect to the various contributing factors such as bank height, WSE fluctuation, riparian vegetation, bend geometry, etc. The data set related to the 21 transects should be re-analyzed through a multi-variate method with respect to the erosion on the bank (at the top, upper, mid, lower, and toe) and the median WSE fluctuation.

2. Consistency of Conclusions with Scientific Evidence Presented

Included below are our peer review comments relating to the consistency of the conclusions stated in the Study 2 and Study 3 Report. We believe that many of the Studies' conclusions were accurate and reflected a sound review of the significant amount of data, both historic and current, that was collected. Our comments below therefore only focus on Study conclusions that are not properly supported by the data presented in the Studies, or were not stated in conjunction with other related findings.

Study Conclusion #1: *"Taken together, natural conditions in the study area, by both reducing the resisting forces and enhancing the driving forces, create a situation where the riverbanks are likely near the threshold of erosion. As a result, minor natural or anthropogenic changes in the study area have the potential to initiate erosion already primed by the river valley's natural history and character."* (Page 109 Study 2 and Study 3)

"Given the significant changes in the rate and amounts of erosion documented through historical aerial photography and multiple mapping efforts, respectively, normal project operations that have changed little in several decades cannot adequately explain the observed patterns of erosion. Attempting to identify a single cause for erosion fails to recognize that multiple processes operate collectively to effect change on the riverbanks through space and time." (Page 115 Study 2 and Study 3)

Peer Review Comment: The study points out the significance of river banks that are at the "threshold of failure" by stating on page 11 "*When a bank is at the threshold of failure, a slight increase in shear stress or a small decrease in shear strength can lead to bank erosion"*. The study then concludes, on page 109, that the riverbanks in the study area *"are likely near the threshold of erosion"* and that *"As a result, minor natural or anthropogenic changes in the study area have the potential to initiate erosion already primed by the river valley's natural history and character."* These statements further support the need to confirm whether project operations are playing any role in the

reductions in bank instability. Because the study area has been classified as being near the threshold of failure, analysis of the data does not support a conclusion that dismisses the significance of the potential role of WES fluctuation in the cycle of erosion based on the fact that it is not the *"single cause for erosion" (page 115 Study 2 and Study 3)*.

Recommendation #10: TransCanada should revise the Study 2 and Study 3 Report to assess how the "threshold" conditions of the study reach may be impacted by even the slightest change in erosive force, whether acting alone, or in conjunction with other erosive forces.

Study Conclusion #2: *"The apparently increasing rate of erosion in the upper Wilder impoundment (Figure 5.3-1a) is more likely related to upstream inflows than Wilder project operations. The upper Wilder impoundment is closer to the McIndoes project than to Wilder dam. Therefore, McIndoes inflows along with significant natural discharges likely have a greater impact on erosion rates in upper Wilder impoundment than Wilder project operations."* (Page 111, Study 2 and Study 3, Assessment of Project Effects)

Peer Review Comment: This statement is not supported by any data included and described in Study 2 and Study 3.

Recommendation #11: TransCanada should provide their data on the upstream inflows in the Wilder impoundment and analysis to support their conclusion regarding the impact of these inflows.

Study Conclusion #3: ***"****The fact that these three sites experienced recession only once during two years of monitoring and that 12 additional monitoring sites mapped as unstable did not experience any bank recession at all may seem incongruous but actually indicates that bank recession, even in the most unstable areas monitored, does not occur annually but rather occurs episodically at time scales extending more than two years."* (Page 52, Study 2 and Study 3)

"Fluctuations in WSE related to normal project operations … are consistent with notching and overhangs observed at the base of 8 of 21 monitored banks at some point during the monitoring period." (Page 111, Study 2 and Study 3)

Peer Review Comment: Section 5.4.2 Repeat Monitoring indicates that only three of the 21 monitored transects experienced measurable recession at the top of the bank, and that erosion does not occur annually but rather episodically at time scales beyond the 2-year monitoring period. The study also acknowledges: *"At many sites, the position of those daily fluctuations on the bank aligns with the location of notching at the base of the bank: (page 53 Study 2 and Study 3), "Fluctuations in WSE related to normal project operations … are consistent with notching and overhangs observed at the base of 8 of 21*

monitored banks at some point during the monitoring period" (page 111 Study 2 and Study 3). These observations seem to indicate that as many as 38% (8/21) of monitored banks may experience notching as a result of project-caused WSE fluctuations. According to the final study the notching at the base of the bank likely drives the *"idealized cycle of erosion"* depicted in Figure 5.6.2-1 and results in eventual top of bank recession. It is noted therefore that this episodic erosion could be related to WSE fluctuation and may not be able to be adequately assessed within a 2-year monitoring period.

Recommendation #12: TransCanada should extend the cross section monitoring beyond the two-year monitoring period proposed in the RSP, for the above reasons and because the Study itself indicates that this period was not long enough to analyze the *"cycle of erosion"* at all sites.

Study Conclusion #4: *"The magnitude of water surface fluctuations in the study area is less than 2.0 ft for 75% of the study area's length so hydraulic gradients between groundwater levels in the bank and the adjacent river level are likely small, whereas waves breaking against the bank at the same elevation as water level fluctuations may generate stronger erosive forces."* (Page 111 Study 2 and Study 3, Executive Summary and Assessment of Project Effects)

Peer Review Comment: Hydraulic gradients depend on the elevation of surface water and groundwater, which were not measured. As there was no assessment of hydraulic gradients, wave actions, or erosive forces, no valid comparison can be made between the two bank erosion factors. This statement also raises the question of whether daily WSE fluctuations increases the vertical range on the bank that becomes exposed to wave action and ice jams and their associated erosive forces.

Recommendation #13: TransCanada should retract this conclusion, unless additional data is supplied that supports this statement. TransCanada should analyze how the WSE fluctuation may increase the vertical range on the bank that is exposed to additional erosive forces such as boat waves, piping and ice jams, which are all issues identified in the RSP.

Study Conclusion #5: "*The approximately 40% of bank instability mapped through the study area is similar to more free-flowing portions of the Connecticut River (Field, 2005), so normal project operations cannot be considered to be a cause of excessive erosion."* (Page 114, Study 2 and Study 3)

Peer Review Comment: Throughout Section 5.3 Analysis of Historical Aerial Photography (page 23 Study 2 and Study 3) and in subsequent sections, comparisons are made between impounded sections and riverine sections with the assumption that conditions

in the riverine sections are natural, normal or unaffected by project operations. However, riverine sections are also subject to the downstream effects of dams, which includes exacerbated / accelerated bank erosion due to sediment trapping by the dam and sediment deprivation in the downstream reaches. While these Studies are not focused on the downstream effects of the dams, this "hungry water" effect (Kondolf, 1997) renders any conclusions from such comparisons invalid.

Recommendation #14: TransCanada should provide additional data in Study 2 and Study 3 Report regarding the previous assessment of free-flowing portions of the Connecticut River, if it is to be used as a scientifically supported comparison to the impounded reaches. Specifically, TransCanada should show how these "free-flowing" reaches are not impacted by other factors such as limited upstream sediment inputs due to the presence of upstream dams.

Study Conclusion #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."* (Page 114, Study 2 and Study 3, Conclusions)

Peer Review Comment: This statement is not supported by any data included and described in Study 2 and Study 3. This statement speaks to the importance of flood flows and tractive forces in the *"cycle of erosion"* described in the study; however, it appears that no attempt was made to quantify the shear stress created by flood flows or to utilize relevant data from Study 4 – Hydraulic Modeling Study.

Recommendation #15: TransCanada should complete additional analysis of the hydraulic conditions.

Study Conclusion #7: *"While other processes such as waves or seepage forces created by project-related WSE fluctuations may exert some control on the cycle of erosion, 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*." (Page 114, Study 2 and Study 3, Conclusions)

Peer Review Comment: This study conclusion does not follow a logical thought process since although it is stated that *"seepage forces created by project-related WSE fluctuations may exert some control on the cycle of erosion"* the role of their impact cannot be negated based solely on the fact that these initial erosive forces are taking place in a riverine environment where high flows are ultimately transporting eroded material downstream and continuing the cycle indefinitely.

This statement discounts the role of fluctuating WSE on bank erosion because it is likely acting on only a portion of the *"cycle of erosion"*; however, the study describes a *"cycle of erosion"* that is initiated with the creation of a notch or overhang at the toe of the bank (see Figure 5.6.2-1). Further, the description from the Executive Summary states that *"Bank erosion in the study area is a cyclic process that begins with the formation of notches and overhangs at the base of the bank. The resulting over-steepening at the bank's base destabilizes the upper bank generating planar slips, rotational slumps, topples, and flows that transfer bank material downslope. Material supplied from the erosion of the upper bank accumulates at the base of the bank and can ultimately lead to the stabilization of the bank unless the sediment and fallen trees are removed by river currents, wave action, groundwater seepage, or other forces. If the material is removed, the notching at the base of the bank can begin afresh and the cycle of erosion repeated."* (Page ES-1, Study 2 and Study 3)

The study also reports that *"Erosion can result from seepage forces generated by WSE fluctuations (Budhu and Gobin, 1995) with overhangs developing when seepage is focused along a single layer (Fox and Wilson, 2010)"* (page 111 Study 2 and Study 3).

Recommendation #16: Based on the data presented, TransCanada should revise the statement as follows:

> "Processes such as waves or seepage forces created by project-related WSE fluctuations may exert some control on the initiation of the cycle of erosion; however, they cannot be considered as resulting in excessive erosion that negatively impacts other resources on their own, since ultimately the continuation of erosion depends on flood flows that sustain the cycle of erosion."

This revised conclusion is based on the observed results and acknowledges that bank erosion is caused by multiple contributors at different stages of the cycle of erosion. Importantly, it does not eliminate WSE fluctuation as one of the potential contributing factors. It is also important to note that the report does not include a discussion of the potential loss of resistive forces such as vegetation growth at the toe of the bank due to daily WSE fluctuation, which could also contribute to the ongoing cycle of bank erosion. Thus, the implication is that project-caused WSE fluctuations may not be the sole cause of bank erosion but that it could be exacerbating and accelerating bank erosion.

Study Conclusion #8: The study concludes in the last paragraph that *"normal project operations that have changed little in several decades"* (page 115 Study 2 and Study 3)

Peer Review Comment: There is no data or descriptions in the study on how operations have changed, or not changed, over time.

Recommendation #17: TransCanada should provide additional data supporting their claim that "normal project operations that have changed little in several decades".

DELIVERABLES

This section includes our comments on the "Deliverables" as described in the RSP. We have only commented on the deliverables from the RSP that we feel were not conducted as provided for in the RSP.

Statements from RSP: *"An interim study report will be prepared after the first year of study is complete synthesizing the above deliverables into a narrative that addresses the study goals and issues raised in various study requests. The report will be provided to stakeholders for review and comment."* (Page 25 RSP Study 2)*, and "The interim study report will be prepared after the first year of study is complete. The report will be provided to stakeholders for review and comment."* (Page 36 RSP Study 3)

Peer Review Comment: Interim Reports for Study 2 or Study 3 were never provided to the Erosion Working Group to review and comment.

Recommendation #18: FERC should consider the August 1, 2016 Study 2 and Study 3 Report to be the interim report and that the Erosion Working Group's current review of Study 2 and Study 3 Report be integrated into a revised study that the Erosion Working Group is then able to review as the final study as proposed in the RSP.

SUMMARY CONCLUSIONS

Based on our review of the Study 2 and 3 Report, our review team has made 18 recommendations as discussed earlier in this memorandum. Most critically, we find that the Study 2 and Study 3 Report did not "*ascertain the relative importance of water-level fluctuations associated with project operations in the erosion process relative to other contributing factors"* as stated in the RSP and has instead stated that *"trying to distinguish specific effects of normal project operations among the panoply of potential controls on bank erosion in any given location is not possible"*. A better understanding of causation should be ascertained with a different methodology such as a statistical analysis of the data collected or a bank stability model that utilizes a wider variety of geotechnical and vegetative parameters, such as geotechnical strength, maximum rooting depth, and hydraulic gradient between ground water and river water levels.

The Study Report does not consider adjacent land use as a factor (other than the presence or absence of riparian vegetation at the top of bank), and yet numerous peer-reviewed research studies have investigated and confirmed that adjacent land use has a strong role in bank stability and erosion. Nor does the study consider the impact that daily WSE fluctuations may have on limiting vegetative growth at the toe of the river banks, although the study itself acknowledges the important role that vegetation can have on increasing bank resistance to erosion.

The Study Report does not adequately "i*dentify the effects of shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat)"* as stated in the RSP, and instead bases its conclusions on other studies that were not tasked with assessing the effects of shoreline erosion on these critical resources.

In addition, the coordination with the Erosion Working Group promised in the RSP was not conducted, and the interim reports were not delivered for review, such that the study could have been adjusted as needed to successfully complete the objectives stated in the RSP.

TransCanada should revise the Study Report or issue an Addendum to the report that includes the revisions as per the recommendations set forth in this peer review.

Scientists, Engineers & Environmental Planners Designing Innovative Solutions for Water, Wetland and Soil Resource Management

May 15, 2017

MEMORANDUM

To: Andrea Donlon, CRC

From: Laura Wildman, P.E., Princeton Hydro, LLC
Paul Woodworth, Fluvial Geomorphologist, Princeton Hydro, LLC

Re: FERC Re-Licensing Process for Great River Hydro, LLC
Peer-Review of ILP Study 2 and Study 3
Riverbank Transect and Riverbank Erosion Studies
Final Study Report, dated February 4, 2017

FERC Numbers:
Project No. 1892-026 – New Hampshire/Vermont
Project No. 1892-045 – New Hampshire/Vermont
Project No. 1892-073 – New Hampshire/Vermont
Great River Hydro, LLC

The Connecticut River Conservancy (CRC) (formerly Connecticut River Watershed Council) is a stakeholder and participant in the re-licensing process of the Federal Energy Regulatory Commission (FERC) for the three hydropower facilities owned by Great River Hydro, LLC (formerly TransCanada Hydro Northeast Inc.) on the Connecticut River, Wilder Dam, Bellows Falls Dam, and Vernon Dam. Princeton Hydro (PH) was retained by CRC to complete a peer review of technical erosion studies, specifically the Integrated Licensing Process (ILP) Study 2 and Study 3: Riverbank Transect and Riverbank Erosion Studies, revised by TransCanada on February 4, 2017. This memorandum is a critical review of the revised ILP Study 2 and Study 3 and aims to address the following questions as defined in 18 CFR § 5.15 Conduct of studies (d) Criteria for modification of approved study, the RSP, and FERC's November 29, 2016 Determination on Requests for Study Modifications and New Studies – Wilder, Bellows Falls, and Vernon Hydroelectric Projects:

- Is the revised report now in compliance with the Revised Study Plan (RSP) dated 8/14/2013 and FERC's study plan determination dated November 29, 2016 on the study report from August?
- Were the new analyses conducted in a way that is generally accepted scientific practice?
- Are the results and conclusions valid?

COMPLIANCE WITH THE 8/14/2013 RSP AND FERC'S 11/29/16 DETERMINATION

FERC's Determination on Requests for Study Modifications and New Studies, dated November 29,2016, ("FERC's Determination") requested additional information regarding modeling (shear-stress and velocity analysis, as well as logistic regression analysis of bank instability), assessment of hydraulic gradient between water surface elevations and groundwater, and effects of shoreline erosion on other resources. The format of our response uses the section headings from FERC's 11/29/16 Determination, including: 1) *River 2D Modeling,* 2) *Hydraulic Gradient between Water Surface Elevations and Groundwater*, and 3) *Effects of Shoreline Erosion on Other Resource*, to discuss critical omissions such as a shear-stress velocity analysis, hydraulic gradient data, and an adequate analysis of other resources, respectively, as well as the inconclusive nature of TransCanada's logistic regression statistical analysis. Excerpts from FERC's Determination on Requests for Study Modifications and New Studies, Nov. 29, 2016 have been included at the beginning of each section below, followed by our peer review comments and recommendations. We conclude our document with short sections on Accepted Scientific Practice, and the Validity of Results and Conclusions, followed by a brief Summary section.

1. River 2D Modeling

Based on TransCanada's promise in response to comments dated October 31, 2016, to "**conduct shear-stress and velocity analyses** using the one-dimensional Hydrologic Engineering Center's River Analysis System (HEC-RAS) model in the revised report for studies 2 and 3…to identify the likely causes of erosion at the 21 erosion monitoring sites…", FERC recommended the following in its Determination:

"Using **HEC-RAS modeling in combination with logistic regression statistical analysis** may be adequate **to identify and describe the likely causes of erosion** at the 21 monitoring sites. When TransCanada files its revised study report in January 2017, we will review the results, including the proposed HEC-RAS modeling and regression analysis, and as appropriate, **consider the need for additional analysis**, including use of the River2D model. Based on the information available at this time, we expect that the revised report will be adequate for staff's analysis and to develop any necessary license requirements (section 5.9(b)(5)). Therefore, we do not recommend requiring TransCanada to conduct any River2D modeling at this time."

Peer Review Comments Regarding Compliance with FERC Determination

Shear-stress and Velocity Analysis

No shear-stress and velocity analysis, using the HEC-RAS model to identify the likely causes of erosion at the 21 erosion monitoring sites, was included in the revised Study 2 and 3. The revised study again refers to the original Study 4 – Hydraulic Modeling Report dated March 1, 2016, which was not recently revised. There is no mention of a HEC-RAS model in the revised Study 2 and 3, and no results listed shear stress throughout the study reach, although it is presumed this data was used as input for the logistic regression analysis. Study 4 – Hydraulic Modeling Report also does not include the tabular output data from the one-dimensional HEC-RAS model, which would list velocity and shear stress by model cross section, nor does it include any of the standard water surface profiles or cross-sectional modeling data, such that Princeton Hydro could review the validity of this modeling.

The revised Study 2 and 3 does list velocity data for a limited number of flows, with no associated shear stress data, in Table 5.8-1 on page 123, Section 5.8, and in Tables 6.1-1 and 6.1-2. The velocity data and analysis in 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. The velocity data and discussion in Section 5.9 (Table 5.8-1) focuses only on the change in velocities during periodic operational drawdowns, in preparation for anticipated high flows (as described in page 120 of the report). The data presented in Table 5.8-1 actually show that velocities *increase* between 36% and 400% during these periodic operational drawdowns, resulting in velocities significantly in excess of the threshold velocity for sediment entrainment later discussed in Section 6.1. The data presented in Table 5.8-1 therefore suggests that periodic operation drawdowns, in preparation for high flows, could regularly mobilize sediment at the toe of the streambank at 9 of the 13 monitored impoundment cross sections. However, the revised Study 2 and 3 then attempts to discount the significance of this finding by running a scenario where only WSE fluctuates and flow remains constant even though they state that, "such a scenario does not actually occur" (page 122). Again, no shear stress was included in the velocity data included in Section 5.8.

The discussions included in section 5.9 and 6.1, do not "identify the likely causes of erosion at the 21 erosion monitoring sites" as was indicated in TransCanada's response to the requested study modifications, and as was stated in the FERC Determination dated November 29, 2016.

It is not possible for Princeton Hydro, FERC, or any of the stakeholders to review the one-dimensional flow analysis, referred to in Study 4, the presumed source for the velocity data listed in Study 2 and 3, without standard output tables, profiles, and model cross sections. HEC-RAS model reviews are typically completed by opening the actual model and reviewing both the input and output data, since reviewing just output data assumes that the model was set up and run accurately.

Princeton Hydro Recommendation: We recommend that TransCanada conduct the shear-stress and velocity analyses using the one-dimensional Hydrologic Engineering Center's River Analysis System (HEC-RAS) model to identify the likely causes of erosion at the 21 erosion monitoring sites, and provide all of the needed input and output data, as well as the HEC-RAS model itself, such that a review of the modeling and analysis is possible.

Logistic Regression Analysis of Bank Instability

A Logistic Regression Analysis was performed in partial response to requests by Princeton Hydro and FERC; however, we find the selected analytical test to be inappropriate, the results in conflict with the known causative physical forces of bank erosion, and the results to be invalid. The analysis focuses solely on the data set that categorizes all banks within the study area into one of six classes of stability or instability. The analysis does not include the data set derived from the review of aerial photographs at 0.5-mile increments, nor the data set related to the 21 transects, as was recommended in the FERC Determination dated November 29, 2016 or in Princeton Hydro's Recommendation #9 on page 13, in the memo entitled FERC Re-Licensing Process for TransCanada Hydro Northeast Inc., dated September 30, 2016. According to Appendix E of Study 2 and 3, the input data provided to the statistician who conducted the logistic regression analysis were two comma delimited text files corresponding to the left and right river banks, which included shear stress data at high normal operational flows and the 10-yr recurrence interval flood flow averaged across the full width of the channel. This input data was not

included in Appendix E, and again no tabular data relating to shear stress by location was reported, including at the 21 monitored cross sections.

Shear stress computations generated from one-dimensional modeled flow, which is averaged across the full width of the channel, yields single values for shear stress at a cross-section and do not generate results that differentiate between the outside and inside banks of the channel. Without explanation of the source and type of the shear stress data utilized in the analysis, the results associated with shear stress are difficult to interpret and may be invalid.

The analysis reduces the six classes of stability into two binary categories (stable or unstable). This initial step in the process could skew the analysis if, as explained in the September 30, 2016 Princeton Hydro memo (page 12), the bank category of "armored" is represented as "stable." Armored banks were previously unstable to such a degree to necessitate engineering intervention. Thus, their characteristics, WSE fluctuation, height, shear stress, etc. are all conditions that should be attributed to "instability".

The analysis concludes that there are no single strong predictors of bank instability; and, that bank height, shear stress (at the lower flow), and WSE fluctuation were the top three, albeit low (up to 3.5% deviance explained in the single predictor model, and 7.4% deviance explained in the multiple predictors model) predictors of bank instability. Statistical analyses are useful when they can account for much higher (e.g. greater than 50%) explanatory power. Regression analysis assumes observations are independent variables; however, as explained on page E-2 of Appendix E, the observations in this data set are not independent. Princeton Hydro had pointed out the potential for spatial autocorrelation in this dataset in the September 30, 2016 memo, and thus had suggested "more rigorous spatial statistical methods should be employed." The fact that the data is subject to spatial autocorrelation may be the cause of the poor predictive power of the analysis and brings into question the validity of comparing the results of shear stress, bank height, WSE fluctuation, etc.

The analysis produces a strongly counter-intuitive 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. A basic understanding of the physical forces and the cycle of erosion would clearly support the notion that bank instability would increase with one or all of those factors – this conclusion to the contrary is highly suspect and raises serious doubts about the validity of the input data, the statistical method employed, and its interpretation. For example, the use of cross-section-averaged shear stress from a one-dimensional 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.

A statistical analysis of the dataset of the 21-transects, which was not completed, could incorporate the presence of bank materials and stratification, which are acknowledged as factors that contribute to bank instability relative to WSE fluctuation (discussed in section 2 below). While a much smaller dataset, the 21 transects are likely sufficiently separated so as to reduce or avoid problems with spatial autocorrelation.

Importantly, the revised study emphasizes how the shear stresses at high flows are the primary driver of the cycle of erosion as they are the only flows sufficient to remove soil from the bank toe (however, their data on Figure 6.1-1. page 131 does not support that statement). Assuming that the

results can be compared relative to each other (despite the inherent problems with this statistical test related to the nature of the dataset), this analysis finds high flow shear stress to have less effect than WSE fluctuation and bank height. This suggests that WSE fluctuation has nearly equivalent importance on determining the probability of erosion as high flows, contrary to assertions made throughout the revised study report. Furthermore, the results of the analysis 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.

Princeton Hydro Recommendation: We request that the input data, or the regression residuals, be evaluated for spatial autocorrelation using Moran's I or a similar spatial index to determine the degree of spatial autocorrelation and spatial dependencies, and if significant, we request an alternative statistical test or at a minimum, further discussion about the utility and validity of the results despite the current test's limitations. Further, we recommend additional statistical analyses on the data set derived from aerial photographs at 0.5-mile increments, and on the data set related to the 21 transects as was recommended in the FERC Determination dated November 29, 2016.

2. Hydraulic Gradient between Water Surface Elevations and Groundwater

The FERC Determination stated, "It is unclear how or if TransCanada determined the hydraulic gradient between impoundment water surface elevations and groundwater elevations along the shoreline (i.e., the report for studies 2 and 3 does not include any groundwater elevation data). Therefore, Commission staff recommends that the revised report that will be filed in January 2017 include additional information that **describes how the hydraulic gradients were calculated and the resulting potential for riverbank erosion** (e.g., naturally occurring seepage and project-related seepage). The discussion should **include any observations of groundwater seeps or seepage-related erosion** at the 21 erosion monitoring sites **and any groundwater elevation data** that was collected during the studies."

<u>Peer Review Comments Regarding Compliance with FERC Determination</u>

The revised Study does not describe how the hydraulic gradients were calculated and the resulting potential for riverbank erosion, nor does it include observations of groundwater seeps or seepage-related erosion at the 21 erosion monitoring sites and any groundwater elevation data.

As previously stated in our September 30th, 2016 peer review of the original Study 2 and 3 and as per our current review of the revised Study 2 and 3, no ground water data, and thereby no hydraulic gradient data for the streambank, was collected or analyzed for the review of how operational WSE fluctuations potentially effect streambank stability. The revised Study 2 and 3 states that "even small WSE fluctuations could still contribute to bank instabilities" (page 138), but then discounts this potential without any data; basing their assumption on the magnitude of the assumed hydraulic gradient (discounting 25% of the reaches with higher fluctuations) and what they refer to as the short duration of the fluctuations, which occur on a daily basis.

The following four excerpts taken from the revised Study 2 and 3, further highlight the importance of assessing the hydraulic gradient between impoundment water surface elevations and

groundwater elevations along the shoreline, based on site specific groundwater field data for the 21 monitored sites.

> Page 138 : "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 stability of two adjacent banks with slight differences in bank composition could be very different despite experiencing identical WSE fluctuations, thereby complicating efforts in discerning whether bank instability is the result of project-induced WSE fluctuations."
>
> Page 124: "The character of sediments in the study area creates banks with limited resistance to erosion. The bank sediments at the monitoring sites, representative of the study area as a whole, are nearly ubiquitously comprised of fine-grained and unconsolidated floodplain or glaciogenic sediments that are particularly prone to erosion (see Appendix A stratigraphic columns). Frequently observed inter-beds of permeable sand and less permeable silt can further reduce the resisting force of floodplain sediments by creating horizontal surfaces along which groundwater can preferentially move, potentially increasing seepage forces acting on the bank."
>
> Page 132: "When the water surface in an impoundment is increased when a dam is raised, the previously dry bank sediments inundated by the rising water becomes saturated, the pore pressures increase, and the resisting forces of the bank material decrease. Together with the added weight of the water in the bank sediment (causing an increase in the driving forces), the reduced strength of the bank material creates an unstable situation that leads to bank failure (Brunsden and Kesel, 1973; Lawson, 1985)."
>
> Page 165: "…although such operations could contribute to erosion by creating seepage forces associated with daily fluctuations."

This last excerpt was taken from Section 6.6, Study Conclusions, and clearly highlights the need to assess seepage forces associated with daily operational fluctuations.

In addition to assessing the hydraulic gradient associated with daily operational WSE fluctuations, it is also critical to assess the potential for streambank instabilities caused by periodic operational drawdowns in preparation for high flow events. The revised Study 2 and 3 does not include a discussion of the potential for seepage forces and bank instabilities during periodic operational drawdowns, which occur over longer durations than the daily WSE fluctuations. Although it does bring up stability concerns relating to periodic operational drawdowns, when it states on page 120 that, "As a result of lowering WSE at the dams, a convexity in the longitudinal profile develops in the impoundments, most pronounced at the lower end (Figure 5.8-1 on page 121 – this is the second figure labeled 5.8-1 in the report), that could potentially engender a channel response as a stable river profile typically has a concave-up profile in contrast to the observed convexity." This same discussion shows that velocities during periodic operational drawdowns exceed the threshold velocity for sediment entrainment at 70% of the 13 erosion impoundment monitoring sites, and as such periodic drawdowns to precipitate movement of accumulated sediment away from the tow of the streambanks, similarly to high flow events and a handful of the higher operational flow events at the 21 monitored cross sections.

Princeton Hydro Recommendation: We recommend that Great River Hydro collect groundwater elevation data and observations of groundwater seeps or seepage-related erosion at the 21 monitored transects and, as requested, analyze that data to determine how operational WSE fluctuations potentially effect streambank stability. This analysis is needed since, as stated in Study 2 and 3 on page 138, "even small WSE fluctuations could still contribute to bank instabilities." Great River Hydro should calculate the hydraulic gradients specific to the full range of operational WSE fluctuations including both normal operational WSE fluctuations and periodic operational drawdowns, inclusive of durations for both current operational practices. The analysis should incorporate the data already collected by TransCanada at the 21 transects relating to the layering of sediments within the banks and the stratification of permeable and less permeable zones. The studies should describe how the hydraulic gradients were calculated and the resulting potential for riverbank erosion (e.g., naturally occurring seepage and project-related seepage). The discussion should include data, observations, analysis, and discussion for potential riverbank erosion and all 21 erosion monitoring sites. Without this data the validity of the conclusions of Study 2 and 3 remain in question.

3. Effects of Shoreline Erosion on Other Resource

The FERC Determination stated, "An objective of study 3 (see the fourth bullet on page 27 of the approved RSP) was to 'identify the effects of shoreline erosion on other resources (e.g., riparian areas and shoreline wetlands, rare plant and animal populations, water quality, and aquatic and terrestrial wildlife habitat).' TransCanada proposed to conduct this analysis partly by using "maps showing the location of different bank conditions and features along the river […] to investigate whether bank erosion has the potential to affect other resources.' The report for studies 2 and 3 provides a limited analysis of other resources and suggests that other studies (i.e., studies 6, 8, 14, 15, 24, 25, 27, and 30) determined erosion is 'unlikely to have measureable negative effects on those resources.' The report for studies 2 and 3 does not include any maps comparing areas with documented erosion to the maps created for other studies.

…the discussion of existing information should be expanded to provide a more detailed description of the effects of ongoing erosion within the project boundary on other resources. Therefore, we recommend that the revised study report that will be filed in January 2017 include a **detailed qualitative discussion of the potential effects of ongoing erosion** within the project areas **on riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic habitat, and terrestrial habitat**. Where possible, this discussion should include **comparative maps and site-specific observations**. "

Peer Review Comment Regarding Compliance with FERC Determination

Our comments on how the effects of shoreline erosion were assessed regarding other resources are addressed as follows:

3.1. Cultural and Historic Resources

No maps are provided. Six of seven sites were recommended for listing in the National Historic Register and protection. A qualitative assessment of the potential effects of ongoing erosion on these cultural and historic sites is not provided.

3.2. Recreation Facilities

67 public access sites are identified, 7 sites were linked to erosion concerns. No mapping is provided. TransCanada manages impacts from erosion, scour, and sedimentation at FERC Project recreation sites through as-needed maintenance. A qualitative assessment of the potential effects of ongoing erosion on these recreation sites is not provided.

3.3. Wetlands

Only three example maps are provided. Statistics were presented that show that wetlands are more prevalent at stable banks and in the dam impoundments than the riverine reaches. The discussion raises the question whether the wetlands promote bank stability or whether stable banks promote wetlands. A qualitative assessment of the potential effects of ongoing erosion on wetlands is not provided.

3.4. Rare Plants

Jesup's Milk Vetch

- Four known sites; no mapping is provided. Ongoing bank erosion is not likely to adversely impact Jesup's Milk Vetch as it inhabits bedrock outcrop crevices.

Northeastern Bulrush

- Not located in field surveys. Ongoing bank erosion is not likely to adversely impact NB as it inhabits beaver dams and habitats beyond the impoundment.

Other Rare Plants

- No mapping is provided. Other rare plants were 2x more commonly found at stable banks (65 out of 96 at stable sites, 23 out of 96 at unstable sites). One species is an erosion specialist and benefits from eroded sites. Ongoing bank erosion may adversely impact other rare plants.

3.5. Rare Animals

Cobblestone Tiger Beetle

- No mapping is provided. Cobblestone Tiger Beetle (CTB) was found at 7 of 14 study sites, 5 of which were stable. Erosion is an important process for maintaining CTB habitat; however, the discussion does not acknowledge that bank erosion rarely yields the coarse-grained material that forms CTB habitat. Contrary to the report's findings, ongoing bank erosion does have the potential to adversely impact CBT.

Fowler's Toad

- No mapping is provided. Fowler's Toad habitat is naturally rare in the CT River; FT was located at 1 of 10 study sites that had suitable habitat. The report concludes that periodic scouring and erosion during high flow events would contribute to creating and maintaining FT habitat.

Dragonflies and Damselflies

- Only two example maps are provided. Dragonflies and Damselflies (D/D) were found at 11 of 11 study sites, including 6 Species of Greatest Conservation Need. As species were co-located with stable and unstable sites, the report concludes that ongoing bank erosion is unlikely to adversely impact D/D and may maintain desirable habitat conditions.

3.6. Terrestrial Wildlife

Bank Swallows

- No mapping is provided. Bank Swallows require eroded banks for colony nests.

King Fishers

- No mapping is provided. King Fishers utilize eroded banks for individual nests.

Bald Eagles

- No mapping is provided. While single potential nest trees can be lost due to bank erosion, the report concludes that the greater population is unlikely to be impacted by ongoing bank erosion.

3.7. Aquatic Resources

Water Quality

- Water quality monitoring reported in Study 6 found turbidity to be within state standards. Few recorded peak spikes in turbidity were found to occur in response to high flows resulting from heavy rain events. However, there is no discussion of how ongoing bank erosion is contributing to measure peaks in turbidity. Further, periodic drawdowns in anticipation of high flows also generate high velocities which are likely to generate bank erosion and contribute to turbidity. Discussion is provided on the impacts of turbidity to spawning, although there is no assessment on the impacts to sight-feeding fish or gill respiration, both of which are known to be impacted by turbidity and total suspended solids (TSS).

Aquatic Habitat and Substrate

- Statistics are presented that show that fines are far more prevalent in the impounded reaches (72-84%) and that coarse-grained substrates are far more prevalent in the riverine reaches (65-75%). This stark contrast would seemingly have substantial effects on benthic communities; however, it is not acknowledged.

Fish Spawning

- Three species spawn in slack-water habitat. At least four species practice nest-cleaning behaviors, where they sweep away fine sediments. Six riverine species do not actively clean nests, and indeed multiple nests were found abandoned, for unknown reasons. These riverine species could be adversely affected by ongoing bank erosion, although the report does not clearly state this.

Freshwater Mussels

- Statistics are presented showing the co-location of Freshwater Mussels with stable and unstable banks. However, the report states that surveys were not conducted randomly but rather "purposely avoided areas with highly unstable banks, because, based on surveyor experience, mussels are less likely to be found near those types of banks." This fact renders the statistics invalid, and reinforces the concern that ongoing bank erosion could adversely effect freshwater mussel species.

Princeton Hydro Recommendation: We recommend that TransCanada include mapping as requested in the FERC Determination dated November 29, 2016 including riparian areas and shoreline wetlands, rare plant and animal populations, water quality, aquatic habitat, and terrestrial habitat. Locational information for stationary state-listed species can be made privileged. More importantly, we recommend further qualitative discussion about the potential impacts that ongoing bank erosion and the release of fine sediments may have on (i) the Cobblestone Tiger Beetle habitat, (ii) water quality impacts related to sight-feeding and respiration of fish, (iii) aquatic habitat and substrate, (iv) spawning of riverine fishes, and (v) freshwater mussels.

ACCEPTED SCIENTIFIC PRACTICE

- **Erosion Ratio**: While a statistical analysis was added to Study 2 and 3, the revised study still utilizes and makes conclusions based on the "erosion ratio." This approach is not an accepted scientific practice and was not proposed and a method for inclusion in the RSP. No citation or reference is provided for this metric, and the metric is not used, to our knowledge, in the extant fluvial geomorphic scientific literature. We understand through our conversations with CRC, that Field Geology Services used the erosion ratio in a table in their 2007 fluvial geomorphology study of the Turners Falls impoundment of the Connecticut River. The TransCanada study does not demonstrate that the method conforms to generally accepted scientific practice; in fact the revised study states that "the erosion ratio approach for identifying potential causes for erosion has not been widely used" (page 103 Revised Study 2 and 3). Please refer to our previously prepared peer review comments from September 30th, 2016, for a more detailed explanation of the potential biases associated with the erosion ratio.

VALIDITY OF RESULTS AND CONCLUSIONS

Study Conclusion #1: "Flow velocities and shear stresses during normal project operations have been shown to be inadequate, within the impoundment sections and at nearly all locations within the riverine sections, to mobilize sediment accumulating at the base of the banks and are by themselves unable to sustain the cycle of erosion." (from page 140 of the Revised Study 2 and 3)

Peer Review Comment: The study continually discounts the role that normal project operations may have on erosion, based on their statement that normal project operational flows are not responsible for mobilizing accumulated sediment at the base of the banks, even though their own data (Figure 6.1-1. page 131) demonstrates that operational flows can entrain sediment accumulations at the toe of the

slope. While we concur with the study that mobilization of eroded streambank sediment that has deposited at the base of the bank typically occurs during high flows, we do not concur that it therefore follows that WSE fluctuations caused by normal project operation do not play a role in initiating the erosion at the toe of the bank, which is also a critical element in the bank erosion cycle. While the initial toe of bank notching may result in a lower quantity of sediment being mobilized, it does directly contribute to the bank failures that then result in sediment deposits at the toe of the bank, once the bank has failed. The cycle of erosion is only propagated when all of its elements continue to occur. It does not logically follow to place a higher significance on only one element of the cycle, such as mobilization of the sediment depositions at the toe of the bank due to high flow. As the study states, "Not all causal mechanisms need be present at any given site to effect erosion, but where they are present they all work in concert to increase bank instability." (page 124)

In addition to the above referenced invalid study conclusion we would also refer FERC to our peer review comments and recommendations from our September 30, 2016 peer review for Study Conclusion #4 on page 15 and Study Conclusion #5 on pages 15 and 16.

PEER REVIEW SUMMARY

Princeton Hydro finds the revised Final Study Report, dated February 4, 2017 to be incomplete, inconclusive, and at least partially, invalid. The Final Study Report does not fulfill the obligations put forth in the Revised Study Plan, nor the follow-up requests in the FERC Determination on Requests for Study Modifications and New Studies, dated November 29, 2016. Essential data, related to the hydrologic and hydraulic analyses and subsequent analyses, including detailed stage monitoring and hydraulic modeling output of velocity and shear stress, were never provided for review or analysis. Statistical analysis from that data was compromised by spatial autocorrelation, rendered inconclusive results, contradicted assertions made in the Revised Study Report, and led to interpretations that are counter to the known physical processes that effect bank stability.

Scientists, Engineers & Environmental Planners Designing Innovative Solutions for Water, Wetland and Soil Resource Management

March 6, 2018

MEMORANDUM

To: Andrea Donlon, River Steward, CRC
Kathy Urffer, River Steward, CRC

From: Paul Woodworth, Fluvial Geomorphologist, Princeton Hydro, LLC
Laura Wildman, PE, Princeton Hydro, LLC

Re: FERC Re-Licensing Process for Great River Hydro, LLC
Peer-Review of ILP Study 2 and Study 3
Riverbank Transect and Riverbank Erosion Studies
Supplement to Final Study Report, dated 11/15/2017

FERC Numbers:
Project No. 1892-026 – New Hampshire/Vermont, Wilder Hydroelectric Project
Project No. 1892-045 – New Hampshire/Vermont, Bellows Falls Hydroelectric Project
Project No. 1904-073 – New Hampshire/Vermont, Vernon Hydroelectric Project
Great River Hydro, LLC

The Connecticut River Conservancy (CRC) (formerly Connecticut River Watershed Council) is a stakeholder and participant in the re-licensing process of the Federal Energy Regulatory Commission (FERC) for the three hydropower facilities owned by Great River Hydro, LLC (GRH, formerly TransCanada Hydro Northeast Inc.) on the Connecticut River: Wilder Dam, Bellows Falls Dam, and Vernon Dam. Princeton Hydro (PH) was retained by CRC to complete a peer review of the Supplement to Final Study Report, Integrated Licensing Process (ILP) Study 2 and Study 3: Riverbank Transect and Riverbank Erosion Studies, dated 11/15/2017. The Supplement to Final Study Report was in response to FERC's request to provide (i) an analysis of estimated critical shear stress, near-bank velocity, and the potential correlation of these factors with project operation at the 21 monitoring sites, and (ii) near-bank velocities associated with multiple water surface elevations (e.g., minimum flow, average project operating range, maximum project hydraulic capacity), as measured at the six sites with ADCPs. See the full wording of FERC's request below. Where necessary, this memorandum also refers to the Revised Final Study Report, dated 2/4/2017. This memorandum is a critical review of that report and aims to address the following questions as defined in 18 CFR § 5.15 Conduct of Studies (d) Criteria for modification of approved study, the RSP, and FERC's 11/29/2016 Determination on Requests for Study Modifications and New Studies – Wilder, Bellows Falls, and Vernon Hydroelectric Projects:

- Is the supplemental report now in compliance with the Revised Study Plan (RSP) dated 8/14/2013 and FERC's determination letter dated 7/21/2017?
- Were the new analyses conducted in a way that is generally accepted scientific practice?
- Are the results and conclusions valid?

Compliance with Revised Study Plan and FERC's determination letter

1. FERC's specific recommendation related to *River Transect Assessments* is as follows:

   "Because critical shear stress and near-bank velocities can play a significant role in the erosion process, staff recommends that Great River Hydro file an addendum to the revised study report by November 15, 2017, that includes an analysis of estimated critical shear stress, near-bank velocity, and the potential correlation of these factors with project operation at the 21 monitoring sites. This discussion should include a table for each monitoring site that lists critical shear stresses and near-bank velocities with respect to water surface elevations corresponding to project operation (e.g., minimum flow, average project operating ranges, maximum hydraulic capacity). For each monitoring site, Great River Hydro should describe the river channel features corresponding to each water surface elevation, including stratigraphy, the presence or absence of vegetation, the presence of any visual erosion indicators (e.g., slumps, falls, notching, undercutting), and other notable bank features (e.g., groundwater seeps)."

2. FERC's specific recommendation related to *Streamflow Velocity Analysis* is as follows:

   "…Commission staff recommends that Great River Hydro include, in the November 15, 2017 addendum, near-bank velocities associated with multiple water surface elevations (e.g., minimum flow, average project operating range, maximum project hydraulic capacity), as measured at the six sites with ADCPs. For the remaining 15 sites, staff recommends that Great River Hydro include the average velocity associated with multiple water surface elevations as calculated by the HEC-RAS model. If possible, Great River Hydro should include a discussion or estimate of the near-bank velocity for these 15 sites based on available data. Additionally, where available, this analysis should be supplemented with literature-based, soil-specific estimates of threshold velocities for each of the 21 monitoring sites, in order to determine the potential for project operation to effect riverbank erosion."

3. FERC's specific recommendation related to *Streamflow Velocity Analysis* is as follows:

   "Commission staff recommends that Great River Hydro make the requested HEC-RAS data available to stakeholders upon their request to allow for their supplemental analysis. Any data analyses filed by stakeholders in the proceeding will be independently reviewed by Commission staff."

While the Supplemental Study includes an analysis of estimated critical shear stress, near-bank velocity, and other factors regarding project operation at the 21 monitoring sites, certain elements of this study do not meet FERC's recommendation, as follows:

4. GRH did not initially make the native digital HEC-RAS model files available for review by stakeholders as recommended by FERC in (C) above. However, upon request they did provide the HEC-RAS files to CRC in a flash drive, which we were able to review briefly (see further comments later in this memo). In addition, the Hydraulic report (Appendix C) did not include model output such as graphics of the modeling domain with velocity and shear stress contours,

color-mapping, or output tables, all of which should be provided to evaluate the model's performance and accuracy. Resulting velocity and shear stress values are listed at the specific cross-section locations in the report body, but general output should also be provided, particularly in the absence of the native digital HEC-RAS model files. It is noted that standard HEC-RAS model output was also omitted from the Study 4 Hydraulic Modeling Report dated 3/1/2016; thus, no thorough evaluation of the HEC-RAS modelling effort has been performed to date.

5. Velocities measured with ADCP at six sites were not included as recommended by FERC in (B) above. Measured velocities provide a means of calibrating and/or validating the model results. PH requests the data associated with velocities measured with ADCP at the six sites as requested by FERC in (B) above.
6. While a table of values was provided for each river transect, cross-sections were not depicted showing the water surface elevations relative to bank conditions, including stratigraphy, the presence or absence of vegetation, the presence of any visual erosion indicators (e.g., slumps, falls, notching, undercutting), and other notable bank features (e.g., groundwater seeps). While Appendix A of the Revised Final Study Report (2/4/2017) included plots of transects, observed erosional features were plotted separately from water surface elevations that correspond to discharges, which differ from the discharges utilized in the Supplement to the Final Study Report (11/15/2017). Depicting all of these characteristics is essential to assess any interactions and potential correlation among the factors listed above. As this Supplement was specifically focused on the 21 transects, PH requests plotted cross-sections for each site with (i) annotations of erosional features (as depicted in the 2/4/2017 Final Report), (ii) water surface elevation fluctuation as measured by water level loggers, and (iii) the water surface elevations corresponding to the three discharges analyzed in the Supplement.

Accepted Scientific Practice

7. The methodology as described of the shear stress and velocity analysis conforms to generally accepted scientific practice. Literature references for published critical velocities and critical shear stresses are valid and applicable.
8. A preliminary review of the HEC-RAS model files yielded the following observations:
    a. Model domains appeared to cover substantial river length and over-bank areas.
    b. Of the 2-D geometries examined, it could not be confirmed if breaklines had been used to more accurately represent breaks in slope like at the top of bank or at the bottom of bank. River bathymetry appeared to be very uniform, potentially lacking detail. Topography on the floodplain appeared to be much more varied and detailed.
    c. Of the 2-D geometries examined, whole geometries were represented with a single Manning's N, or roughness, with no differentiation between in-channel roughness or floodplain roughness, which could produce erroneous results.
    d. While the model was run in "unsteady flow" (considered to be a more accurate mode), it was run at a single flow, which is functionally equivalent to running the model in "steady flow". This is atypical.

e. There were multiple model scenarios for each dam, and various dam heights and flows – a thorough outside review would require substantial time. Given the irregularities noted above and the complexity of the modeling effort, FERC should complete their own thorough examination of the modeling to confirm that standard hydraulic modeling practices were followed and that any deviations are adequately justified.

Validity of Results and Conclusions

9. The Supplemental Study diminishes the value of the critical shear stress because it does not account for cohesion, compaction, and other forces resisting entrainment. However, as reported on page 124 of the Revised Study 2 and 3 (2/04/2017), "The character of sediments in the study area creates banks with limited resistance to erosion. The bank sediments at the monitoring sites, representative of the study area as a whole, are nearly ubiquitously comprised of fine-grained and unconsolidated floodplain or glaciogenic sediments that are particularly prone to erosion (see Appendix A stratigraphic columns)." For this reason, PH believes critical shear stress is not as conservative a metric as claimed in the Supplemental Study.
10. Section 3.0 states "only 8 out of 21 sites show any potential for sediment entrainment." PH notes that this is over 30% of the surveyed cross-sections – a significant portion – and may not include the banks that have already been actively stabilized. (If the single site that had been armored is added, 9 out of 21 sites equates to 43%.)
11. The Supplemental Study reports that at least 15 sites exhibit a "beach" that fronts the bank. A "beach" feature is atypical of free-flowing rivers, but it is very common in the lower reaches of the CT River that are tidally influenced. The daily water surface fluctuation inhibits the establishment of natural vegetation on this portion of the bank; without this daily water surface fluctuation, this beach would likely re-vegetate and promote greater stability to the bank.
12. Assuming the study correctly demonstrates that near-bank shear stress and velocities during operational flows are insufficient to entrain sediment at the banks, this Supplemental Study and the Revised Study do not discount the role played by operational water surface fluctuations in perpetuating the bank erosion cycle as described in the Revised Final Study. We assert that this Supplemental Study was mistakenly focused on near-bank shear stresses and velocities, when sub-daily water surface fluctuations can still inhibit vegetation and cause bank instability. Water surface fluctuation directly contributes to bank failures that result in sediment deposits at the toe of the bank, which is then entrained, allegedly only by flows above operations. The cycle of erosion turns only when all of its elements continue to occur. This Supplemental Study does not definitively prove that project operations are not a contributing factor to bank erosion.