



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

100 Cambridge Street Suite 900 Boston, MA 02114 • 617-292-5500

Maura T. Healey
Governor

Kimberley Driscoll
Lieutenant Governor

Rebecca L. Tepper
Secretary

Bonnie Heiple
Commissioner

June 20, 2024

Debbie–Anne A. Reese, Acting Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: Massachusetts Department of Environmental Protection’s Consultant Review of FirstLight’s Supplemental BSTEM Modeling Report

Dear Acting Secretary Reese:

This letter relates to Turners Falls P-1889-085 and Northfield Mountain Pumped Storage, P-2485-071, which currently are subject to relicensing by the Federal Energy Regulatory Commission. The Massachusetts Department of Environmental Protection (MassDEP) is the certifying authority for the Commonwealth of Massachusetts for purposes of Section 401 of the Clean Water Act. MassDEP is assessing the project’s compliance with the Massachusetts Surface Water Quality Standards (SWQS), 314 CMR 4.00, and other appropriate requirements of state law through review of the project’s 401 Water Quality Certification (WQC) application. As part of that process, MassDEP contracted with Inter-Fluve, Inc., to review FirstLight’s Supplemental BSTEM Modeling Report (May 2023) (Supplemental Report). The focus of that review was to assess the Supplemental Report’s findings and conclusions concerning the extent to which FirstLight’s operations cause erosion. Interfluve’s review is summarized in the attached Technical Memorandum: Review of the BSTEM Modeling and Reporting, dated May 2024 (Technical Memorandum).

The Supplemental Report presents an extensive body of work that includes years of analysis related to hydrologic, hydraulic, and bank erosion conditions within the Turners Falls Impoundment. While the Supplemental Report is informative, there are limitations with respect to demonstrating the full extent to which FirstLight’s operations cause erosion. Accordingly, MassDEP will continue to consider all available information, including other quantitative and qualitative reports that investigate project-related erosion, to further evaluate and appropriately mitigate for erosion impacts from project operations.

Thank you for your consideration of this submittal. Questions and/or comments can be directed to Elizabeth Stefanik via email at dep.hydro@mass.gov.

Attachment

Sincerely,

A handwritten signature in cursive script, appearing to read "David Hilgeman".

David Hilgeman, PE
MassDEP Wetlands Program



July 12, 2023. 3:00pm. Northfield Mountain Intake.

Technical Memorandum

Review of the BSTEM Modeling and Reporting
Northfield Mountain Pumped Storage Project (No. 2485) and
Turners Falls Hydroelectric Project (No. 1889)

SUBMITTED TO

Stephanie Moura
Massachusetts Department of Environmental Protection
100 Cambridge Street, Suite 800
Boston, MA 02114

Cc: David Hilgeman, Timothy Jones

MAY 2024

PREPARED BY

Sarah Widing, PE
Tim Brush
Inter-Fluve, Inc.
220 Concord Avenue, 2nd Floor
Cambridge, MA 02138

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1. Introduction

1.1 CONTEXT

This memorandum summarizes the findings of a peer review, conducted by Inter-Fluve, at the request of the Massachusetts Department of Environmental Protection (MassDEP), of selected technical documents with regards to two hydroelectric projects located on the Connecticut River.

The two hydroelectric projects (Projects) are owned by FirstLight (Project Proponent).

- ▶ Northfield Mountain Pumped Storage Project (FERC No. 2485), Northfield, Massachusetts, and
- ▶ Turners Falls Hydroelectric Project (FERC No. 1889), occupying portions of Hinsdale, New Hampshire; Vernon, Vermont; and Erving, Northfield, Gill, and Montague, Massachusetts.

The Project Proponent is currently in the process of relicensing the Projects pursuant to the requirements of the Federal Energy Regulation Commission (FERC). The Project Proponent is required to apply for and obtain a Clean Water Act Section 401 Water Quality Certification in order to obtain the licenses for the Projects. As administrator of the Section 401 Water Quality Certification Process in Massachusetts, MassDEP will be responsible for this certification. Specifically, “MassDEP is obligated to determine whether there is reasonable assurance that the proposed relicensed operations will be conducted in a manner which will not violate Massachusetts Surface Water Quality Standards at 314 CMR 4.00.”¹

The Project timeline, relevant to the contents of this memorandum, includes the following events:

- ▶ In 2012, FirstLight initiated the relicensing process. Scoping meetings associated with the process identified the existing hydroelectric projects as a probable contributor to bank erosion in the Turners Falls Impoundment (TFI). Bank erosion and the consequences of bank erosion contribute to water quality impairments^{2,3} to the designated uses of the Connecticut River. Based on these consultations, FirstLight designed and conducted several studies, including Study 3.1.1, the Full River Reconnaissance Study (FirstLight, 2014); Study 3.1.2, the Erosion Causation Study (FirstLight, 2017a, b); and Study 3.2.2, the Hydraulic Study (FirstLight, 2015); and others, to evaluate the existing condition of the TFI.
- ▶ In 2021, MassDEP hired Inter-Fluve to begin a peer review of specific selected technical studies associated with FirstLight’s relicense application to FERC. Specifically, Inter-Fluve reviewed documents related to the hydrologic, hydraulic, and bank erosion and stability modeling performed by consultants in support of the application. The bank erosion and

¹ <https://www.mass.gov/info-details/401-wqc-for-the-firstlight-hydroelectric-re-licensing-project>

² CN 568.1 Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle. May, 2023.

³ CN 505.1 Appendix 15. Connecticut River Watershed Assessment Listing Decision Summary. Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle. November, 2021.

stability modeling was performed using the U.S. Department of Agriculture – Agricultural Research Service (USDA-ARS) Bank Stability & Toe Erosion Model (BSTEM).

- ▶ In 2023, FirstLight issued a Supplemental Study⁴ (FirstLight, 2023), which is a companion to the Original Study⁵, to evaluate the effect of proposed changes to the Project operations, as described in the 2022 Agreement in Principle (AIP)⁶ (AIP, 2022), on erosion conditions in the TFI.

This memorandum provides Inter-Fluve’s review of the Original and the Supplemental Studies and includes the following sections:

- ▶ Section 2 describes the documents reviewed specifically as part of this scope of work.
- ▶ Section 3.1 summarizes Inter-Fluve’s key findings from the review of the Original Study.
- ▶ Section 3.2 summarizes Inter-Fluve’s findings from the review of the Supplemental Study.
- ▶ Section 4 provides Inter-Fluve’s recommendations for incorporating the findings into the water quality certification process.

Note that the AIP has subsequently been superseded by the 2023 Settlement Agreement (SA)⁷ (SA, 2023). The proposed operating conditions described in the SA are similar, but not identical, to the proposed operating conditions described in the AIP. The Supplemental Study does not present modeling work specific to the SA, therefore this document does not include a review of model results and conclusions with respect to the SA.

1.2 SCOPE OF WORK

The scope of work for this review, as defined in the contract between MassDEP and Inter-Fluve, consists of the following specific review categories:

- ▶ A review of the qualifications of the individuals who completed the work,
- ▶ A summary of the appropriateness of the modeling and inputs, and
- ▶ An assessment of the soundness of FirstLight’s interpretations and conclusions.

Section 3.2 of this memorandum explicitly addresses each of these items.

⁴ In this document, the “Supplemental Study” refers to the 2023 Supplemental BSTEM Modeling Report (FirstLight, 2023).

⁵ In this document, the “Original Study” refers to Study 3.1.2 (FirstLight, 2017a,b), also known as the Erosion Causation Study.

⁶ In this document, AIP stands for Agreement in Principle and refers to (AIP, 2022)

⁷ In this document, SA stands for Settlement Agreement and refers to (SA, 2023)

2. Documents Reviewed

This memorandum describes a peer review specific to the documents briefly summarized below, which are a subset of the extensive body of work related to this project. Refer to Section 5 for a complete list of documents referenced in this memorandum.

2.1 ORIGINAL EROSION CAUSATION STUDY (FIRSTLIGHT, 2017A, B)

In April 2017, FirstLight submitted Study Report 3.1.2, Northfield Mountain/Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability (FirstLight, 2017a) and Evaluating the Impact of Increasing Usable Storage Volume of the Upper Reservoir on Streambank Erosion in the Turners Falls Impoundment (FirstLight, 2017b). The Original Study examined the impact of existing conditions, as observed, on bank erosion in the TFI.

The Original Study stated the following conclusions:

- ▶ Boat waves are the dominant cause of erosion in Barton Cove.
- ▶ Natural high flows are the dominant cause of erosion at other locations in the TFI.

Section 3.1 of this memorandum summarizes Inter-Fluve’s review of the Original Study and provides commentary on these stated conclusions.

2.2 SUPPLEMENTAL STUDY (FIRSTLIGHT, 2023)

In May 2023, FirstLight submitted a Supplemental BSTEM Modeling Report (FirstLight, 2023). The Supplemental Study examined the impact of *proposed* operations, as defined in the AIP, on the bank erosion in the TFI. The Supplemental Study is companion to the Original Study (FirstLight, 2017a, b), which examined the impact of *existing* operations on bank erosion in the TFI.

The Supplemental Study included a comparison and discussion of the differences in predicted bank erosion rates between the modeled results for existing (Original) and proposed (Supplemental) conditions.

The Supplemental Study stated the following conclusions:

- ▶ The dominant causes of erosion will not change under the proposed condition.
- ▶ Boat waves will continue to be the dominant cause of erosion in the ‘lower reaches’ (14%).
- ▶ Natural high flows will continue to be the dominant cause of erosion at other locations in the TFI (86%).
- ▶ The proposed condition is anticipated to be a contributing cause of shoreline erosion at detailed study sites 18L, 8BR, 12BL and both the right and left banks between Barton Cove and the French King Gorge.

Section 3.2 of this memorandum summarizes Inter-Fluve’s review of the Supplemental Study and provides commentary on these stated conclusions.

2.3 AGREEMENT IN PRINCIPLE (AIP, 2022)

The proposed conditions evaluated in the Supplemental Study are defined in the Agreement in Principle (AIP, 2022) (Appendix A of the Supplemental Study). Proposed project operations include hydrologic and hydraulic manipulations related to the following operational considerations:

- ▶ Total bypass flows
- ▶ Flows at Turners Falls Dam
- ▶ Flows at Station No. 1
- ▶ Minimum flows below Cabot Station
- ▶ Ramping rates at Cabot Station
- ▶ Flow stabilization below Cabot Station and allowable deviations for flexible operations
- ▶ Variable releases and flow below Turners Falls Dam
- ▶ Flood flow operations
- ▶ Cabot Station emergency gate use
- ▶ Turners Falls Impoundment water level management

Refer to Tables 1.1.1-1 and 1.1.1-2 of the AIP for specific conditions.

2.4 SETTLEMENT AGREEMENT (SA, 2023)

This section of the memorandum is provided to inform the reader that this peer review is relative to information that has already been superseded by additional Project application materials.

The Supplemental Study (FirstLight, 2023) was published prior to the issuance of the SA (SA, 2023). The SA describes a consensus agreement between the settling parties, which include FirstLight; the National Marine Fisheries Service; the U.S. Fish and Wildlife Service; the Massachusetts Division of Fisheries and Wildlife; the Nature Conservancy; American Whitewater; Appalachian Mountain Club; Crab Apple Whitewater, Inc.; New England FLOW; and Zoar Outdoor. Note that there are some differences between the flow conditions defined in the AIP and those agreed to as part of the SA. The Supplemental Study acknowledged that the finalized SA contained notable differences. The differences, quoted directly from the Supplemental Study, include:

- ▶ “The Minimum Flow below Turners Falls Dam from 7/1-11/15 is 500 cfs under the SA and 400 cfs* under the AIP, and both minimum flows are on an “or NRF⁸, whichever is less” basis.
- ▶ The SA includes Draft License Article A150, Variables Releases from Turners Falls Dam and Variable Flow below Station No. 1, while the AIP was based on the whitewater flow release schedule; however, the schedules were similar. In both cases, all flow releases from the Turners Falls Dam or below Station No. 1 were for 4 hours, were on a NRF, or inflow, whichever is less basis, and occurred between July 1 and October 31. Relative to the Turners Falls Dam releases, under the SA there are 10-11 days of 4,000 cfs releases versus 9 days of 5,000 cfs under the AIP. Relative to the flows below Station No. 1, under the SA there are 14 days of flow versus approximately 23 days under the AIP; however, both flows were the same magnitude.

**Technically, the F/F AIP was 250 cfs, but FirstLight simulated 400 cfs for this period as it was considered the potential upper boundary.”*

These differences are not part of the modeling and results reported in the Supplemental Study. The documents reviewed by Inter-Fluve as part of this work do not quantify the extent to which these differences may or may not affect bank erosion in the TFI.

⁸ NRF stands for Naturally Routed Flow.

3. Summary of Findings

This section of the memorandum states the key findings of Inter-Fluve’s review of the Original Study and the Supplemental Study.

3.1 FINDINGS FROM INTER-FLUVE’S REVIEW OF THE ORIGINAL STUDY

The goal of the Original Study was “to identify and evaluate the causes of erosion in the Turners Falls Impoundment and to determine to what extent they are related to Project operations” (FirstLight, 2013). Inter-Fluve’s review of the Original Study identifies questions about the limitations of the modeling methodology and the conclusions and interpretations drawn from the model results. In general, Inter-Fluve finds that the project documentation does not present sufficient information to demonstrate that the studies fully meet the stated goal.

The conclusions presented in the Original Study are founded on the fundamental assumption that the models adequately represent hydrologic, hydraulic, and erosion processes relevant to the study area. However, Inter-Fluve finds that the documentation does not adequately demonstrate that the modeling tools used in the study appropriately quantify the processes suspected to be driving the erosion within the TFI.

Key conclusions from Inter-Fluve’s review of the Original Study include:

- ▶ A conceptual model of bank profile evolution and erosional processes in the TFI, communicated at the beginning of the report, would have been helpful in guiding the reader and reviewer through the process of justifying the utility of the selected modeling tools. Formulating a conceptual model would strengthen the study by providing a basis for selecting an analytical approach, including bank erosion modeling and the use of BSTEM. The conceptual model would be based on a thorough literature review of erosional processes in impoundments, field observations specific to conditions in the TFI, and analyses of existing data. The methodology for evaluating the causes of erosion would then follow from an understanding and representation of the erosional processes in the context of the geomorphic trajectory. Without a conceptual model, a reader is unable to evaluate whether or not the relevant processes are adequately represented in the analytical framework. The preparers may have performed the work in alignment with a conceptual model; however, the documentation reviewed does not communicate this to be the case.
- ▶ If, based on a representative conceptual model, BSTEM would be considered an appropriate tool for analyzing bank erosion in the TFI, then the following recommendations would follow:
 - It may be premature to make conclusions about the impact of project operations on erosion in the TFI. A proposed conditions model should be developed to incorporate the proposed changes to project operations. The results of the proposed conditions

model should be compared to the results of the existing conditions model. Differences in the results would reveal locations where the model predicts that changes to project operations will result in changes to erosion rates.⁹

- If the impact of the Northfield Mountain operations is to be determined through the comparison of model results for the Baseline condition and the Scenario 1 condition, then the BSTEM input data for Scenario 1 should be modified. The observed existing bank condition, as a model input, is not representative of a condition in the absence of daily water level fluctuations caused by Northfield Mountain operations; the observed existing condition is altered by the existing/ongoing Northfield Mountain operations. The BSTEM input data would need to be modified to reflect a bank profile and bank vegetation condition that would occur in the absence of the daily water level fluctuations caused by Northfield Mountain operations. Without this modification, the study, as designed, cannot isolate and quantify the impact of Northfield Mountain operations on stream-side vegetation and, consequently, on bank erosion. Conclusions and interpretations that follow from the comparison are not properly qualified.
- The analyses of riverbank stability and erosion in Study 3.1.1 (FirstLight, 2014) and causes of erosion in Study 3.1.2 (FirstLight, 2017a, b) should explore how the interpretation of the results changes if stabilized or bedrock/resistant banks are removed from the statistical analyses of the results. It would be informative to focus more specifically on how the vulnerable, unprotected, erodible banks are responding to and are affected by hydroelectric operations and other potential causes of erosion.

3.2 FINDINGS FROM INTER-FLUVE'S REVIEW OF THE SUPPLEMENTAL STUDY

This section of the memorandum provides a narrative of the findings, identified by Inter-Fluve, during our review of the Supplemental Study. The findings are organized in accordance with the review categories requested by MassDEP in the contract scope of work for this review.

3.2.1 Author Qualifications

The 2013 Full River Reconnaissance Report (FirstLight, 2014) provides a list of well-qualified individuals that had been approved by MassDEP for conducting the field surveys¹⁰. These individuals were employed at Cardno Entrix, NEE, Simons and Associates, and Gomez and Sullivan. In addition, the team included an independent geotechnical engineer (Kit Choi, PhD, P.E.).

⁹ Note to reader: This finding was made before the AIP and the Supplemental Study were issued. The Supplemental Study addresses this item by providing an evaluation of erosion rates under proposed operating conditions and by comparing the results to the existing condition results.

¹⁰ Study No. 3.1.1, Section 1 (Introduction), page 1-3.

The Original Study, (FirstLight, 2017a,b) was prepared by personnel employed at Cardno Entrix, Simons and Associates, Gomez and Sullivan, and the same geotechnical engineer.

The Supplemental Study (FirstLight, 2023) provides no information about the individuals who authored the report. The cover of the Supplemental Study indicates that two consulting companies, Gomez and Sullivan Engineers and Cardno (now Stantec), contributed to the report. Both firms were on the consultant teams that prepared earlier related reports (FirstLight, 2014, 2017a, b).

Based on the contents of the Supplemental Study, Inter-Fluve finds that there has been continuity in the consulting companies who have prepared the studies, but is unable to conclude that there has been continuity in advisory staff or project staff throughout the duration of the relicensing process.

3.2.2 Model Conception

The Supplemental Study appears to rely on the same geotechnical input, modeling methods, and assumptions as the Original Study and, therefore, exhibits the same limitations identified for the Original Study. The study methods and the study conclusions are based on many assumptions that are not explicitly stated and summarized. It is unclear whether the stated and unstated assumptions have been validated based on the information provided in the report. Even if the assumptions have been appropriately validated, the conclusions drawn are predictions that have yet to be affirmed.

The Supplemental Study does not indicate if or how the modeling procedure for the supplemental work may differ from or have evolved from the modeling procedure from the Original Study, and if or how that may affect results and interpretations. Furthermore, the report does not specify if the same version of each of the model software packages (e.g., HEC-RAS, River2D, BSTEM-Dynamic, HEC-ResSim) was used consistently throughout the study period; different versions can produce slightly different results and introduce an additional source of error into the calculations.

3.2.3 Model Inputs

Inter-Fluve offers the following comments with respect to model inputs.

- ▶ Manning's "n" values (i.e., values representing the roughness of the channel bed) can have a substantial effect on hydraulic calculations. Using Manning's "n" values to calibrate a model can mask limitations of the model.

The Original Study did not include a summary or comparison of the field-identified versus the calibration-tuned roughness values. The Original Study did not include a discussion of the appropriateness of the calibration-tuned values and the implications of using those values on the results and conclusions of the study.

The conclusions presented in the Original Study and the Supplemental Study rely heavily on the results of the BSTEM model. It is Inter-Fluve's opinion a systematic analysis and discussion of field-estimated versus calibrated Manning's "n" values and a corresponding

sensitivity analysis is necessary to identify potential model limitations. The findings of a sensitivity analysis could affect the study conclusions.

- ▶ The Supplemental Study indicates that, “Allowable deviations in flow stabilization” identified in FirstLight’s Agreement in Principle (AIP, 2022) were not simulated because of the inability to predict when these allowances would be invoked. The Supplemental Study states that deviations are only permitted to occur during up to 3% of the total hours of operation between April 1 and November 30 and claims that the contribution to erosion would be negligible and thus representation in the modeling is unnecessary. This claim represents an untested assumption that has not been quantified or discussed with respect to model results and study conclusions.
- ▶ The Supplemental Study indicates that comparative boat wave analyses were only performed for eight of the twenty-five detailed study sites, (i.e., eight sites where the Original Study concluded that boat waves contributed to erosion). The omission of the boat wave analyses at the remaining seventeen sites makes it impossible for the study to identify sites where boat wave erosion may become a problem under the proposed operating condition. Project operations may force boat waves into being an issue, and therefore this is an underrepresented potential project impact caused by superpositions of the forcing of water fluctuations and boat wakes.

3.2.4 Model Interpretations and Conclusions

The results of the supplemental BSTEM modeling are summarized in Table 3.1-1 of the Supplemental Study. FirstLight interprets these results to arrive at the stated conclusion that Project operations have minimal impact on bank erosion in the TFI. The following points summarize Inter-Fluve’s key findings with respect to FirstLight’s analyses.

- ▶ Notwithstanding other concerns outlined herein, the Supplemental Study indicates that Project operations will be a contributing cause of erosion over a substantial portion of the TFI (see Figure 3.2-2 in the Supplemental Study).
- ▶ The choice to omit boat wave modeling analyses and results at the majority of the detailed study sites is not adequately justified. Information presented in the Supplemental Study suggests that the superposition of boat waves and water level differences caused by Project operations will affect the elevation at which forces act on the bank profile and consequently, rates of bank erosion. By omitting the boat wave analyses, the study, as conducted, cannot identify sites where boat wave erosion may become a problem under the proposed operating condition. As a result of this omission, conclusions about the dominance of boat wave action in causing erosion are not adequately supported, and, therefore, extrapolation of these results along the entire TFI is not appropriate.

- ▶ The BSTEM model developed for the Original Study was calibrated to specific flow conditions (i.e., historical records from 2000 to 2014) that intended to represent the existing condition of the study area. The BSTEM model developed for the Supplemental Study incorporates flow conditions intended to represent the future proposed conditions as described in the AIP.

Table 3.1-1 in the Supplemental Study compares the model-predicted erosion rates for the existing and proposed conditions. Model results indicate that the changes to the project operations will affect (both positively and negatively) erosion rates at sixteen of the twenty-five detailed study sites. For any detailed study site where the model predicts a change in erosion rates, we must conclude that the model results support the conclusion that project operations affect erosion at that site. A positive sign indicates the models predict an increase in erosion rates caused by proposed project operations, a negative sign indicates the models predict a decrease in erosion rates caused by proposed project operations.

If all twenty-five sites are considered, three (11%) predict a reduction in erosion rate between the baseline and AIP scenarios, nine (36%) predict no change, and thirteen (52%) predict an increase in erosion. These results clearly suggest that the model predicts that a majority of the detailed study sites will experience an increase in erosion rates following the proposed changes (as modeled) in Project operations. See also Figure 3.1-1 in the Supplemental Study.

The finding that the proposed operations will result in increases in erosion becomes even stronger if sites where previous bank stabilization projects have been constructed are removed from the analysis. If sites with previous and effective bank stabilization projects (i.e., those with “post” in the transect name) are removed from consideration, then of the remaining eighteen sites, two (11%) predict a reduction in erosion rate between the baseline and AIP scenarios, five (28%) predict no change, and eleven (61%) predict an increase in erosion.

Furthermore, if sites with previous bank stabilization projects and sites where predicted erosion rates fall below the study author’s threshold for significance, (equal to or less than 0.16 ft³/ft/yr¹¹) are removed from the calculation (as may be the case at locations that have been intentionally stabilized or at locations with underlying bedrock), then of the remaining sixteen (erodible) sites, two (13%) predict a reduction, three (19%) predicted no change, and eleven (69%) predict an increase in erosion.

¹¹ The Original Study states that predicted erosion rates equal to or less than 0.16 ft³/ft/yr are considered insignificant because they are within the accuracy of the survey data used to calibrate the BSTEM model. This appears to be a limitation related to measurements, not model calculation tolerances. Neither the Original Study nor the Supplemental Study identifies the model calculation tolerance for any of the models. Neither study provides a quantitative or statistical analysis of model error associated with the study as a whole.

These results support the conclusion that proposed project operations, as defined in the AIP, and modeled in this effort, will increase erosion within the TFI at locations where the bank consists of erodible, un-stabilized material.

- ▶ The percentage contribution of each of the “dominant” and “contributing” causes was calculated for each site and then extrapolated to the entire TFI using the methodology described in Study 3.1.2. Generally, percent contribution results for a particular detailed study site were extrapolated to other river segments within the same hydraulic reach according to proximity (i.e., halfway upstream and halfway downstream to the next detailed study site). Summary statistics for the entire TFI were then computed. The extrapolation methodology, and thus summary statistics, may be problematic in that they rely solely on proximity and do not account for differences in land use or bank material properties, which the BSTEM modeling has shown to be an important factor in erosion rates.

4. Summary, Considerations, and Recommendations

4.1 SUMMARY

The Original Study and the Supplemental Study present an extensive body of work that was conceived and developed through collaborative processes (with opportunities for stakeholder input) and executed by competent professionals. The studies describe modeling efforts and analyses of hydrologic, hydraulic, and bank erosion conditions within the TFI and they represent a substantial effort that is a valuable resource to the relicensing process. However, the studies have some limitations with respect to providing reasonable assurance that the proposed relicensed operations will be conducted in a manner that will not violate Massachusetts Surface Water Quality Standards (314 CMR 4.00).

The studies are informative, but they are not necessarily definitive. The existing conditions model presented in the Original Study has been calibrated to represent a historical observed condition. The conclusions presented in the Supplemental Study are based on model predictions, not on observations. Until the model results have been validated through observation, the results and conclusions must be qualified as being predictions resulting from model simulations, not in-situ observation.

The studies, as designed, implemented, and described in the associated reports do not appear to address some items of specific interest to MassDEP relevant to the Water Quality Certification process. Neither the Original nor the Supplemental Study addresses the current or proposed impacts of project operations on the existing impairment to stream-side vegetative cover. Neither study addresses the current or the proposed impacts of bank erosion on turbidity, total suspended solids, and sediment within the TFI, or other qualitative and minimum water quality standards that fall under MassDEP’s regulatory purview.

Regardless of any model limitations, the results of the Supplemental Study indicate that proposed project operations are likely to increase the risk of erosion at 13 out of 25 detailed study sites. On this basis alone, future observations and a mitigation plan to address emerging conditions in the TFI would be prudent.

While future data collection and modeling work may be useful for the purpose of validating the models and affirming the conclusions drawn from the model results, the work may not provide answers to specific questions and concerns relevant to the MassDEP 401 Water Quality Certification within the appropriate licensing and permitting time frame.

4.2 ITEMS TO CONSIDER

- ▶ **With respect to the 401 WQC, impairments, and designated uses:** Neither the Original nor the Supplemental Study appear to address the current or the proposed project impacts of bank erosion on turbidity, total suspended solids, and sediment within the TFI – three consequences of bank erosion that impact or have the potential to impact designated uses of the affected reaches. Furthermore, the studies do not address the current or proposed impacts of project operations on the existing impairment to streamside vegetative cover.
- ▶ **With respect to a baseline condition for the purposes of compliance with the 401 Water Quality Certification:** the existing condition scenario, described in the Original Study, does not represent a condition free from the effects of existing project operations (e.g., Turners Falls Project Operations, Northfield Mountain Project Operations). This study design choice may limit the ability of the models, results, and interpretations to evaluate project performance with respect to the antidegradation provisions of the Massachusetts Surface Water Quality Standards (314 CMR 4.04), particularly 314 CMR 4.04(1) and (2), the protection and maintenance of the level of water quality necessary to protect existing and designated uses and high quality waters.
- ▶ **With respect to modeling limitations:** Some processes that affect bank erosion and post-event recovery do not appear to have been incorporated into the analytical models. These processes include, but are not limited to, vegetative recovery, seepage, piping, rotational failure, deposition, and ice effects. The Original and Supplemental Studies do not provide quantitative evidence to support omission of each of these processes from the studies. The relative contribution of these processes to bank erosion in the study area is not quantified.
- ▶ **With respect to model selection:** The Original Study was performed using standard and enhanced custom modeling tools available at the time. In the intervening years, the Army Corps of Engineers Hydraulic Research Center has improved the HEC-RAS software package to include 2-dimensional unsteady flow hydraulic modeling, RASMapper tools, and BSTEM modeling tools within an integrated calculation framework. These tools combine the capabilities of 1-dimensional and 2-dimensional unsteady flow hydraulic modeling and a

version of BSTEM. If the Project Proponents choose to continue to develop and validate the erosion model of the study area, they might consider adapting the models to an integrated computational framework if the adaptation would result in a better representation of processes affecting the study area and reduce or eliminate some potential sources of modeling error.

4.3 RECOMMENDATIONS

Inter-Fluve recognizes that the study period within the FERC Integrated Licensing Process is past and that FERC has noticed the projects as Ready for Environmental Analysis, so Inter-Fluve is not recommending that modeling or other analyses be re-done or revised at this point.

Inter-Fluve recommends that MassDEP request that the Project Proponents develop a Monitoring Plan to field-verify the assumptions and conclusions drawn in FirstLight's studies. Inter-Fluve recommends that MassDEP request that the project Proponents develop an Adaptive Management and/or Mitigation Plan that may be implemented if monitoring activities indicate that assumptions and conclusions are not fully supported by the data. The Adaptive Management and/or Mitigation Plan would provide a pathway and process for responding to impairments resulting from Project operations if/as they emerge during the licensing period.

Inter-Fluve recommends that MassDEP consider the following requirements in the water quality certification:

1. **Develop a Monitoring Plan** – a formal plan prepared in consultation with, and contingent upon approval by, MassDEP to monitor a representative set of stations for erosion, turbidity, and vegetative cover in critical zones. The monitoring program should begin with a comprehensive baseline survey of representative stations to form a basis for future comparisons. Periodic re-surveys (e.g., two- to five-year intervals) should be conducted to compare with the newly-established baseline for erosion and vegetative cover.

Given FirstLight's conclusion that high-flow events are the major cause of erosion, MassDEP may consider requiring monitoring of high-flow events to document their impacts. More specifically, high-flow event stations should be pre-determined so that when a high-flow event is forecast, FirstLight can survey the selected sites prior to the high-flow event and again immediately following the event to document the impact of the event. High-flow event monitoring could be conducted for a series of events over a range of high flows deemed by MassDEP to be representative of typical high flows in the Connecticut River. The high-flow event monitoring could serve to either validate FirstLight's conclusions or to identify sites where FirstLight's conclusions may not be supported by observational data.

MassDEP may also consider requiring continuous turbidity monitoring at selected representative near-shore sites just upstream and just downstream of locations identified as prone to erosion. Monitoring during 'typical' flows (e.g., non-spill conditions at the Vernon

Project and Turners Falls Project), as well as during high-flow events (i.e., with mutually agreeable definition of such), could provide useful information specifically relevant to the quantitative water quality standards.

2. **Develop a Mitigation/Adaptive Management Plan** – a formal plan prepared in consultation with, and contingent upon approval by, MassDEP to design and implement appropriate mitigation, where required by MassDEP, to explicitly describe an adaptive approach to address situations where monitoring data have not fully supported FirstLight’s conclusions on erosion, and to respond to emerging conditions through the new licensing period.

5. References

(AIP, 2022) Agreement in Principle to Develop a Relicensing Settlement Agreement, March 17, 2022. (Appendix A to Supplemental Study, 2023).

CN 568.1 Final Massachusetts Integrated List of Waters for the Clean Water Act 2022 Reporting Cycle. May, 2023.

CN 505.1 Appendix 15. Connecticut River Watershed Assessment Listing Decision Summary. Final Massachusetts Integrated List of Waters for the Clean Water Act 2018/2020 Reporting Cycle. November, 2021.

(FirstLight, 2013) *Simons & Associates, et al.* 2013. Revised Study Plan for the Turners Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485). Prepared for FirstLight, Northfield, MA.

(FirstLight, 2014) Relicensing Study No. 3.1.1, 2013 Reconnaissance, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889). Prepared for FirstLight, Northfield, MA. Prepared by Simons & Associates, Cardno, Gomez & Sullivan Engineers, New England Environmental, Inc., and Kit Choi, PE.

(FirstLight, 2015) *Gomez and Sullivan Engineers.* 2015. Relicensing Study No. 3.2.2 Hydraulic Study of Turners Falls Impoundment, Bypass Reach and Below Cabot, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889). Prepared for FirstLight, Northfield, MA.

(FirstLight, 2017a) Relicensing Study 3.1.2, Northfield Mountain/ Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889). Prepared by Simons & Associates, Cardno, Gomez & Sullivan Engineers, and Kit Choi, PhD, PE for FirstLight.

(FirstLight, 2017b) Relicensing Study 3.1.2, Northfield Mountain/ Turners Falls Operations Impact on Existing Erosion and Potential Bank Instability, Evaluating the Impact of Increasing Usable Storage Volume of the Upper Reservoir on Streambank Erosion in the Turners Falls Impoundment, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889). Prepared by Simons & Associates, Cardno, and Gomez & Sullivan Engineers for FirstLight.

(FirstLight, 2023) Supplemental BSTEM Modeling Report, Northfield Mountain Pumped Storage Project (No. 2485) and Turners Falls Hydroelectric Project (No. 1889). Prepared by Gomez & Sullivan Engineers for FirstLight. May, 2023.

(SA, 2023) 2023 Flows and Fish Passage Settlement Agreement Explanatory Statement, March 31, 2023. United States of America before the Federal Energy Regulatory Commission.