March 31, 2016
VIA ELECTRONIC FILING

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

Re: FirstLight Hydro Generating Company, FERC Project Nos. 2485 and 1889
March 16, 2016 Study Meeting Summary

Dear Secretary Bose:

Pursuant to the process plan and schedule issued on September 14, 2015 by the Federal Energy Regulatory Commission (FERC) (Process Plan), FirstLight Hydro Generating Company (FirstLight) filed thirteen study reports for the relicensing of its Turners Falls Hydroelectric Project (FERC No. 1889) and Northfield Mountain Pumped Storage Project (FERC No. 2485) on March 1, 2016. Pursuant to the Process Plan, on March 16, 2016, FirstLight held a meeting to discuss the study reports filed on March 1, 2016. Attached as Attachment A is FirstLight's meeting summary. Pursuant to the Process Plan, comments on the summary are due May 2, 2016.

In addition to the meeting summary, attached as Attachment B is the PowerPoint presentation made at the March 16 meeting. FirstLight is filing its meeting summary and PowerPoint presentation with the Commission electronically. To access the document on the FERC website (http://www.ferc.gov), go to the "eLibrary" link, and enter the docket number, P-1889 or P-2485, to access the document. FirstLight is also making the same available for download at the following website: http://www.northfieldrelicensing.com.

Sincerely,

Gus Bakas

Attachment A: Meeting Summary
Attachment B: PowerPoint Presentation

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ATTACHMENT A: MEETING SUMMARY

Location: Northampton Hotel, Northampton, MA

Date: March 16, 2016

Attendance:

Patrick Crile (via phone) – FERC	Paul Ducheney – Holyoke Gas & Electric	Mike Swiger – Van Ness Feldman
John Baummer (via phone) – FERC	Norm Sims – AMC	Julia Wood – Van Ness Feldman
Nick Ettema (via phone) – FERC	Bob Nasdor – AW	Sarah Verville – TRC Solutions
Brandon Cherry – FERC	Tom Miner – CRWC/FRCOG	Wendy Bley – TRC Solutions
Steve Kartalia – FERC	Jen Griffen (via phone) – TransCanada	Ethan Nedeau – Biodiversity
Bill Connelly – FERC	John Ragonese – TransCanada	Chris Tomichek – Kleinschmidt Associates
Brett Towler – USFWS	Don Pugh	Kevin Nebiolo – Kleinschmidt Associates
Melissa Grader – USFWS	Karl Meyer	Brandon Kulik (via phone) – Kleinschmidt Associates
John Warner – USFWS	Andrea Donlon – CRWC	Steve Knapp (via phone) – Kleinschmidt Associates
Alex Haro – USGS-Conte Lab	Katie Kennedy – TNC	Tom Sullivan – Gomez and Sullivan Engineers
Micah Kieffer – USGS-Conte Lab	Bob Flaherty – WHMP 96.9	Jason George – Gomez and Sullivan Engineers
Bjorn Lake – NOAA	Jim Donohue – FirstLight	Gary Lemay – Gomez and Sullivan Engineers
Bill McDavitt – NOAA	Gus Bakas – FirstLight	Ian Kiraly (via phone) – Gomez and Sullivan Engineers
John Nagle – US EPA Region 1	Doug Bennett – FirstLight	Matt Denno (via phone) – Gomez and Sullivan Engineers
Kevin Mendik (via phone) – NPS	Joe Lucas – FirstLight	Kevin Miller (via phone) – Gomez and Sullivan Engineers
Caleb Slater – MADFW	John Shue – FirstLight	Mark Wamser – Gomez and Sullivan Engineers
Jessie Leddick – MADFW	Carol Churchill – FirstLight	
Robert Kubit – MADEP	Marc Silver – FirstLight	

Introductions, Meeting Purpose, and Process Timeline

In advance of the meeting, the PowerPoint presentation was posted to the FirstLight website and stakeholders were notified accordingly. The PowerPoint presentation is attached as Attachment B.

Mark Wamser (Gomez and Sullivan) opened the meeting and welcomed everyone. Mark asked everyone to introduce themselves, and reminded everyone that John Howard of FirstLight had taken a new overseas assignment, and that Jim Donohue had stepped in to lead the relicensing effort for FirstLight. Mark noted that there were lots of studies to cover in a single day, and that he was going to make an effort to stick to the agenda, even if it meant limiting questions and discussion to a degree. He also noted that the only studies being discussed were the 13 studies that were filed with FERC on March 1, 2016. He reminded folks that many of these studies had been posted to the relicensing website for review long before they were officially filed with FERC. He also reminded attendees that the final license application (FLA) was scheduled to be filed with FERC by April 30, 2016.

During introductions, John Shue (FirstLight) took the opportunity to update the group on the status of the project sale. He noted that the sale was part of a larger divestiture of GDF assets in North America. He told the group that while the project sale is not final, the new owner, PSP Investments, does not anticipate changing direction on the relicensing effort, or making changes to the relicensing team.

Don Pugh asked a question about the schedule for the next round of study reports. He noted that the schedule he saw showed studies being filed October 14, 2016, with a meeting 4 days later, which would put the meeting on a weekend. Mike Swiger (Van Ness Feldman) noted that the studies would be filed October 14, 2016, but would generally be available on the relicensing website for review before that. Brandon Cherry (FERC) explained that FERC is reviewing the schedule proposed by FirstLight, and that FERC will issue a revised study process plan in April 2016. He noted that the process plan will clarify the relicensing schedule going forward. He also reassured the group that there will be an opportunity for agencies and stakeholders to comment on the need for "2nd year studies" and for FERC to make a determination on need for such "2nd year studies".

With that, Mark introduced Chris Tomichek (Kleinschmidt) as the first study presenter.

3.3.4 – Evaluate Upstream Passage of American Eel (Tomichek)

Chris Tomichek reviewed the eel study reminding the group that this was a 2-year study that was conducted in 2014-2015. She noted that the work in 2014 focused on identifying potential yellow eel recruitment and passage locations to determine the best sites for eel traps. In 2015, after a site visit with the agencies, eel traps were located at the Spillway ladder, Cabot ladder, and the Cabot emergency spillway gate. Also, a medusa trap was located in the Station No. 1 tailrace.

Chris reviewed the results of the 2014 observations, reminding the group that most eels were observed in the Spillway ladder area, and a few in the emergency gate spillway area. She showed a plot summarizing the 2014 eel observation; the peak of the run occurred in mid-July. Chris then reviewed the results of the 2015 temporary eel traps. She noted that 5,972 eels were collected in the traps between July 9, 2015 and November 2, 2015. Most were collected at the Spillway ladder (87.7%), while 7.1% were collected at the emergency spillway, and 5.2% at the Cabot ladder. Chris noted that no eels were captured in the Station No. 1 medusa trap. Finally, Chris showed a plot of the length of eels collected, noting that most (97.1%) were in the 10-20 cm length range. Chris then described that as part of the study they had evaluated the effects of project operational conditions on eel collection rates. She noted that there was no significant correlation found between eel collection rates and precipitation, river flow, or spill. She also noted that they had found no correlation between moon phase and collection rates. She summarized the study conclusions, and noted that

the only variance to the study was the angle of one of the eel trap ramps, which had been discussed with the agencies.

Andrea Donlon (CRWC) asked why Cabot lower gate wasn't a good place for an eel ramp. Chris explained that the location of the ramps was determined during on-site consultation with stakeholders. Don Pugh wondered about the conclusion in the report that Turners Falls dam operation and associated spillage does not affect collection rates at the Spillway ladder ramp. He noted that most of the spill in 2015 occurred early in the season before the peak of the eel movement, and that eel capture was light after spill occurred again in October. Alex Haro (USGS) asked Chris about the consistency of the 1 foot differential between attraction flows for spillway and gatehouse ladder was that consistent throughout. Joe Lucas (FirstLight) and Chris explained that the differential was maintained. Alex also asked if Kleinschmidt had checked for and/or observed any eels at the top of the Cabot fish ladder at the shut-off gate. Chris said she thinks Bryan Apell had checked that location, but would have to check with him to see what he had observed. Alex commented that the percentage of small eels (<10 cm) observed at this project is less than the portion of small eels at Holyoke. [*After the meeting, Chris Tomichek checked with Bryan Apell who indicated the shutoff valve was checked once during the study period and no eel were observed; however the observation (~2130 hr) was made late in the season when recruitment was relatively low*.] Alex explained that it's possible that the size of the Milieu eel ramp substrate used at Turners Falls may have resulted in the collected of larger eels. However, he noted that Kleinschmidt had followed the agreed upon protocol.

3.3.6 – Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects
(Tomichek and Nebiolo)

Chris Tomichek (Kleinschmidt) presented an overview of the shad spawning study, reminding the stakeholders that the study was done in two phases. She reviewed work completed under each of the phases; noting that phase 1 was used to identify areas utilized by shad for spawning, and that phase 2 was used to further identify spawning areas and to evaluate the effect of project operations on observed spawning below Cabot. Chris showed a map of the Project showing the location of the observed spawning areas downstream of Cabot Station and in the Turners Falls Impoundment (TFI). She reminded stakeholders that shad spawning areas were identified based on observed surface activity and splashing in 15 minute intervals. She noted that in the TFI, spawning was only observed in an approximate 39 acre area at the upper end of the TFI, in the vicinity of Stebbins Island. Chris asked if there were any questions about the spawning location identification portion of the study. In response to several questions, Chris reiterated that the efforts to identify shad spawning activity had been intensive, with searches occurring between May 26-June 22, 2015, 3 nights per week, from before sunset to 1:00 AM in the morning. In response to a question from Karl Meyer regarding spawning in the bypass reach, she noted that they had found some spawning in the Rock Dam pool, which had been searched on foot. Karl Meyer questioned whether the pool above Rock Dam had been searched, to which Chris responded that she would check to confirm the location of the Rock Dam pool and what was observed.

Chris then turned the presentation over to Kevin Nebiolo (Kleinschmidt) to describe the work that was done to evaluate the effect of Cabot Station operation on downstream spawning activity. Kevin explained that they had statistically evaluated the relationship between observed spawning activity (in 15 minute intervals) and changes (both up by increasing generation and down by reducing generation) in Cabot Station unit operation. He described the statistical tests, including regression analysis and a negative binomial test. He indicated that

the results of the statistical tests showed no significant relationship between changes in project operations (unit operation) and observed spawning activity. He noted that temporally, peak spawning activity was right at dusk, and then declined after sunset. For this reason, he explained that some changes in observed spawning activity might be related to timing of spawning rather than changes in project operation. Don Pugh asked a clarifying question about photoperiod regression analysis, and Kevin reiterated that there is temporal effect, but other variables may be affecting. In response to a question from Bill Connelly (FERC) about potential auto-correlation, Kevin explained the spawning locations that were used in the statistical analysis and that the observations at a site were compared before and after the change in operation.

Kevin then explained that they used water surface elevation data to look at potential spawning habitat loss. He described and showed an example habitat duration curve based on the water surface elevations at one site. He noted that based on the habitat duration analysis, it was found that 10% of the spawning area is impacted by changes in project operations. John Warner (USFWS) asked Kevin if they had developed a habitat duration plot for each spawning site. Kevin said they had. John Warner also asked if the water surface elevations used for the analysis were based on modeled data for a single year, or for a multi-year period. Kevin said he wasn't sure, but would check to find out and get back to John with that answer. [*After the meeting, Mark Wamser looked into this further. The water surface elevations used in the analysis are based on the study period – May 13 to June 22, 2015. The WSELs are based on the hydraulic model developed for the reach below Cabot Station, which produced hourly WSELs. These WSEL's were then used in the duration analysis*]. John then pointed out that since the question to be answered by the study was a shad spawning issue rather than an egg deposition issue, he thought that the analysis should look at available spawning habitat (based on a spawning water depth of 5.5 ft) rather than exposure of river bed, as loss of habitat. John also noted that the study only looked at observed spawning sites, not the entire river. Returning to the earlier discussion of observed spawning in the bypass reach, John noted that while safety was a consideration, and that the bypass reach was a challenging place to access, he believes there are some paths down to bypass, and that more of the bypass is reachable on foot than just the Rock Dam pool area that was surveyed. He also noted that absent any real data about spawning in the bypass reach, USFWS will have to rely on the IFIM results to evaluate spawning habitat in that reach. Chris responded that they had surveyed the area of the bypass reach indicated in the study plan. This led to a question about whether falling water at Rock Dam affected the field crew's ability to hear splashing spawning activity in the pool and further discussion about how frequently the Rock Dam site was visited and what was observed. Chris reiterated that she thought the Rock Dam site was visited several times, but that field crews only saw spawning activity on the last night of the sampling.

In response to Kevin asking if there were further questions, Bill Connelly (FERC) asked a clarifying question about the habitat duration plot. Don Pugh asked about the connectivity of the spawning sites and why and how the spawning sites identified in phase 1 were different from those observed in phase 2. Chris explained that the sites changed a little bit between phase 1 and 2 work, and that new sites were added as more spawning were observed over the course of the study. Andrea Donlon (CRWC) asked about spawning sites in the TFI, which prompted some discussion about how TFI sites were located and delineated. Melissa Grader (USFWS) noted that the example water surface elevation plot shown in the presentation looks like it has a higher rate of change (about a 10 foot fluctuation) in water surface elevation than seen elsewhere. Mark Wamser agreed, and noted that might be due to the "tight" nature of that particular river cross section, but he said Gomez and Sullivan would look into this question. **[***After the meeting, Mark Wamser looked into this further—specifically the cross-section plot showing the water surface elevation at Spawning Site 9 under the minimum, maximum*

and median elevations (Slide 22). The minimum, maximum and median elevations shown on the plot are based on the hydraulic model for the reach below Cabot Station. The hydraulic model was operated in an unsteady mode (hourly time step) to simulate the actual conditions only during the survey period from May 13 to June 22, 2015. The flow, as recorded at the Montague USGS Gage during this period, varied from a low of approximately 3,180 cfs to a high of 39,300 cfs. Thus the maximum and minimum maximum WSEL shown on the figure is based on a flow of approximately 39,300 cfs and 3,180 cfs, respectively, hence the reason for the approximate 10 foot difference.]

3.3.20 – Study to Evaluate Entrainment of Ichthyoplankton at the Northfield Mountain Pumped Storage Project (Tomichek and Nebiolo)

Chris introduced the ichthyoplankton study and reviewed the study objectives. She described how the Northfield Mountain entrainment sampling was conducted, including efforts to demonstrate that the sampling water was similar to water in front of intakes. She also described the QA/QC process used. In response to a question about testing 3 units of operation rather than 4 (since one unit was out of service), Chris reminded the group that the 3 versus 4 unit issue was related to the juvenile shad study, not the ichthyoplankton study. Chris summarized the findings indicating that shad densities in the entrainment samples were low. Based on the total volume of water pumped over the entire spawning season, it was estimated that 3 million shad eggs and 500,000 shad larvae were entrained at Northfield Mountain in 2015. Chris explained that while those sound like big numbers, when they are converted to juvenile and adult equivalents, that equates to 696 juveniles and 94 adult American shad entrained.

Melissa Grader (USFWS) noted that a 1992 study estimated over a million eggs and 3,000,000 larvae entrained, and asked Chris what might account for the difference. Chris indicated that she was aware of those earlier study results, but could not explain the difference. However, she did note that the earlier study did not actually sample the pumped water the way the 2015 study did, so the sampling technique might explain some of the difference. Andrea Donlon noted that the shad spawning study had found peak spawning activity to occur between mid-May and mid-June, but that the entrainment study did not begin until late June. She asked if the study estimates accounted for potential entrainment earlier in May. If not, she suggested that the study estimates might be low, since they may have missed the peak of the spawning season. Kevin Nebiolo acknowledged that they did not have entrainment samples from earlier in May, so they were unable to estimate entrainment rates before May 28. In response to a clarifying question from Don Pugh, Kevin explained again the method used to extrapolate the season-long entrainment estimates for eggs and larvae, noting that in general they used samples to develop an entrainment rate, by volume, for the week, and then summed the total based on the volume of water being pumped each day (total volume of water). Don asked if the entrainment rates/counts can be transferred to a "normal" year. Chris indicated this could be done, but reminded stakeholders that it would tricky, since the actual study looked at entrainment rates for different operating scenarios (1, 2, 3 and 4 unit pump rates). Don Pugh noted again that since the study did not produce entrainment rates/counts for the spawning season prior to May 28, he wasn't sure why the season-long entrainment total is not underestimated, since the weeks prior to May 28 were not accounted for.

Andrea Donlon asked why the ichthyoplankton entrainment sampling was delayed until May 28. Chris noted the delay was caused by a delay in getting a chemical hood installed in the powerhouse which was necessary for working with formaldehyde. Andrea Donlon asked a final question about whether there is any shad spawn in tributaries to the TFI. Chris noted that there may be some spawning in the tributaries.

3.3.11 – Fish Assemblage (Kulik, via phone)

Brandon Kulik (Kleinschmidt) gave an overview of the fish assemblage study. He described the objectives, and then reviewed the sampling periods and methods used for sampling both the TFI and the bypass reach. Brandon then summarized the study findings. He noted that the study resulted in the collection of 5,908 fish, representing 28 species. In the TFI, he explained there are basically three reaches based on habitat type, the riverine upper TFI, the more lentic lower TFI, and the middle TFI which serves as a transition zone between riverine and more lentic conditions. He presented the fish species findings for the entire TFI, on a seasonal basis, noting that in the summer the catch was dominated by spottail shiner, smallmouth bass and yellow perch. Spatially, the upper TFI supported greater numbers of smallmouth bass, fallfish, rock bass, tessellated darter and American eel, while bluegill, pumpkinseed, largemouth bass, banded killifish, white sucker and yellow perch were in greater abundance in the lower TFI. In the bypass reach, samples were dominated by smallmouth bass, American eel and bluegill. Brandon then reviewed community diversity results which showed that the diversity of the fish assemblage is somewhat greater in the upper TFI then declines as one moves to lower TFI. Conversely, he noted that catch per unit effort (CPUE) actually was greater in the lower TFI, and declined moving upstream. Finally, Brandon reviewed the 2015 study results with earlier sampling of fish at the project in 2008 and 1978. Overall, the present study found 28 species, while past surveys found 19-22 species. In terms of species composition, he showed tables comparing the dominant species found in 2015 with those found in the earlier studies. In the TFI, the comparisons show that four (4) of the six (6) most dominant species remained the same from 1978 and 2008 to 2015. He noted that young-of-the-year (YOY) of anadromous species were among the six (6) most dominant species in both the 2008 and 2015, while they were absent in the 1978 survey. He opined that this was probably a result of the fact that fishways had not yet been built on the Connecticut River in 1978, so anadromous fish had no access to Turners Falls Project waters at that time.

Karl Meyer asked a question about sampling around the Rock Dam area of the bypass reach. He wondered why the pool upstream of Rock Dam was sampled, but the pool downstream was not. Brandon indicated that the sampling was limited by their collection permit which did not allow fish sampling below Rock Dam. After some general discussion about this issue, Bill McDavitt (NMFS) explained that the collection permit had been issued by NMFS after conferring with FirstLight on the study needs. Katie Kennedy (TNC) asked how the habitat analysis scores and ratings (e.g., rich, poor, etc.) were developed and if that information was available in the report. Brandon explained that the QHEI habitat scores are broken down and provided in tables in the study report. Brandon also described how they attempted to compare similar habitat types, noting that some areas didn't meet IBI criteria, but that efforts were made to sample the two different habitat types equally. Katie hoped that the study had sampled both rich and poor habitats. However, she noted that she did not see a table of habitat scores in the report. Brandon clarified that the individual habitat criteria scores for each site are on the field data sheets, not tabulated in the report. Brandon indicated that the field data sheets with the individual habitat scores could be provided in an excel spreadsheet.

10 minute break.

3.2.1 – Water Quality Monitoring Study (George)

Jason George (Gomez and Sullivan) updated the group on the water quality monitoring study. He reviewed the study objectives, and explained that the focus of the study was on temperature and dissolved oxygen (DO) conditions in the TFI, bypass reach, power canal and below Cabot Station. He noted that there were 18

DO/temperature continuous monitoring sites, and that monitoring began in April and continued through mid-November, 2015. He said, per the RSP, they started in April by monitoring water temperature, and that DO monitoring began in mid-May for most sites once flows subsided and continued through September. The installation of the water temperature/DO monitor at Site 7 (TFI boat barrier) was delayed due to ice cover but was installed by mid-May. Jason showed a map of the monitoring sites. Regarding overall conditions for the sampling period, Jason explained that in 2015, May was warm and dry, June was wetter and cooler, and July through September generally had a low flow and was warm.

Jason then summarized the results of the study. Overall, he said the study found the TFI to be well mixed, with no evidence of thermal stratification, and no significant changes in DO from top to bottom of the water column, across the entire sampling period. He showed representative vertical DO and temperature profiles of the TFI across the entire sampling season. He pointed out that all the DO data collected was above the state standards of 5 mg/l, and that the highest temperature measured was 28.1°C. He also showed a plot of monthly average, minimum, and maximum DO concentrations for all of the sampling stations. Jason went on to describe study efforts to examine any observable effects on DO or temperature associated with Project operations, including operation of the Vernon Project, Northfield Mountain, and the Turners Falls Project. In the TFI, Jason showed some sample plots of temperature and DO at the TFI monitoring stations in relation to periods of Vernon Project operations (discharge in cfs) and Northfield Mountain operations (pump-back or discharge in cfs). He noted that the sample plot was representative of what was observed over the entire season, and showed no discernible relationship between DO or temperature conditions in response to changes in Vernon and/or Northfield Mountain operating conditions. Jason showed similar plots of DO and temperature over time in the bypass reach in relation to spillage at Turners Falls Dam and operation of Station No. 1. He noted that this comparison suggested that some spill events produce an increase in bypass reach DO of 1-2 mg/l. He also noted that later in summer, there were some brief periods of super-saturation that occurred during periods of spillage. Finally, Jason showed the results of similar comparisons of downstream DO and temperature conditions in relation to Cabot Station operations. For both DO and temperature, Jason noted that there was no discernable pattern of effect of Cabot Station operations. He did note that on one occasion DO in the bypass reach dropped noticeably just after the Station No. 1 units came on line, but that this was an isolated occurrence. Jason presented the results of the water temperature rate of change analysis using data from monitoring sites downstream of Cabot Station. Jason explained that, based on data from periods when Cabot Station was operating, versus periods when Cabot Station was idle, there were no discernable differences in water temperature rate of change.

Jason concluded the presentation by summarizing the results of the study, noting again that the results showed that the TFI did not stratify in 2015, even though temperature and flow conditions were generally typical during the summer and fall months. He also noted again that all Massachusetts water quality standards were met, and that operation of the Vernon Project, Northfield Mountain, Station No. 1 and Cabot Station appeared to have little or no effect on temperature or DO conditions in the respective downstream waters.

Melissa Grader (USFWS) noted that the entrainment study had a DO measurement of 4.8 mg/l. Jason reminded Melissa that the entrainment study measurement was taken within the powerhouse, and would not be reflective of TFI conditions. Melissa also asked about why some of the vertical measurements ended at a different depth (up to 5 meter difference) at the same station on some days as others. Jason explained that it could be a result of needing to use the back-up meter (which had a shorter cable on the probe), or just due to boat movement across variations in the bathymetry at the site which resulted in small differences in depth even

at the same general sampling location. Melissa then commented that despite the study results, it was hard to fathom that the TFI does not stratify in some of the deep TFI locations. She asked if Jason thought the lack of stratification was due to Northfield Mountain operations. Jason opined that he did not think that it was Northfield Mountain operations that prevent stratification, but that it is likely that flow has something to do with it. This led to further speculation from the group about why the TFI does not stratify. John Baummer (FERC) asked about water temperatures in the Northfield Mountain Upper Reservoir, to which Jason replied that there were no water quality monitoring sites in the Upper Reservoir. John Baummer also asked if there is a flow gage on the Fall River, to which Jason responded no. In response to a question about the availability of the raw water quality data, Jason said it could be provided, but that they would need to figure out how best to share the data. It was suggested that it would be good to put the data on the Northfield Mountain website.

3.3.12 – Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station (George and Kiraly**)**

Jason George (Gomez and Sullivan) explained that Ian Kiraly (Gomez and Sullivan) was on the phone to help review the study and that Gary Lemay (Gomez and Sullivan) who did the hydraulic modeling was available to answer questions as well. Ian began the study presentation with a review of the study objectives and some study area photos reminding stakeholders of the configuration of the emergency spillway gate structure, log sluice, and downstream sturgeon spawning and rearing habitat areas. He next reviewed the methods explaining that flow and flow frequency from the spillway gates was analyzed to determine which flows are most common through the gates and what other conditions are present during different spill flows. He explained that flow velocities and shear stress were determined from the River2D hydraulic model that was developed as part of Study 3.3.1 (IFIM Study), and that the potential for sediment mobilization was evaluated from relative shear stress (RSS), whereby a calculated RSS value of 1=50% chance of particle mobilization. Ian then characterized the primary findings with respect to emergency spillway flows. First, he showed a slide summarizing log sluice operations, noting that for most of the study period, the log sluice is operated as downstream fish passage with a flow of ~ 219 cfs. On rare occasions flows through the log sluice are increased to the 500-750 cfs or 1,000-1,500 cfs for debris sluice operations.

Ian then summarized the overall findings with respect to flow and flow frequency from the emergency spillway gates. He explained that most of the releases were a high frequency of low flows at the spillway, likely due to keeping a gate open for ice and debris. He noted that there was a low frequency of flows >1,500 cfs, and that events with flow >1,500 cfs occurred during a range of bypass flows, but primarily during moderate to high generation at Cabot Station. He also noted that spill flow >1,500 cfs had a median duration of 0.92 hours. Finally he noted that spillway discharges were only greater than 5,000 cfs when more than four gates were open. Next, Ian showed a series of slides showing the hydraulic modeling results with respect to velocity, shear stress and relative shear stress under a variety of spillway operations, Cabot Station operations, and bypass flow conditions. He noted that each operational and bypass flow condition scenario was compared to the baseline condition. In terms of results, Ian explained that of the scenarios modeled, there are many that produce RSS conditions under which substrate mobilization could occur. He noted that based on these results, it is likely that sand mobilization is common and doesn't only occur during emergency spillway operation.

Ian summarized the study conclusions with respect to velocity, sediment mobilization potential and sediment deposition potential. Regarding velocity, Ian noted that discharge from the emergency spillway can increase

velocities in the sturgeon spawning area, but that the location of the high velocity areas depends on Cabot Station generation and bypass flow conditions. He noted also that many areas within the sturgeon spawning area could still be suitable for spawning. Regarding the potential for sediment mobilization, the findings show that emergency spillway discharge does have the potential to mobilize sand under a variety of operational and flow conditions, but that substrate mobilization potential of gate flow releases appear similar to common springtime bypass reach flows (10,000-20,000 cfs).

Bob Nasdor (AW) noted that the River2D model scenarios evaluated bypass flow of 1,500 cfs, and asked if bypass flows of 2,500 or 3,500 cfs were examined as well. Ian explained that they did look at some 2,500 cfs bypass flow scenarios. Bob then asked if the results suggested any benefits to habitat associated from going from a 1,500 to a 2,500 cfs bypass flow. Ian responded that there was no 1,500 cfs bypass flow scenario modeled and a direct comparison was not made. Following up on a comment made by Ian at the outset of the presentation about historic versus more recent operation of the emergency spillway, Micah Kieffer (USGS) asked a question about what is meant by "antiquated operations", what historic spillway operations were like, and whether those old operational protocols would happen again. Jason explained that in the past FirstLight had opened the emergency spillway gates for reasons other than emergency conditions. This led to a brief discussion about historic versus current emergency spillway operation, and a general acknowledgement that under today's operation, emergency spillway operations are generally confined to large quick releases of flow that are triggered by high canal levels; and that such events don't last long. Micah explained that in his mind, the greatest impacts to organisms and habitat downstream of the emergency spillway occur during spill events that happen during low flow periods. He suggested that the study should focus on potential impacts to habitat from emergency spills during really low flow periods. Micah would like a scenario of 500 cfs in the bypass, 200 cfs in the Deerfield, 1,433 cfs from Cabot, with 5,000 and 8,000 cfs emergency spillway flows modeled. It was noted by Doug Bennett, Operations Manager, however, that such a scenario was unrealistic and would never happen. It was also noted that the study showed that emergency spillway use is more likely to occur during higher flow periods. After further discussion about the potential for emergency spillway releases during periods of low flow, Jason indicated that they could potentially evaluate periods of low river flows, and when and how frequently emergency spillway gates were operated during those periods. Micah indicated that with the explanation about the high emergency spillway flows occurring during periods of very low flow, that he is satisfied that no such model run needs to be done. Jason also reminded everyone that the bypass reach IFIM study will examine flow/habitat impacts. Karl Meyer noted that sturgeon move upstream of the spawning area and could be impacted by dewatering of the bypass reach. Bjorn Lake (NOAA) suggested that perhaps flows from the emergency spillway should be constrained by the flow duration curve when sturgeon are in the area. He also asked if the study had considered using CFD or 3D modeling to get a better estimate of bed-shear. In response Gary Lemay (Gomez and Sullivan) indicated that they had not, but noted that although the River2D model was calibrated on a depth-averaged basis, given the number of scenarios that were modeled (and therefore the number of model runs needed), it wasn't practical to use a CFD model. This led to further discussion about the possible use of the 3D model for this study which concluded with Tom Sullivan (Gomez and Sullivan) pointing out that the while the 3D model may be a bit more accurate, the 2D model produces conservative results, since it is likely that the mid-depth velocities are greater than the near-bottom velocities. Gary Lemay also pointed out that most of this river reach of interest is shallow, and therefore, using a depth average model is probably a reasonable approach.

Finally, in response to a question from Andrea Donlon, Ian explained that they did not look at operational conditions where total discharges were less than 1,500 cfs. Ian indicated that they had not evaluated anything less than 1,500 cfs.

Lunch

3.3.8 – Computational Fluid Dynamics (CFD) Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays (Lemay and Denno)

Gary Lemay (Gomez and Sullivan) provided an overview of the results of the CFD modeling effort. He began by reviewing the study objectives, and the variances from the original study plan. He noted that despite the variances they were still able to achieve the study objectives. He explained that the study focused on describing the hydraulics within the study areas (sites) and noted that the hydraulic results would be used later to evaluate effects on fish, when fish passage data are more complete.

He reminded the stakeholders that the CFD modeling was done in four specific zones: Station No. 1 forebay; Cabot Station forebay; the Spillway Ladder; and the Cabot Ladder. He reviewed data collection and model development methods, noting that the CFD model development included verifications runs.

Matt Denno (Gomez and Sullivan, on phone) reviewed the field data collection methods used for the CFD model development, noting that topographic, bathymetric, and velocity data were collected using an Acoustic Doppler Current Profiler (ADCP) unit. He also reviewed the CAD geometry development for each of the CFD models and provided an example result from a verification run where they compared model output with field data to see how well it was modeled. Matt noted that the example shown demonstrates that model does a good job of representing field conditions. He explained that similar verification runs were conducted for all 4 models. Next, Matt showed several examples of model output including a plan view of velocity vectors along transects in front of Cabot Station; and a plan view of flow around and downstream from Cabot Station.

Brett Towler (USFWS) wondered why the models were verified but not calibrated, and why there was no roughness coefficient in the model. Gary explained that they had looked at some other CFD modeling studies conducted at hydro projects and for the most part none of those studies included even model verification. So, the verification conducted for these models was an extra step and more than is typically done. Gary also noted that the verifications were close enough that they really didn't need to calibrate anything. He also noted that the ability to change the roughness coefficient in the model is limited, as there is a single roughness coefficient for the entire model. Gary reiterated that the models seemed reasonably close in verification, and therefore they did not think they needed to change the roughness coefficient. Brett then asked if the models had been verified to water surface elevation and average channel velocity. Gary explained that the verification was primarily a visual comparison of data plots (actual versus modeled), and somewhat qualitative in nature. Brett then asked Gary if fishway and fishway entrance conditions had been modeled and if he could talk about boundary conditions at the Cabot fishway entrance. Brett noted that the fishway was designed for an 8 fps condition at entrances. Gary explained that the CFD model used a fixed flow going through the fishway in order to simplify the model. He explained that for this study, the intent wasn't to model fishway entrance velocity, and therefore the model has a simplistic representation of fishway entrances, but acknowledged that at some point CFD modeling could be used collaboratively to look closer at planned fishway entrance conditions.

Bill McDavitt (NMFS) asked Gary how the boundary conditions for Bascule Gate 1 were modeled. Gary acknowledged that this was a tricky area and explained that he had developed a more detailed sub-model for the bascule gate, and then put it back into the larger model. Bjorn Lake asked a question regarding velocities in front of the intake racks, and how that was modeled. Matt Denno responded to this question by returning to the model output slide showing the Station No. 1 intake rack. He explained that they had pulled out velocity data from a plane 6 inches in front of the rack, on a 1 foot grid, and used that data to calculate normal and sweeping velocities. Bjorn asked how this analysis could be improved going forward. Matt Denno responded that he thinks the approach they used does a pretty good job of evaluating conditions in front of the rack. Bjorn pointed out that because there is not a uniform flow field there are multi-directional cues to fish. Matt Denno suggested that perhaps CFD modeling results could be considered with the results of some of other fish studies to see if there are these effects. Gary Lemay noted that there is not a lot of precedent with other FERC hydropower relicensing studies that cover this ground, but that this might be a technical discussion in the future. Don Pugh asked if velocities in front of the Station No. 1 intakes are similar regardless of the flow through the canals. Matt Denno responded that for the two examples Don asked about, the velocities are similar. Brett Towler asked Gary if he could provide a clip of data (6 inches in front of the rack), if it were requested. Gary indicated that he could. Don Pugh then asked about next steps. Tom Sullivan explained that now that the CFD models are done, the models can be used to evaluate alternatives once the fish telemetry data is available.

3.3.9 – Two Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace (Miller and George)

Kevin Miller (Gomez and Sullivan, on phone) began by reviewing the study objectives for the River2D modeling effort, as well as study variances. He then described the model development and calibration, and explained how the River2D model would be used in conjunction with some of the other fish studies to evaluate the effect of project operations on migratory fish movement. He noted, however, that as part of this study they did look at modeled velocity data with respect to fish swim speeds to consider the potential for velocity barriers and entrainment potential. Kevin then described that there were 60 project operational scenarios modeled (combinations of various river flows, Northfield Mountain operations, and water surface elevations at the Turners Falls dam). He showed several slides of example model scenario results. He noted that separate maps of water surface elevation, velocity and water depth for each scenario were developed and included in the report, for a total of 300 maps.

Jason George (Gomez and Sullivan) then discussed the model results relative to migratory fish. He noted that the fish telemetry data is needed in order to fully evaluate what is going on, but that as part of this study they did look at potential velocity barriers. He explained that the analysis indicated that the French King Gorge area of the TFI exhibits high velocities under high flows, and may create some areas of velocity barriers. He also explained that they had evaluated the potential for flow reversal associated with Northfield Mountain operations, and noted that during pumping flow reversals may occur downstream of Northfield Mountain, and during generating, flow reversals may occur upstream of the station. He reiterated that once actual fish behavior information is available, they will be able to use the model information to evaluate what is occurring relative to actual migratory fish movement.

Brett Towler commented that the River2D model will be used to evaluate the fish telemetry studies, so be aware that the model looks at depth-averaged velocities when considering where the fish are in the water column. Andrea Donlon asked how certain areas got labeled as eddies when other areas that may have eddy-like character did not. She wondered what criteria were used to determine which are eddies or not. She identified Appendix B, Scenario 4, Map B as an example. Mark Wamser indicated that he would look at the maps with Andrea to see what she was asking about, but suggested that it could just be how the GIS base maps were labeled. [*After the meeting, Mark Wamser clarified that Andrea was referring to Table 7.1.2-1 through 7.1.2-4 which denotes "eddies" for some of the modeled scenarios (not a label on the velocity maps). The "eddies" listed in Table 7.1.2-1 through 7.1.2-4 were based on a visual observation of the velocity maps and not on a quantitative analysis*]. Andrea also noted that while the primary use of the 2D model will be to evaluate fish movement, she noted that conditions such as flow reversal should also be looked at regarding possible effects on recreation use. Bill McDavitt wondered, from a practical perspective, how there could be a low flow/high boundary condition or a high flow/low boundary condition. Mark acknowledged that those scenarios are not realistic, but they were run because they were required in the study plan.

3.3.10 – Assess Operational Impacts on Emergence of State-Listed Odonates in the Connecticut River (Nedeau)

Ethan Nedeau (Biodiversity) started his presentation with pictures showing the emergence of dragonfly adults. He then reviewed the study objectives and reminded stakeholders that this study was a 2-year study (2014-2015) and that he had previously reported on the 2014 qualitative (phase 1) portion of the study. He noted that phase 2 (Task 4) of the study was the quantitative survey conducted in 2015. He reviewed the work that was conducted in 2015, including surveys of 5 sites, and an analysis of the magnitude and rate of change of water surface elevations on a daily and hourly basis during the emergence period to assess operational impacts on odonates. He described the methods used, and showed a picture of a typical site. Ethan then presented the results of the phase 2 surveys in terms of the species and numbers of odonates collected at each site. In total they collected 17 species, with the most individuals collected at sites 1 and 2. He emphasized that they didn't get the counts they anticipated, and that altogether they got only 622 specimens. He noted that this was quite a bit lower than the densities observed in 2104. He later explained the cyclical nature of odonate densities and the potential effects of low water temperature and high discharge during what should have been the peak emergence period in June of 2015. He then showed the results of the emergence timing. He noted that overall the counts were low throughout the survey period. Ethan next showed crawl height and crawl distance results, noting that the average crawl height was 5.0 feet and the average crawl distance was 12.4 feet. Ethan next discussed eclosure speed, and reported that the average time from the start to end of metamorphosis was 36 minutes.

Finally, Ethan described the study's evaluation of the effect of changes in water surface elevation (as a result of project operations) on odonate emergence. He explained that for the analysis they had to make several assumptions regarding eclosure time, timing of eclosure with respect to water levels, and susceptibility of larvae. He then explained how they combined water surface elevations and rates of change in elevations to evaluate impacts to odonates based on their observed crawl heights and distances. He showed an example of the results of the analysis in a table which summarized results for sites 1 and 2. At site 1, 1.1% of odonates were impacted based on the daily mean rate of water level change, while at site 2 6.8% of odonates were impacted based on the daily mean water level change. He also discussed the results for site 3 and 4, noting that at site 3, there were a high number of odonates impacted, while at site 4, impacts were low to moderate.

He noted that odonates were affected by Station No. 1 operation and to some degree by the operation of Cabot Station. For all the results, however, Ethan noted that the level of impact on odonates depends on the timing and magnitude of water level changes.

Norm Sims (AMC) asked why so few odonates were observed in 2015, and whether it was a result of water level changes. Ethan indicated that dragonfly populations are cyclical, and therefore, the low numbers might due to a natural low cycle year. He also noted that the weather conditions were unusual in 2015, with a warm May, but an unusually cold and rainy June. He explained that during periods of high flows and cool temperatures dragonfly nymph may choose not to emerge, since dragonflies can spend more than a year as larvae. Andrea Donlon noted that there had been other odonate studies conducted on the Connecticut River, and that she thought this study would take existing information and fill in the gaps of what we didn't know based on the previous studies. She also said she thought the hydraulic model was going to be used to look at flow changes, and to analyze impacts on odonates in the whole study area, not just at a few specific sites that were the "data gap" areas. Ethan responded that his study had focused on study areas that had been identified at the outset in Barton Cove and the bypass reach, but he noted that if there is other odonate behavioral data, a similar analysis of water level changes could be done for those sites. Andrea pointed out that the study plan does include review of the existing odonate data relative the hydraulic model results. Mark Wamser indicated that he wanted to go back and review the study plan. [*After the meeting, Mark Wamser reviewed the approved study plan. Task 5 stated: "A hydraulic model, which will be developed for the whole study area independent of the odonate study, will be used to determine if water level fluctuations affect the emergence and eclosure success of state-listed odonates". The FERC study plan determination (pages B-57 and B-58) recommended that FirstLight deploy water level loggers at each of the survey locations to evaluate water levels. Therefore, FirstLight used the empirical water level data collected in 2015 to evaluate the impacts of water level fluctuations on odonates*.]

Katie Kennedy asked if height and distance of travel information was collected for all species. Ethan explained that it was, noting that all the height and distance data is in the study spreadsheets. Jessie Leddick (MADFW) noted that the state is interested in understanding impacts to the state listed species, even if there are only low numbers of those species. He noted that even though the study plan indicated that species with at least 10 individuals would be evaluated, that he would like to see all the species evaluated. Ethan indicated that the individual species analysis could be done. Jessie Leddick then asked about the average vertical crawl height for odonates elsewhere, and wondered if boat wakes and project operational changes in water levels may be causing odonate individuals to have reduced crawl heights. Ethan indicated that he has crawl data for individual species. Jessie asked about the availability of crawl height data for odonates from other sources, but Ethan stated that this data is scarce. Jesse also wondered if crawl heights that were recorded could be biased because we do not know exactly where larvae stopped to eclose, relative to water levels at the time, if we only observed the exuviae which could have been shed hours or even days earlier. He asked if it were possible to summarize crawl heights only for those specimens that were actually in the process of emerging/eclosing when they were observed, and therefore for which we know the water levels at the exact time of emergence. Ethan acknowledged that this was a legitimate question, and we could re-calculate crawl heights only for those specimens that were observed during the emergence/eclosure process, but that sample sizes would be very low.

3.3.16 – Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the Connecticut River below Cabot Station (Nedeau)

Ethan Nedeau (Biodrawversity) updated the group on the mussel study. He reminded the group that a report had not yet been submitted, so this was a study update only. Ethan began by reviewing the study objectives. He then summarized the results of the mussel surveys, noting that the mussel community in the reach of river from Cabot Station to Sunderland Bridge is dominated by a single species, Eastern elliptio. He also noted that no live state-listed mussels were found in the survey area. Ethan then discussed the status of the ongoing development of HSI curves for target mussel species. He explained that a Delphi panel had been formed, and that the panel had reached concurrence on water depth, flow velocity, substrate and cover criteria. The panel was now working on developing shear stress and relative shear stress criteria; which were more challenging. He concluded by explaining that once the HSI curves are complete, they will be used in the IFIM study to examine the effects of flow on state-listed mussels.

There were no questions about this study.

3.5.1 – Baseline Inventory of Wetland Habitats, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special Status Species (Knapp)

Steve Knapp (Kleinschmidt, on phone) began by reviewing the study objectives. He then summarized the findings of the study. Regarding wetlands and riparian habitats, he noted that most of the SAV mapped was found in patches along the shoreline, and that there was no SAV mapped in the bypass reach (although some does occur). He also noted that no exotic/invasive species were identified downstream of Turners Falls Dam. Regarding RTE plant species, Steve explained that rare species were searched along transects and mapped in 2014. Regarding invasive plant surveys, Steve noted that the most common invasive plants observed at the Project, were Japanese knotweed and common reed. Purple loosestrife was present, but not widespread.

Steve then summarized work on Task 6 which was an assessment of project water level fluctuation impacts on RTE plant species. Steve provided an example of the analysis at transect 1 that focused on impacts to sandbar willow (located near the Sunderland Bridge). He described that the assessment found that the willows occur between elevation 104.0 and 105.1 feet, and that the majority of willow occur above the July median flow. Next, Steve described the work conducted as part of Task 6 to assess the impacts of water level fluctuations on tiger beetle.

Steve then reviewed some of the results of the various assessments. With respect to RTE plant species Steve summarized that 18 transects were examined for RTE species. He highlighted some of the findings with water surface elevation effects on mountain alder, upland white aster, sandbar cherry, Tradescant's aster, and sandbar willow. Overall, Steve concluded, RTE species within the Project are species that are well adapted to dynamic river systems and do not appear to be greatly affected by Project operations. Steve next summarized the findings with respect to wetlands, noting that most common wetland types in the study area are forested floodplain wetlands and shoreline emergent wetlands. Finally, Steve summarized the study findings with respect to tiger beetle. He explained that tiger beetle habitat elevations were evaluated in conjunction with water surface elevation data to consider potential impacts. The results showed that project operations may impact available habitat and disperse tiger beetle individuals, primarily at the lower range of elevations.

However, Steve noted that recreation use at Rainbow Beach and recreational boat wakes may also impact tiger beetles.

Jessie Leddick (MADFW) noted that they had records of three rare plant species (terry grass and 2 spike sedges) from the Project area that were not observed during the relicensing study plant surveys. He wondered if they had been looked for. He suggested that additional surveys for these species may be requested. Jessie also noted that the study plan said that the survey would delineate all suitable habitat, both occupied and unoccupied. Steve acknowledged Jessie's point and explained that the survey transects did cut across both occupied and unoccupied habitat, so both were accounted for. Jessie then asked if flow parameters between occupied and unoccupied habitats were compared. This led to further discussion about information that MADFW was seeking with respect to potential project effects on both occupied and suitable unoccupied habitat. Steve reiterated his belief that the evaluation of water level effects along the study transects did include assessment of both occupied and unoccupied habitats. Jessie concluded the discussion by stating that he would still like to know the extent of suitable but unoccupied habitat. Finally, Jessie asked a question about cobblestone tiger beetles. He noted that they didn't see any analysis of how flows effect the site near the Deerfield River, as had been suggested in the study plan. Steve responded that he understood that the cobblestone tiger beetle had been extirpated at that site, and therefore the focus of the analysis was at Rainbow Beach. Jessie stated that a single survey may not be sufficient to demonstrate absence of a species. He further noted that even if a survey doesn't find the species, there is still the need to evaluate potential impacts to the habitat.

3.4.1 – Terrestrial – Baseline Study of Terrestrial Wildlife and Botanical Resources (Knapp)

Steve Knapp (Kleinschmidt, on phone) began by reviewing the study objectives. He then discussed the results of the study starting with terrestrial wildlife. He summarized that field surveys of wildlife species had observed 15 mammals, 15 reptiles and 64 bird species, including bald eagle. He noted that three bald eagle nests were located within the study area. Regarding botanical resources, Steve explained that the study identified over 335 different plant species within the study area, and that 8 distinct vegetation communities were identified and mapped.

There were no questions on this study.

3.6.1 – Recreation Use/User Contact Study (Bley)

Wendy Bley (TRC) presented the results of the study. She began by reviewing the primary study objectives which were to determine recreation use and demand and to interview the recreating public. She then reviewed the methods that were used, noting that recreation use was determined primarily from spot counts, and calibration counts. She noted that over 1200 spot counts and 1200 calibration counts were made at the Project. She also explained that traffic counters were installed and used at all sites. Finally, she noted, that where available, actual recreation use records and registrations from FirstLight were used to estimate use at some of the sites. With respect to user surveys, she described that two primary surveys were conducted, a Recreation User Survey (over 900 surveys collected) and a Residential abutters survey (95 surveys returned).

Wendy then summarized overall recreation use results, noting that the study estimated 152,769 recreation user days for both projects in 2014. On a seasonal basis, 50% of the use occurred in the summer. She also showed

the use breakdowns by recreation site, noting that the highest use was recorded at the Gatehouse Fishway Viewing Area (which she noted includes a portion of Unity Park and the bike trail), followed by Northfield Mountain Tour and Trail Center. In terms of recreation activity, Wendy noted that by far the popular recreation use at the projects is hiking/walking/jogging, followed by motor boating. Wendy then described how utilization capacity of the recreation sites was estimated. She noted that for most sites capacity was estimated on the basis of available parking, while at campgrounds it was estimated on the basis of the number of campsites. In terms of percent utilization, she noted that State Boat Launch had the highest utilization rate, followed by two of the parking areas used for the Farley Ledge and Rose Ledge climbing sites. These two parking areas, she noted, are on private property outside the FERC project boundary.

Norm Sims asked Wendy to explain the basis for percent utilization estimates; wondering if they are yearly or daily capacities. Wendy explained that she had not developed the estimates, but that she thought that the estimates were based on the peak summer weekend use. However, she said she would check the study report to verify. [*After the meeting, Wendy checked the study report. As noted in the study report, the percent utilization was based on the average of summer weekend use, not the peak maximum summer weekend use as stated in the meeting*]. Norm Sims and Andrea Donlon both commented that they felt that if the capacity is based on some kind of average, that it is probably not capturing peak use days when people are parking on the road because there is no parking available at the site. Wendy agreed that it is possible that the study might not have counted use on every peak-use day. However, she reminded the group that the study did specifically target recreation use counts on the typical high-use summer holiday weekends.

Wendy next highlighted some of the recreation user survey results. She summarized the demographics of the survey respondents, and basic information on how far they had traveled and length of stay. Then she summarized the results of the key opinion/rating questions in the survey. She noted that user ratings for parking, facility condition, overall quality, river access and variety of amenities were all very high. However, she indicated that ratings for toilets and restrooms were notably lower. Bob Nasdor asked if in reviewing responses about river access if an effort had been made to separate responses about access for respondents that were participating in a river/water related activity from those that were doing some land-based activity (such as walking). Wendy explained that the overall rating of river access did not try to segregate respondents by their activity. She also noted that the survey left it to the recreation user to interpret what river access meant. Bob noted that most of the users were walkers and therefore river access might not be an issue for them. Wendy agreed but also suggested that this might be why not as many users responded to the question about river access. Bob also asked about the respondents opinions about water levels. He suggested that a respondent's rating would depend upon the user's recreation activity. Wendy agreed that it probably would. She also noted that the survey data could be further parsed to more closely examine the difference between user's opinions of water levels based on the activities they were participating in that day, but she noted that this would be a whole other level of analysis. Wendy then continued her review of survey results, showing that user ratings for level of use, number of facilities and water levels were generally very good. She also showed the results of open-ended survey questions about what participants liked most and least about their recreation experience. She pointed out that the top five things people reported they liked least about their experience were weather, trash/litter, parking lot and road maintenance, crowded/noisy, and no restrooms/restrooms closed. Values respondents liked most were peaceful/quiet, beauty/scenery, location close to home, and weather. Wendy pointed out that some things beyond the control of the licensee, like weather, made both the liked-most and liked-least lists.

Norm noted that a lot of contradictory information comes in through surveys. Wendy agreed that sometimes you do get contradictory results. As an example, Wendy pointed out that the survey found that, overall, the value recreationists report they liked most was "quiet and peaceful," while the fourth most disliked is "crowded and noisy." She noted that this is a classic example of different users at different sites doing different activities having different perceptions of their recreation experience. A lot of it depends on recreationists' priorities and what they value for an experience.

Wendy then reviewed the residential abutter's survey results. She noted that survey return rates were quite good (45%), and that most of the respondents were year-round residents with property that is adjacent to the river. It was also noted that less than half of the respondents use the public recreation sites provided at the Project. On this basis, Wendy explained, that it appears that there is likely recreation use of the Project, particularly the TFI, that is occurring and that was not captured via the use counts made at the public recreation sites. Other resident survey results found that the most popular recreation activities for residents on a year-round basis are walking, dog-walking, birding, hiking, photography and nature observation. Kayaking, power boating, canoeing, fishing and picnicking were popular in the spring, summer and fall.

Next Wendy reviewed the portion of the study that looked at population and recreation use trends and estimated future use and utilization capacity. She briefly described the method used, noting that it relied on both an estimated increase in project-area population through the year 2060, and Cordell's projected changes in activity specific recreation use over time. Norm Sims asked a question about how population projections are used to estimate increased recreation use. Wendy reiterated that the future recreation use estimates made in the study combine anticipated population growth with a recreation activity specific (e.g., hiking) growth factor, which was taken from Cordell's (USFS) classic study. She noted that the overall population growth estimate for the project area between 2014 and 2060 was projected to be 5.2%. She also noted that the methods used to estimate future recreation use growth rates is detailed in the study report. Norm pointed out that the recreation site growth rates estimated in the report do not account for potential changes in the recreation facilities or sites that may be proposed. Wendy agreed, noting that if the recreation sites or facilities change (e.g., added amenities or expansion), you might change demand and therefore the growth projection may change. Wendy also noted that the recreation growth projection methodology used in the study is sound, and so could be used to evaluate anticipated growth if changes were proposed to an existing recreation site or a site were added. In short, this method could be used to analyze what the recreation site capacity might look like in 2060 based on the new condition. Bob Nasdor disagreed with Wendy on this statement, saying that if, for example, toilets or access were improved, then the capacity might change. Wendy agreed with Bob, but reiterated that the study results are, by necessity, a snapshot in time, and that they study was not designed to address the "if you build it they will come" scenario. Mike Swiger (Van Ness Feldman) noted that as part of the Exhibit E (in the license application), FirstLight will analyze the effects of any proposals that are made with respect to recreation sites and facilities.

Wendy then fielded some additional questions about the study. Norm Sims asked if the boat tour was going to be eliminated. Wendy responded that she was not aware of any plans to eliminate the boat tour. Bob Nasdor noted that not all the recreation sites are open year-round and wondered how use of these sites was evaluated at other times of the year. Wendy explained that spot and calibration counts were done year-round, and that TRC had counted whoever was there using the site, even if the site was not officially open. Norm asked whether the surveys captured any complaints that the boat launch closes too early or about the seasonality or hours of operation of a site. Wendy responded that it is possible that some such responses were received, but

that those had not been parsed out. She also noted that sometimes survey responses to open-ended questions can be hard to interpret. Andrea Donlon asked about the process used for developing estimated annual use. Wendy made an effort to again summarize how the spot counts, calibration counts, traffic counter data and registration data was used to develop the use estimate for the Project overall, and for the individual sites. Andrea asked if the traffic counter data could be made available. Wendy indicated that it was in a database, and therefore could be made available. [*Traffic counter data will be made available on www.northfieldrelicensing.com.]*

Andrea noted that Study 3.6.7 (Northfield Mountain recreation study) had evaluated historic use of the Northfield Mountain recreation opportunities, and asked if the same had been done for the Barton Cove Kayak and Rental. Wendy indicated that historic data from Barton Cove was not examined as part of this study, but that actual use records for 2014 were used to develop the current use estimates for the site. Andrea then asked about the traffic counter at the Poplar Street site. She noted that she was concerned that it was placed at the end of the parking area, and therefore may not have captured all of the vehicle use. She asked if TRC could look into if that traffic counter was moved to a different location to better estimate use. *[After the meeting, TRC looked into this further. CRWC's request was made in the fall of 2014 after issuance of the Initial Study Report, when there were only two to three months of the field season left. In FirstLight's Response to Stakeholder Comments on the Initial Study Report and Meeting Summary, FirstLight responded that while the traffic counters provide helpful information, they are not the sole piece of data being relied on to determine use at each recreation site. The spot counts and calibration counts are also used to determine use, which is then reinforced by traffic counter information Therefore, continuation of the tube counter at Poplar Street in a different location would not have provided any better information than was obtained through collected data.]* Finally, Andrea asked about the boat wake data that was collected as part of the causation study (Study 3.1.2). She reminded the group that she had asked that some analysis of the boat wake data, and the number of boats that it represented by included in the recreation use study. Wendy responded that they had obtained the boat wake video data, but that after reviewing it could not figure out how to appropriately interpret and include it in the recreation use assessment. The problem, she explained, was that the data and video was focused on counting the boats and boat wakes passing the monitoring sites, but didn't provide any information about the number of boats actually utilizing the TFI.

3.6.5 – Land Use Inventory (Verville)

Sarah Verville (TRC) began her overview of the land use inventory study by reviewing the study purpose and objectives. She described that one of the first steps was to collect data on existing land use within the project study area which was all lands within 200 feet of the project boundary. In total, 35 existing land use categories were identified, and these were consolidated down into 9 basic land use types, which were mapped. She also described that maps were developed showing land ownership within the study area, noting that in some cases FirstLight may not own the land outright, but instead may have easements or flowage rights. She then described that the study also identified and mapped conservation easements within the study area. Norm Sims asked a question about the ownership of the Bennett Meadows Wildlife area. Sarah said she would check on that, but thought that property was owned by FirstLight with a conservation easement provided to the state. [*After the meeting, TRC looked into this further and confirmed that Bennett Meadows WMA is owned by FirstLight. The MA Department Fisheries & Wildlife manages the WMA for wildlife. A portion of the WMA is also managed for agricultural purposes.*] It was then asked if there are any conservation easements owned by the Project. Sarah indicated that she could check on that, but that off the top of her head she thought perhaps

Bennett Meadows, and maybe a portion of Connecticut River Greenway State Park. [*After the meeting, TRC looked into this further. It appears that there is a portion of the Greenway Park that is on land owned by FirstLight*]. Bob Nasdor asked if any of the Northfield Mountain project lands are in conservation easements. Sarah responded no, that those lands are just part of the FERC-licensed Project. Bob asked if any lands within the bypass reach are in conservation easements. Sarah responded that she didn't think so.

Sarah then described how the study addressed non project use of Project lands. She explained that the study included an inventory of all non-project use of Project lands approved or permitted by FirstLight. She noted that the inventory included 42 private docks, 24 leased camps and camp lots, 8 landscape approvals and 8 water withdrawals. In response to a question about the water withdrawals, Sarah indicated that she would check on the water withdrawals to examine what these uses were and how old they are. *[After the meeting, Sarah checked the Land Use Inventory Report. Table 4.4-1 identifies the user of each water withdrawal. The water withdrawals include Split River Farm, Northfield Mount Hermon School, Smiarowski Brothers, Nourse Farms Inc. (2), Sudbury Nurseries West, and the Conte Fish Research Lab. In addition, it was determined that five of the water withdrawals are for agricultural purposes (1990 – 2011); one is for a recreational purpose (2010); one is for scientific purposes (1991), and one from 1984 is for a residential lawn.]*

Sarah then discussed how the study took all of the information regarding land use and came up with proposed land use designations for the entire study area. She summarized the acreages included in each designation type. She explained that the land use designations would be used going forward to help the licensee with land management efforts at the project. She showed a sample of the land use designation maps for one section of the Project. Bob Nasdor questioned whether the evaluation considered the number of acres of Project land that are restricted to public access. Sarah said that public access restriction was not specifically delineated in the report. However, Doug Bennett (FirstLight) noted that with the exception of areas around the Northfield Mountain Upper Reservoir, the dams, the powerhouses, switch stations, and station yards, themselves, there were no Project lands that are specifically restricted for public access.

Sarah concluded her review with a summary slide. Andrea Donlon noted that the report does not breakout land use by the lands that are owned by FirstLight. She noted that she was interested in understanding which lands are owned by FirstLight that are designated for public recreation use. She also noted that she would like to know what lands that FirstLight owns that are currently used for private recreation facilities (boat clubs, camps, etc.). Sarah responded that the report does not contain a breakdown of lands FirstLight owns and which of these are used for public versus private recreation use. She noted that there are instances where FirstLight owns lands in fee, but other places where they have flowage or other rights. Andrea reiterated her interest in getting this information, and asked how she could request the data. Brandon Cherry suggested that the data/information request be worked out informally, but noted that Andrea could also file a formal request as part of her comments on the study. Sarah suggested it would be helpful if the request was filed formally.

As there were no additional questions, Mark Wamser thanked everyone for coming and the meeting adjourned at 4:48 PM.

ATTACHMENT B: POWERPOINT PRESENTATION

FirstLight™ Power Resources

GDF SUEZ

Turners Falls Hydroelectric Project (FERC No. 1889)

Northfield Mountain Pumped Storage Project (FERC No. 2485)

March 2016 Study Report Meeting

March 16, 2016

Purpose of Updated Study Report Meeting [18 CFR 5.15(c)(2)]

Per Regulation…..

Within 15 days following the filing of the Updated Study Report (March 16, 2016), the Applicant shall hold a meeting with licensing participants and Commission staff to discuss the study results and the potential applicant's and/or other participant's proposals, if any, to modify the study plan in light of the progress of the study plan and the data collected.

Meeting Objectives

- To summarize the 13 reports filed on 3/1/2016.
- To provide a status update on the mussel report.

Relicensing Process- Next Steps

Study Report Meeting (All Stakeholders and FirstLight)
- March 16, 2016

Study Report Meeting Summary Filed (FirstLight)
- March 31, 2016

Conduct Field Studies (FirstLight)
- Ultrasound Array, 2nd Year of DS Eel

Disagreements/Modifications to Study/Propose New Study (All Stakeholders)
- May 2, 2016

Filing of Final License Application
- April 30, 2016 – falls on a Saturday- defaults to Monday, May 2, 2016

File Responses to Disagreements (All Stakeholders)
- May 30, 2016

Last date for the Director to resolve disagreements and amend the approved study plans (FERC, if necessary)
- June 29, 2016

Study Recap

FERC Filing Date	No. of Studies	Study Name Abbreviations
09/15/2014	2	Full River Reconnaissance, Rec Inventory
12/31/2014	2	Archaeological- Phase 1A only, Historic Structures
09/14/2015	9	Hydraulic Model Study, Aquatic Habitat Mapping, Tributary Access, Canal Drawdown, NFM Land Management, Whitewater, Day/Overnight Rec Facilities, Rec Study of NFM, Traditional Cultural Properties.
03/01/2016	13	Water Quality, US Passage Eel, Shad Spawning, CFD Modeling, River2D model of NFM tailrace, Odonates, Fish Assemblage, Cabot Emergency Gates, Ichthyoplankton, Terrestrial Wildlife & Botanical, RTE, Rec Use/User Survey, Land Use Inventory
10/14/2016	10	Erosion Causation, Sediment Monitoring, IFIM Study, US & DS Adult Shad, DS Juvenile Shad, Entrainment, Littoral Zone, Sea Lamprey Spawning, Mussels Project Ops impact on Rec
03/01/2017	3	DS Eel, Ultrasound Array, Ops Model
Total	39	

Agenda

Times	Study
9:00-9:30 am	Introductions, Review of Meeting Purpose, Meeting Objectives, Schedule
	Fish and Aquatic
9:30 am-Noon	3.3.4- Evaluate Upstream Passage of American Eel at the Turners Falls Project
	3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects
	3.3.20- Study to Evaluate Entrainment of Ichthyoplankton at the Northfield Mountain Pumped Storage Project
	3.3.11- Fish Assemblage
	3.2.1-Water Quality Monitoring Study
	3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station
Noon-1:00 pm	Lunch on your own
	Modeling
1:00-5:00 pm	3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays
	3.3.9-Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace.
	Odonates and Mussels
	3.3.10-Assess Operational Impacts on Emergence of State-Listed Odonates in the Connecticut River
	3.3.16-Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in CT River below Cabot Station
	RTE and Terrestrial
	3.4.1-Baseline Study of Terrestrial Wildlife and Botanical Resources
	3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species
	Recreation and Land Use
	3.6.1-Recreation Use/User Contact Survey
	3.6.5-Land Use Inventory

Fish and Aquatic Resources
Water Quality Resources

3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Background

Between 2003 and 2014 the Holyoke Hydroelectric Project (FERC No. 2004) passed approximately 100-50,000 juvenile American eel annually. There are 35 river miles of eel rearing habitat between the Holyoke and Turners Falls Projects. Although there is evidence of eel passing the Turners Falls Project (the Project) via the fishways, the number of eel attempting to migrate past the dam, and the number successfully passing, are unknown.

Study Objectives

- Identify concentration of eels staging in pools attempting to ascend wetted structures (Phase 1- 2014).
- Assess whether eels can be passed in substantial numbers and whether sites are viable for permanent structures (Phase 2-2015).

Work Completed

Task 1: Systematic Surveys (2014)

Nighttime surveys were conducted to assess eel presence and abundance at the Turners Falls Project. The nighttime surveys were used to site the location of temporary eel ramps which were installed in July 2015.

Task 2: Trap Collection (2015)

Temporary traps were used to determine if eel pass in substantial numbers and whether sites are viable for permanent structures.

3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Task 1: Systematic Surveys (2014)

- Identify concentrations of eel staging in pools or attempting to ascend wetted structures

Nighttime Survey

- 11 surveys
  - Every 1-2 weeks beginning on June 11, 2014 and ending October 9, 2014
  - Visual observation of each site, noting eel presence and abundance

3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Task 1: Eel Monitoring (2014)

- A total of 6,263 eel were observed during 11 nighttime surveys
- The majority of the eel were collected at the Spillway Fishway (n=5,867) and the Cabot Emergency Spillway (n=332).
- Most eel observed on July 2, 10 and July 17.

Locations where eel were observed at the Cabot Emergency Spillway

Eel congregating and climbing the upper gate at the Turners Falls Spillway Fishway

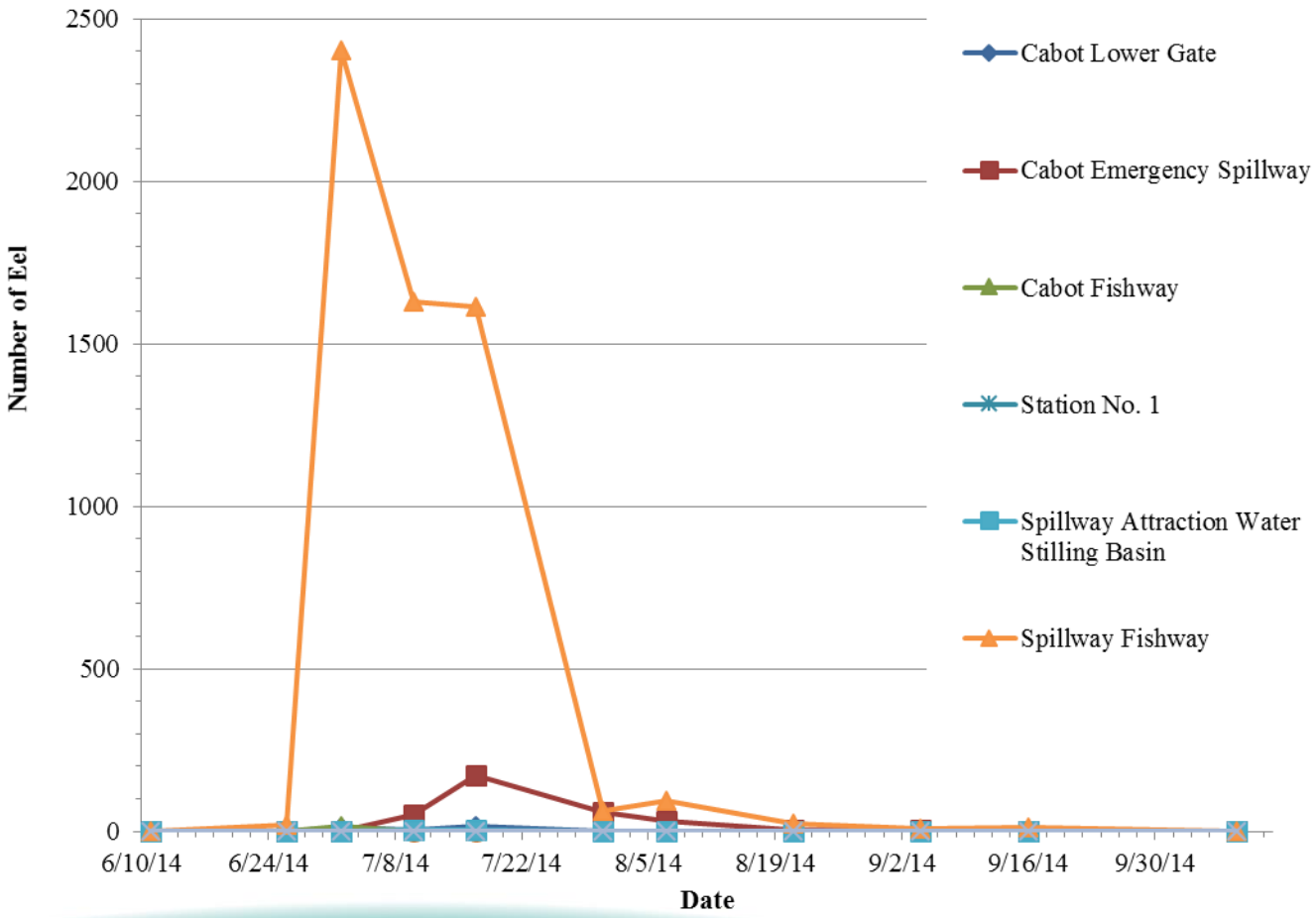
3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Task 1: Eel Monitoring (2014)

Station	TOTAL
Cabot Lower Gate	33
Cabot Emergency Spillway	332
Cabot Fishway	18
Conte` Discharge	0
Station No. 1	3
Mill Hydro Discharge[a]	0
Outfall 1[a]	0
Outfall 2[a]	0
Outfall 3[a]	0
Paper Mill Discharge[a]	0
Spillway Attraction Water Stilling Basin[b]	10
Spillway Fishway[b]	5,867
Tainter Gates	0
TOTAL	**6,263**

[a]Discontinued surveying these locations on July 31, 2014 because of a lack of eel and safety concerns.
[b]Surveyed on July 21, 2014.

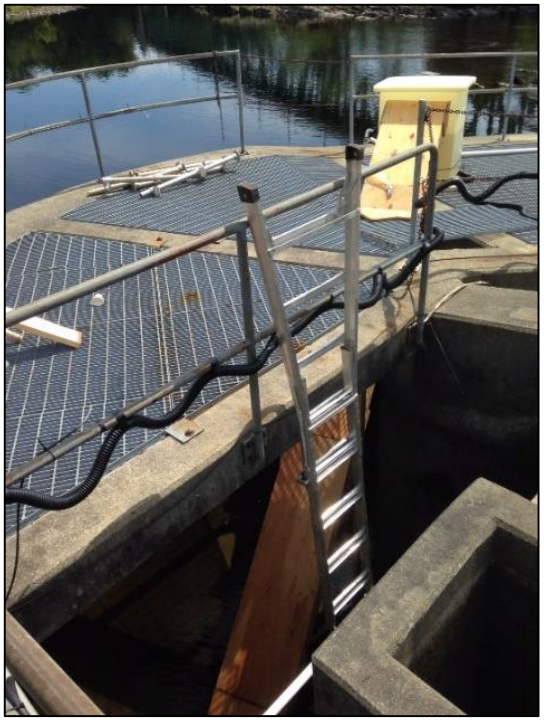
Estimated number of eel observed during the nighttime surveys.



3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

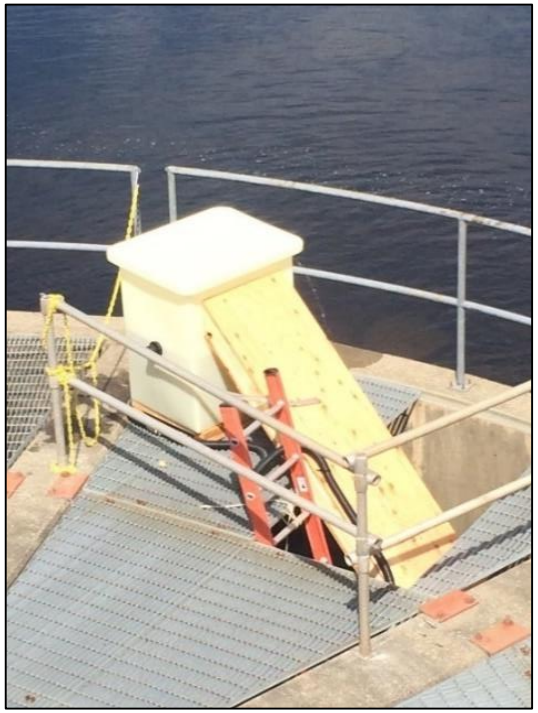
Task 2: Trap Collection (2015)

- In July 2015, temporary eel ramp traps were installed at Spillway Fishway, Cabot Fishway, and Cabot Emergency Spillway.
- Medusa traps were deployed at the Station No. 1 discharge.
- Eel were counted, measured and categorized (<10cm, 10-20cm >20cm) and released in the Turners Falls Impoundment.



Spillway Fishway eel trap, located within the second turning pool

Cabot Emergency Spillway Gate No. 10 eel trap, located at the north end of the spillway



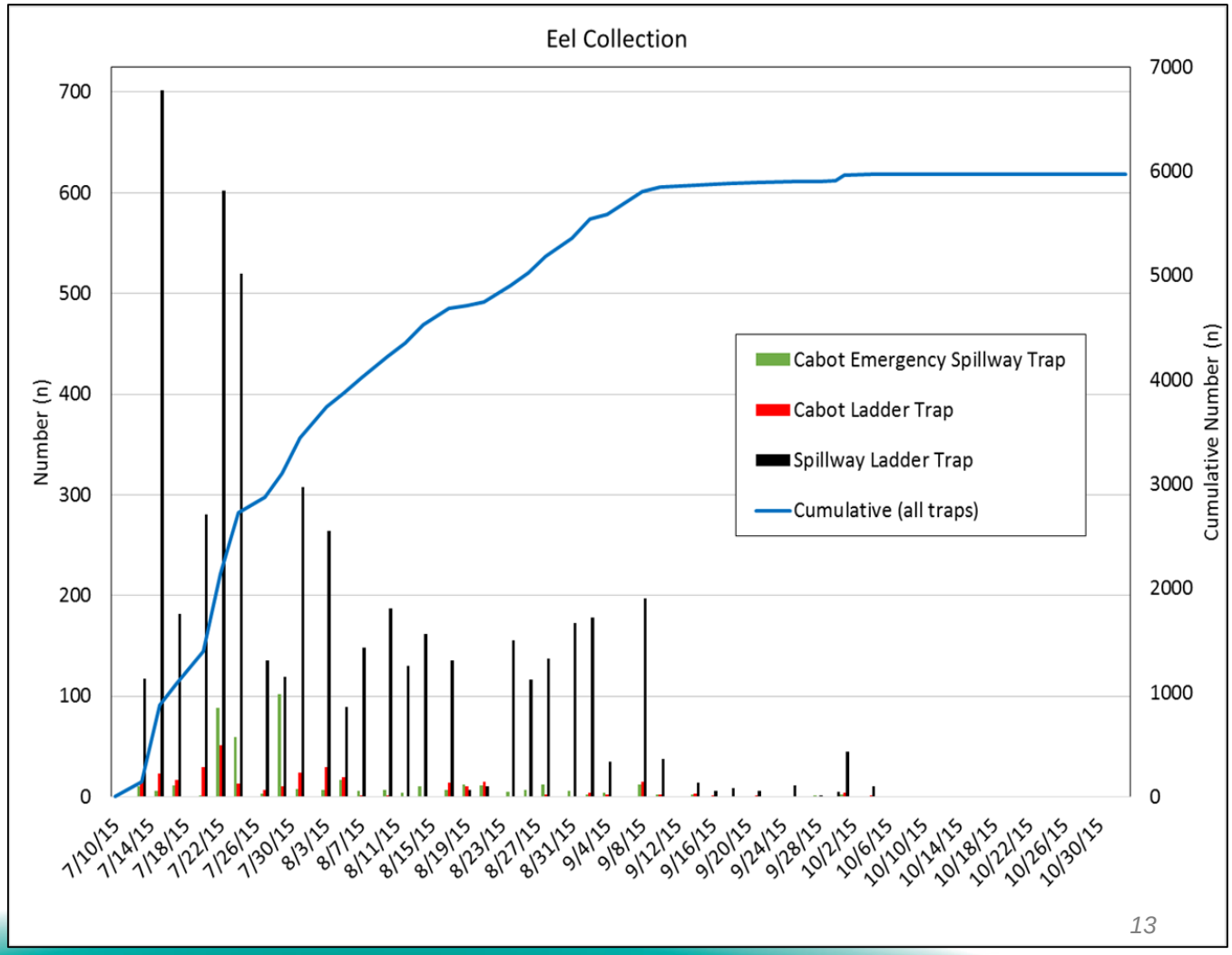
Cabot Fishway eel trap, located in third turning pool

3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Task 2 Findings: Eel Collections

- A total of 5,972 eel were collected between July 9 and November 2, 2015.
- Peak migration occurred in July

Eel Trap Location	Number of Eel
Spillway Fishway	5,235 (87.7%)
Cabot Emergency Spillway	424 (7.1%)
Cabot Fishway	313 (5.2%)
Station No. 1 (Medusa traps)	0

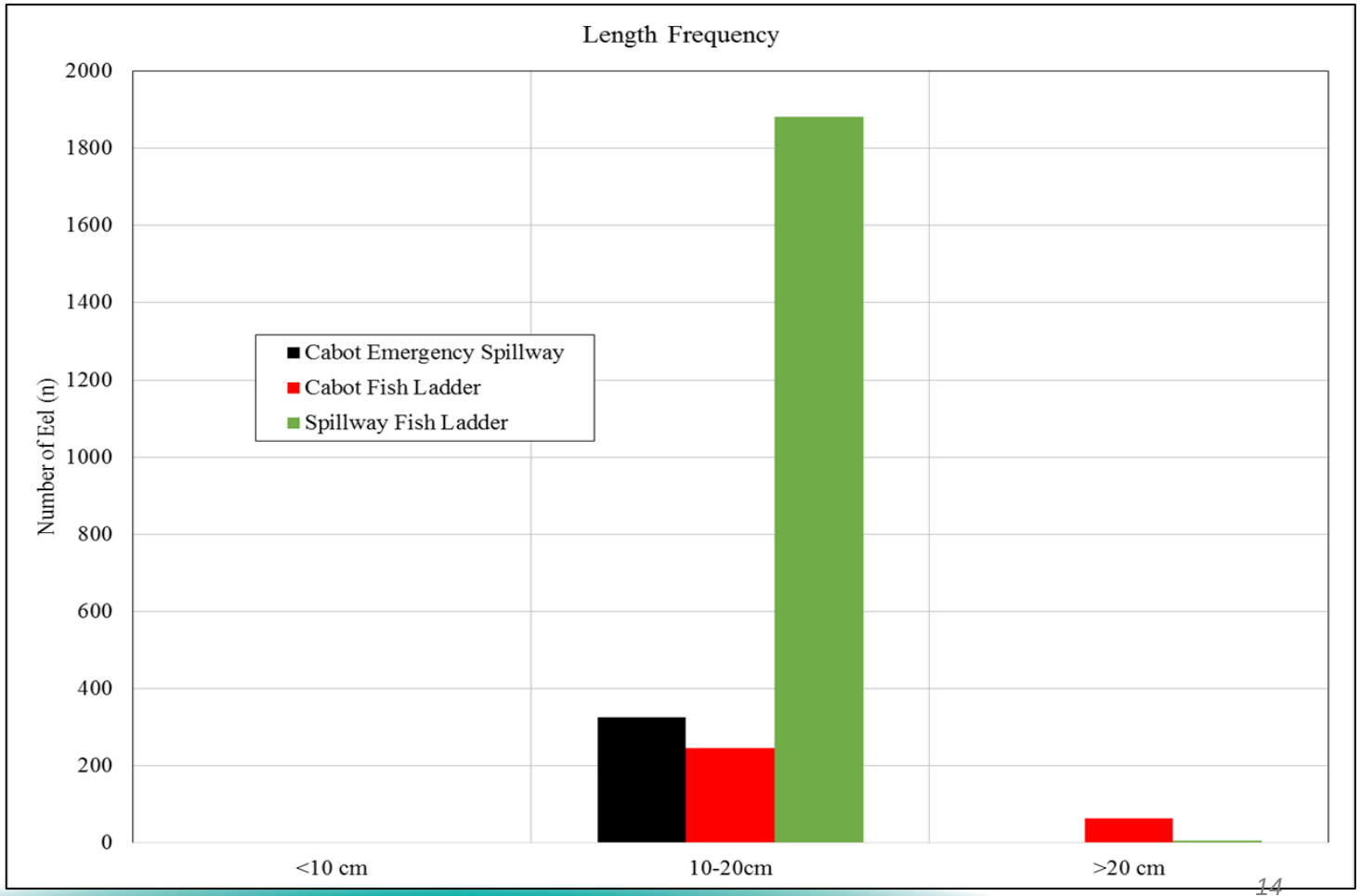


3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Task 2: Length Frequencies of Sub-Sampled Eel Collections at the Project

- A total of 2,526 eel were sorted into the three size categories

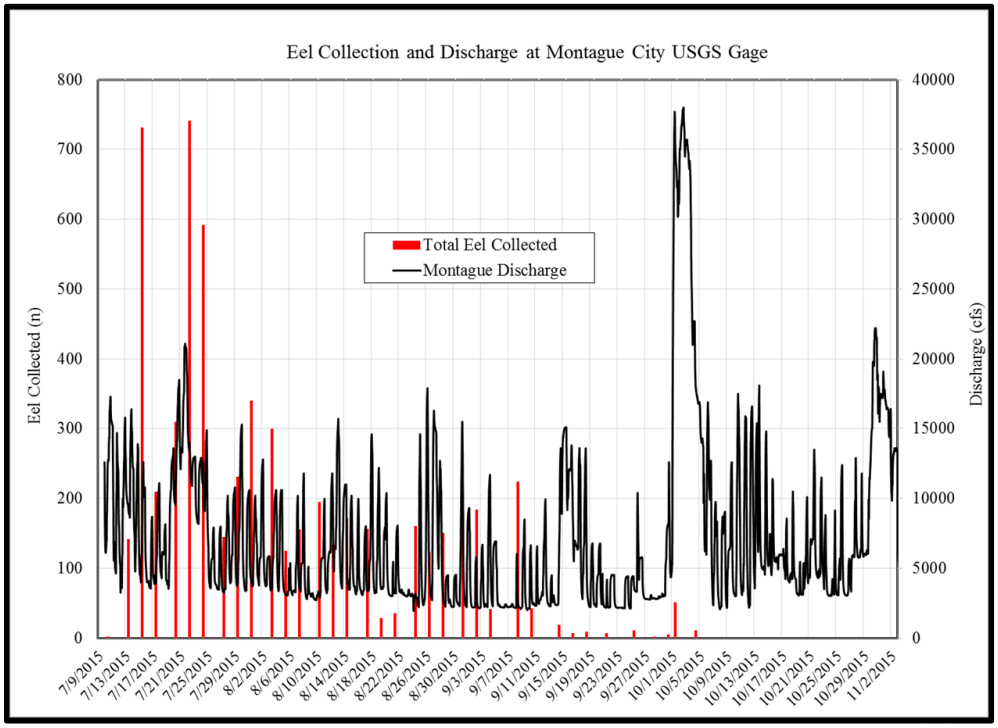
Size Category	Number of Eel
<10 cm	1 (0.04%)
10-20 cm	2,453 (97.1%)
>20 cm	72 (2.85%)

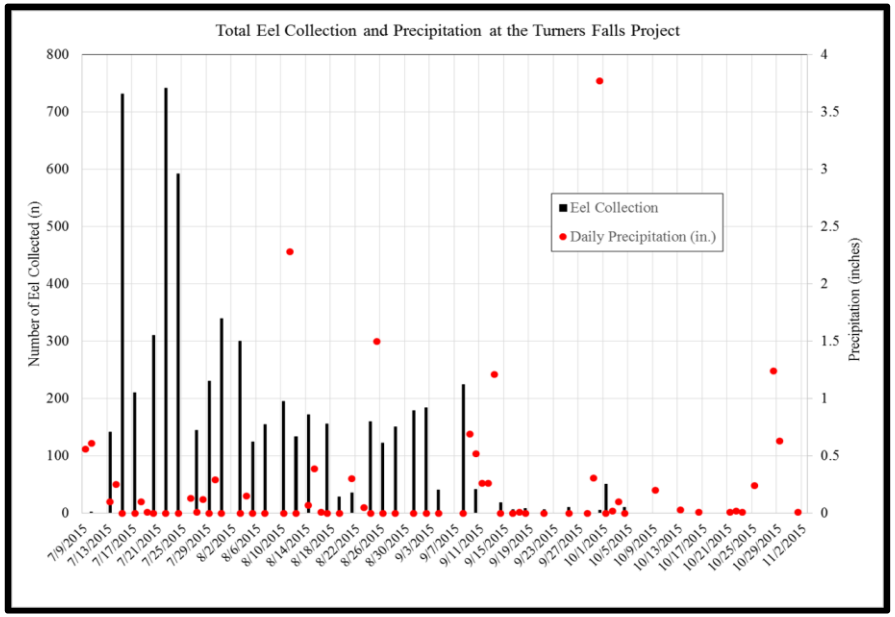


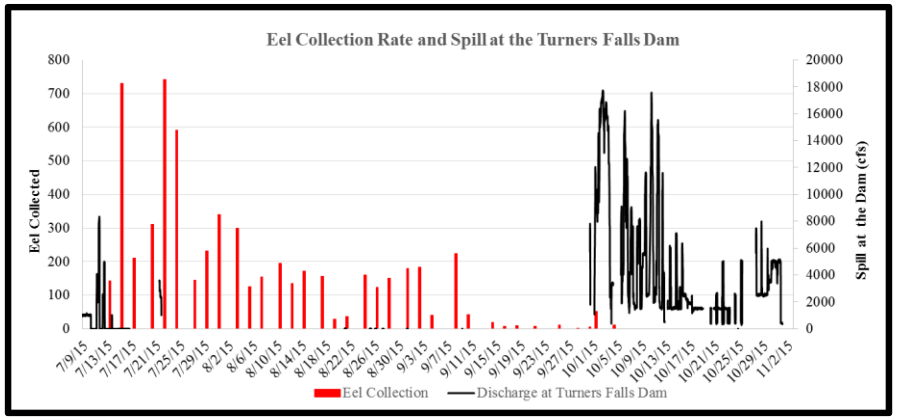
3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Task 2: Environmental and Operational Conditions

- No significant correlation was found between eel collection rates and precipitation, river flow or spill.







3.3.4-Evaluate Upstream Passage of American Eel at the Turners Falls Project

Conclusions

- Study results and observations conducted during the study indicate that the Spillway Fishway attracts the greatest number of migrating eel and probably has the most potential as a site for permanent passage facilities.
- The Cabot Emergency Spillway is not an appropriate location for a permanent passage structure. Spillway operation is intended to rapidly draw down the power canal in the event of a Cabot Station load rejection or canal dike breach or to sluice ice and debris downstream.

Variances

- Based on findings from Task 1 and with the concurrence of state and Federal agencies as well as other stakeholders, traps were not installed at the Cabot Fishway attraction flow stilling basin, and Spillway Fishway attraction flow stilling basin during the 2015 upstream eel migration period.
- The ramps of the eel traps were constructed at an angle between 34-43° based on site specific requirements in consultation with the stakeholders rather than < 35° as stipulated in the RSP.

3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

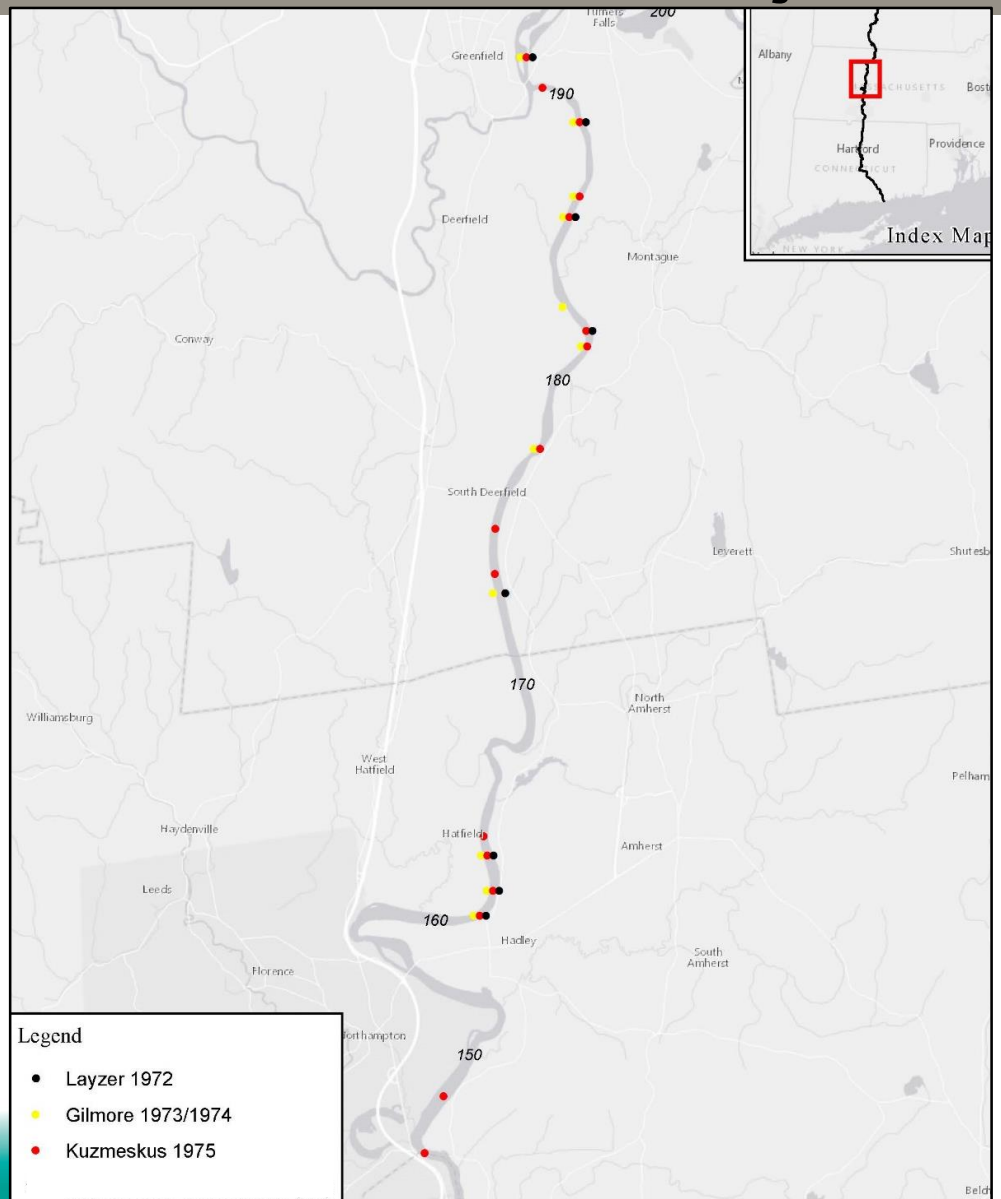
Study Objectives

- Determine areas utilized by shad for spawning by conducting night-time visual and aural observation of spawning activity;
- Identify and define those areas geospatially, and obtain data on physical habitat conditions affected by Project operations (e.g., water depth, velocity, discharge, substrate, exposure and inundation of habitats);
- Collect information to assess Project operation effects on observed spawning activity, under a range of permitted or proposed Project operation conditions;
- Quantify effects (e.g., water velocity, depths, inundation, exposure of habitats) of Project operation on identified spawning areas for a range of conditions, over the complete period of spawning activity and,
- Verify spawning activity as measured by night-time spawning/splash surveys in areas of spawning activity, and downstream of these areas, to gather data to determine project operation effects.

3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

Phase 1 Surveys

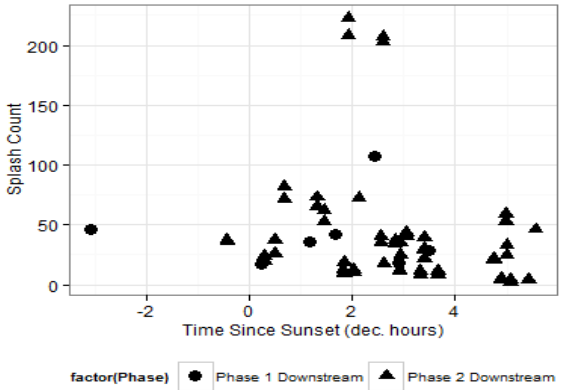
- Surveys in downstream reach were conducted on five nights between sunset and 01:00 from May 13 to May 21, 2015.
- Seven spawning events were observed during Phase 1.
- Almost 4 decades have passed since areas of shad spawning were identified downstream of Cabot Station, some of the same areas remain active spawning grounds for shad.

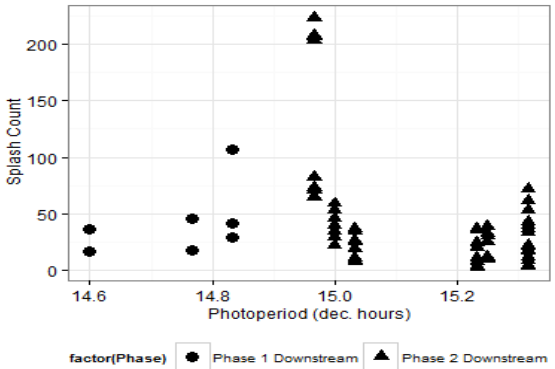


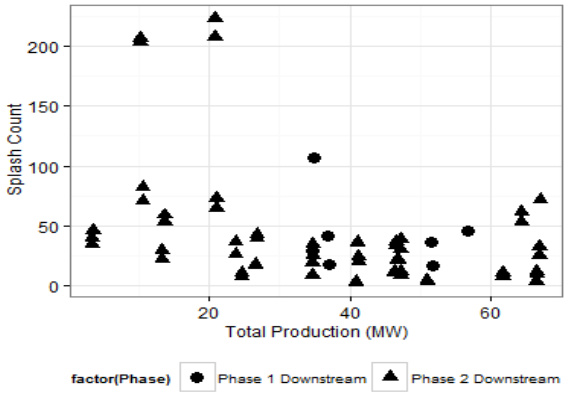
3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

Phase 2 Surveys – Below Cabot Station

- Conducted from May 26 to June 22, 2015, the effects of changing generation at Cabot Station on shad spawning activity, as indicated by splash counts, was assessed.
- A spawning event was identified, splash counts were initially recorded over a 15-minute interval and physical habitat parameters were measured.
- Cabot Station generation was increased or decreased by one or two units and splash counts were again recorded.
- A multiple regression analysis was performed to identify variables that drive spawning, however the models failed goodness of fit testing and the errors suggested a strong temporal signature, which is exemplified in the photo period figure.
- The negative binomial model found no statistical difference in the mean splash counts before (x=47.6) and after (x=36.6) changes in generation at Cabot Station (p=0.302).



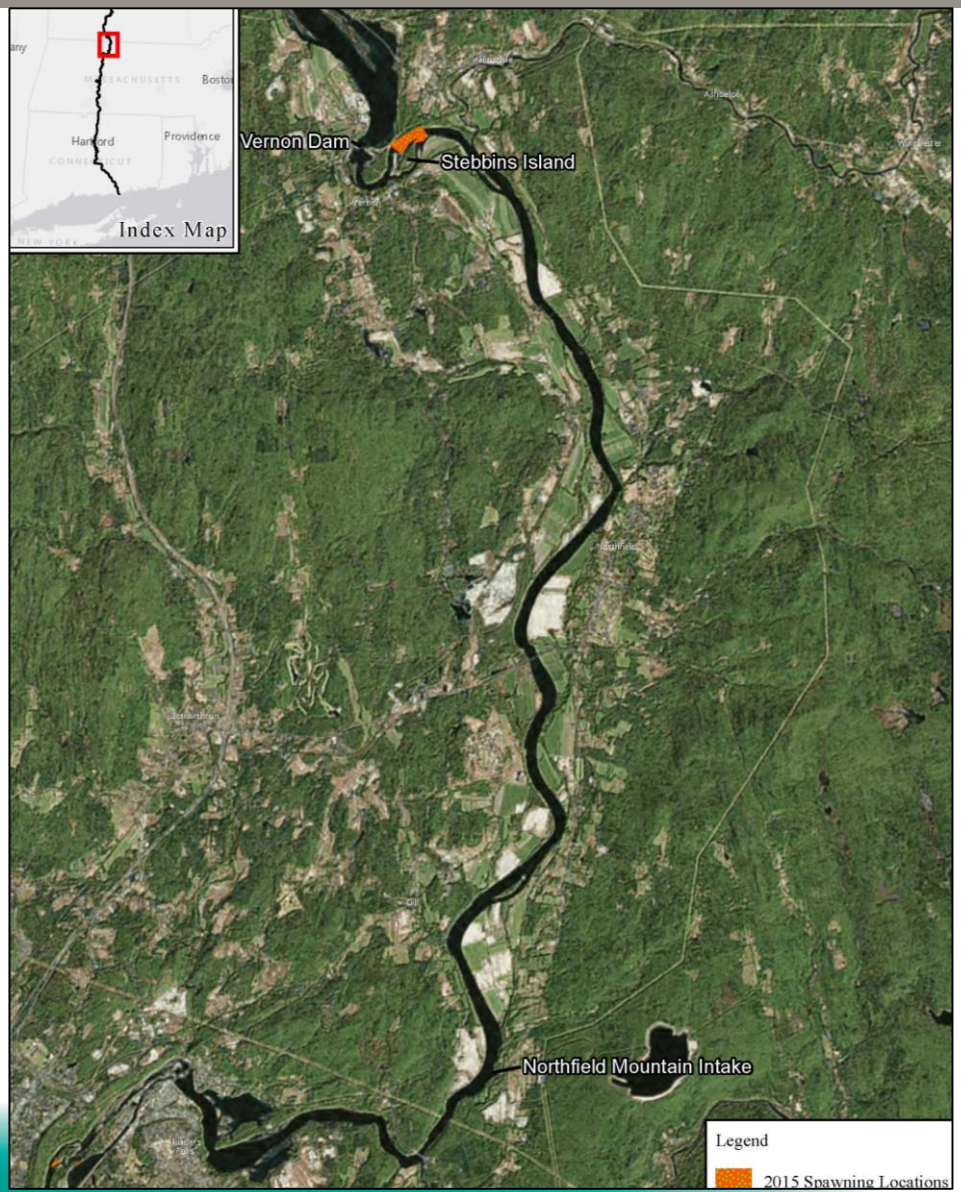




3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

Phase 2 Surveys – Impoundment

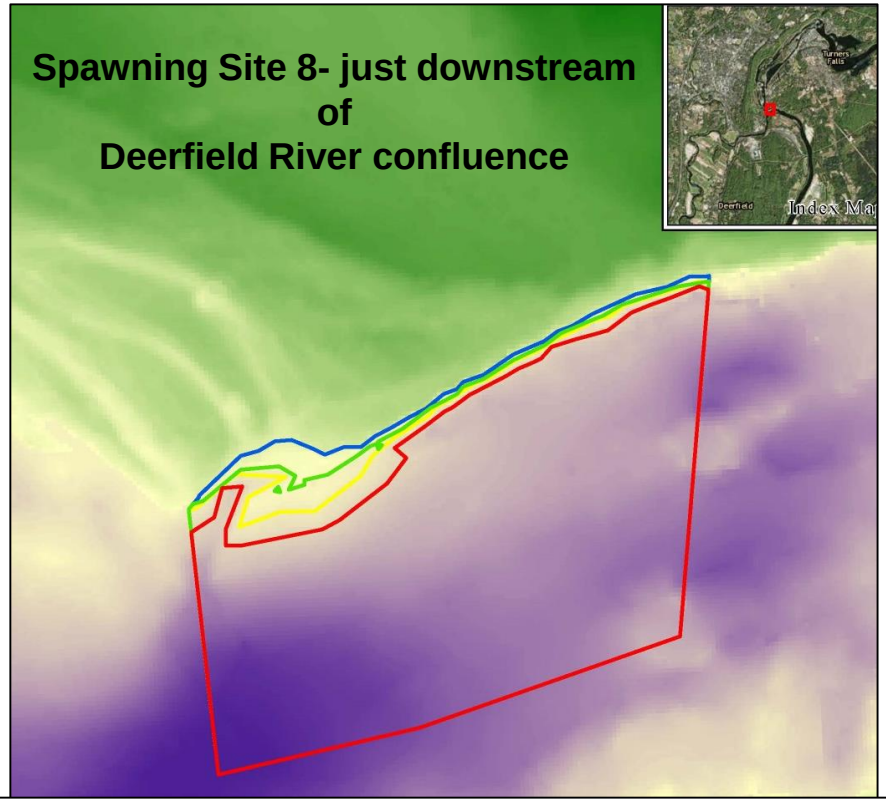
- Spawning activity was documented in a 39 acre area near the downstream end of Stebbins Island during 7 separate events.
- The Vernon Hydroelectric Project is located less than 2 river kilometers upstream from this spawning area.
- Shad eggs and larvae were collected downstream of the spawning area and densities ranged from 7 to 101 eggs per 100 m^3; 2 larvae were also collected.



3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

Spawning Habitat During Generation Changes

- In general, changes in area due to increasing or decreasing Cabot Station generation by 1 or 2 units were minimal.
- Spawning sites were impacted by a maximum of 2% during generation change.
- The magnitude of area changes at the sites closest to Cabot Station was less than at Fourth Island.



Legend

Elevation NGVD29 ft

High : 156.575

Low : 71.48

Wetted Spawning Area At Minimum Observed WSEL During Study Period (WSEL 107.72ft, 3,180cfs @ USGS 01170500)

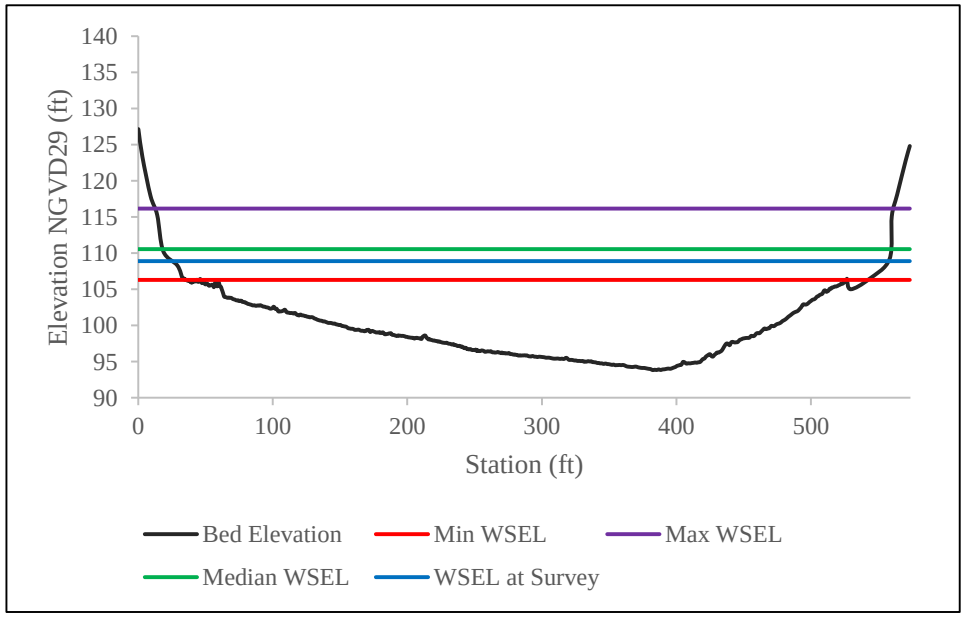
Wetted Spawning Area At Median WSEL During Study Period (WSEL 112.74ft, 13,000cfs @ USGS 01170500)

Wetted Spawning Area at Survey WSEL (WSEL 111ft, 8,310cfs @ USGS 01170500)

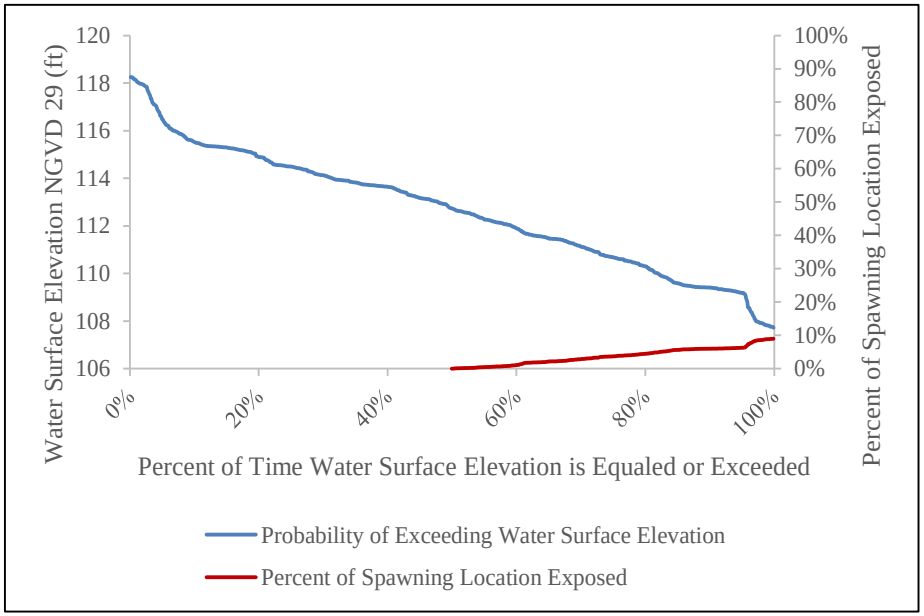
Wetted Spawning Area at Maximum Observed WSEL During Study Period (WSEL 118.37ft, 36,600cfs @ USGS 01170500)

3.3.6- Impact of Project Operations on Shad Spawning, Spawning Habitat and Egg Deposition in the Area of the Northfield Mountain and Turners Falls Projects

Minimum, Maximum, Median, and Survey Time WSEL for Spawning Site 9



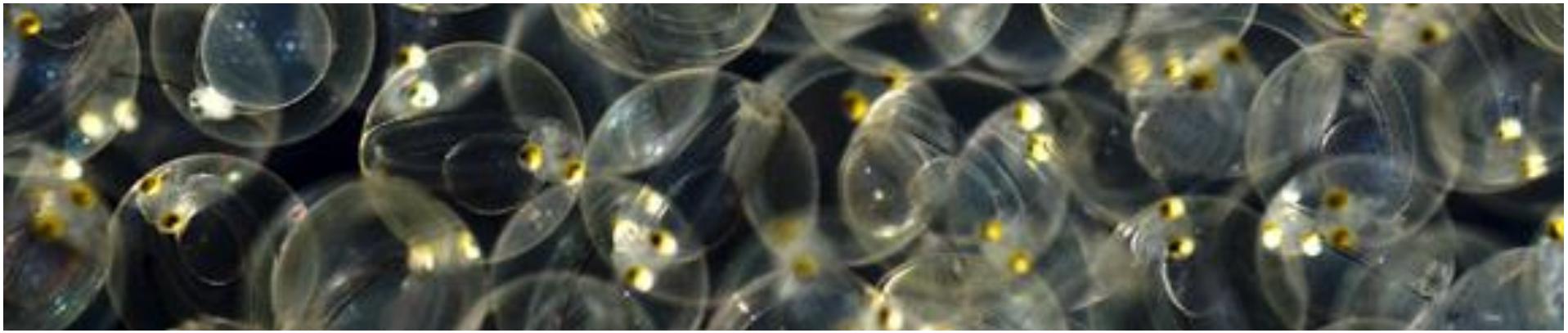
Habitat Duration Curve for Spawning Site 8



3.3.20- Study to Evaluate Entrainment of Ichthyoplankton at the Northfield Mountain Pumped Storage Project

Study Objectives

- Calculate the number of American shad eggs and larvae entrained at the Northfield Mountain Project;
- Estimate the loss of adult and juvenile shad equivalents based on shad egg and larvae entrainment at the Northfield Mountain Project;
- Compare entrainment rates with one through four units pumping; and
- Determine the temporal distribution of entrainment within the prevailing pumping period.



3.3.20- Study to Evaluate Entrainment of Ichthyoplankton at the Northfield Mountain Pumped Storage Project

Entrainment Sampling

Sampling system consisted of PVC and rubber piping, a digital flow meter, a 1,000-liter plastic tank, and a 0.333 mm mesh plankton net. 100 m^3 (26,500 gallons) of intake water at a rate of 3 and 3 ½ gal/sec was filtered for each sample. Approximately 2 hours to collect each sample.

Offshore Sampling

Samples were collected in the intake/tailrace channel with a weighted 60-cm diameter paired bongo nets with 0.333 mm mesh deployed from a boat. Nets were towed until at least 100 m^3 of river water were sampled. General Oceanics flowmeters were suspended in the center of each net to measure the volume of river water filtered during each tow.

Sample Processing

Samples were sorted by biologists trained in ichthyoplankton identification with the aid of a dissecting microscope. American shad larvae and eggs were removed from the samples, identified and enumerated. A QC program designed to ensure that the Average Outgoing Quality Limit for sorting and identification is greater than 90% was followed.

3.3.20- Study to Evaluate Entrainment of Ichthyoplankton at the Northfield Mountain Pumped Storage Project

Findings

- 23 entrainment samples and 12 verification samples were collected from May 28 to June 26, 2015.
- The entrainment sample densities are the sample count divided by the sample volume.
- No larvae were counted in entrainment samples.
- Offshore sampling was conducted adjacent to Northfield Mountain intake on evenings corresponding with the special unit scenarios (6/9/2015- 4 units, 6/10/2015- 3 units, 6/18/2015- 2 units and 6/19/2015- 1 unit).
- Overall shad egg densities collected at the intake were lower than those collected in the entrainment samples.
- The only area shad were detected spawning in the impoundment was 22 RKM upstream, at the downstream end of Stebbins Island. Here, egg densities from May 19 to June 18, 2015 ranged from 7 to 101 per 100 m^3.

3.3.20- Study to Evaluate Entrainment of Ichthyoplankton at the Northfield Mountain Pumped Storage Project

Findings

- Shad densities in entrainment samples were low. When extrapolated by the volume of water pumped during the spawning season just over 3 million shad eggs and 500,000 shad larvae were estimated to be entrained at the Northfield Mountain Project in 2015.
- Based on the entrainment estimate the number of equivalent juvenile and adult American shad lost to entrainment was estimated to be 696 juveniles and 94 adult American shad.
- American shad spawning strategy includes broadcasting large numbers of eggs which experience high natural mortality.
- Female American shad spawn between 150,000-500,000 eggs, with fecundity increasing with age, length, and weight.
- Only about 1 out of every 100,000 eggs survives to become a spawning adult.
- High fecundity is critical for continuing the stock.

3.3.11- Fish Assemblage

Study Objectives

- Document species occurrence, distribution, and relative abundance of resident and diadromous fish within the project area along spatial and temporal gradients.
- Describe the distribution of resident and diadromous fish species within reaches of the river and in relationship to habitat.
- Compare historical records of fish species occurrence in the project area to results of this study.

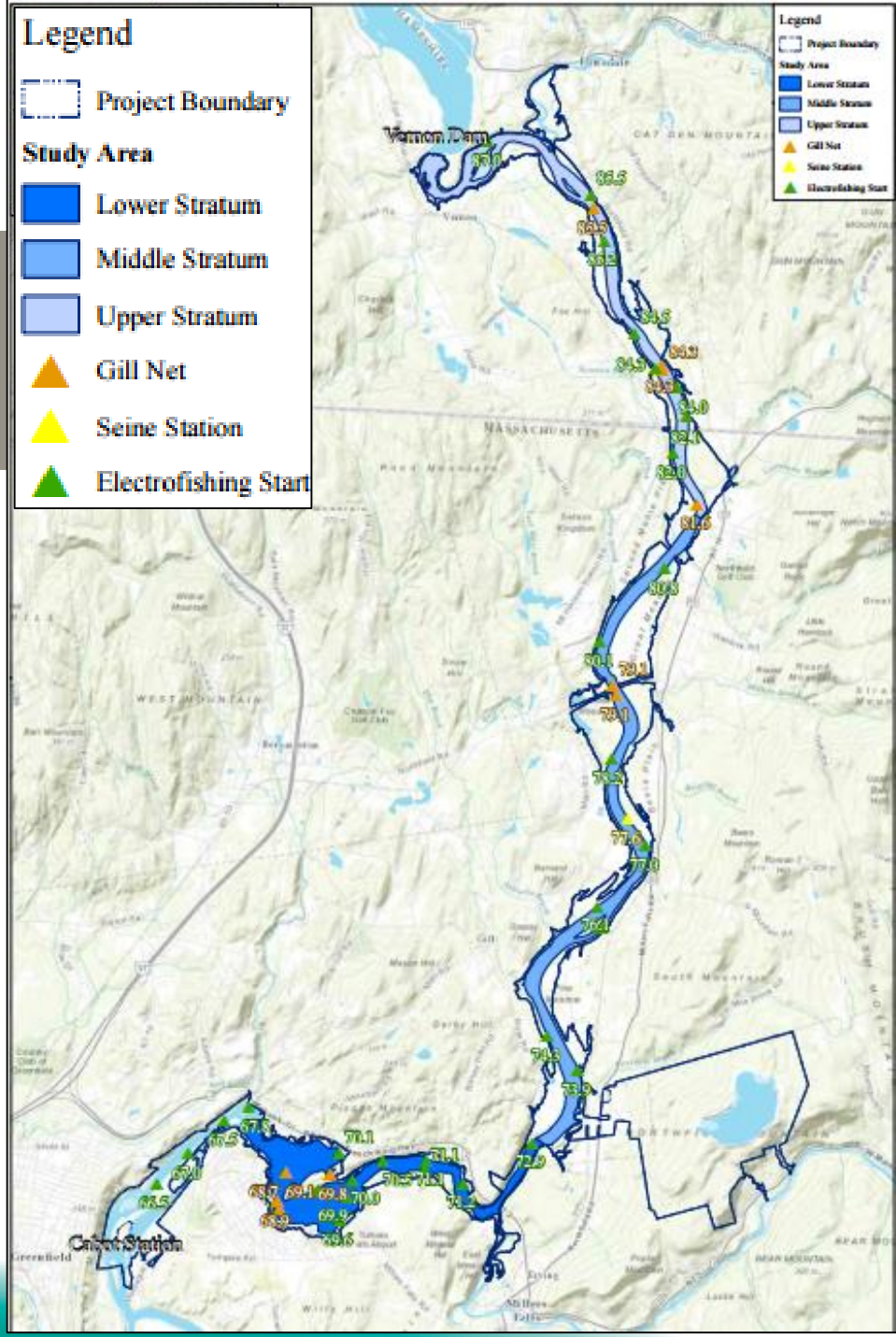
Sampling Periods

- Turners Falls Impoundment- Early and Late Summer
  - Stratified Sampling Design
- Bypass Reach- Late Summer
  - All mesohabitats sampled

3.3.11- Fish Assemblage

Impoundment Sampling

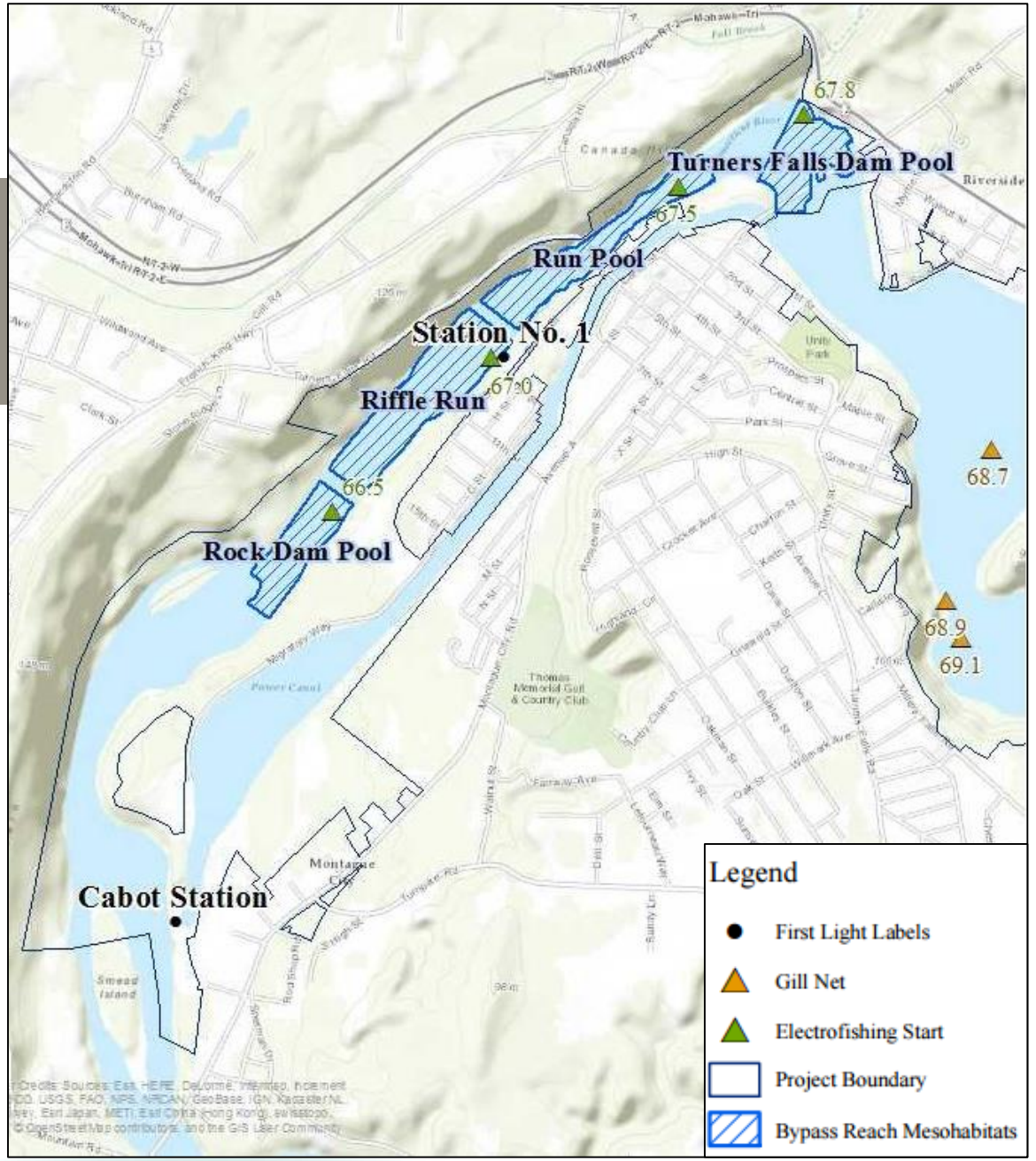
- 24 boat electrofishing samples
- 11 gill net samples
- 6 seine/electrofishing stations



3.3.11- Fish Assemblage

Bypass Reach

- 4 raft electrofishing samples



3.3.11- Fish Assemblage

Species Occurrence, Distribution & Relative Abundance

- 5,908 individuals of 28 species

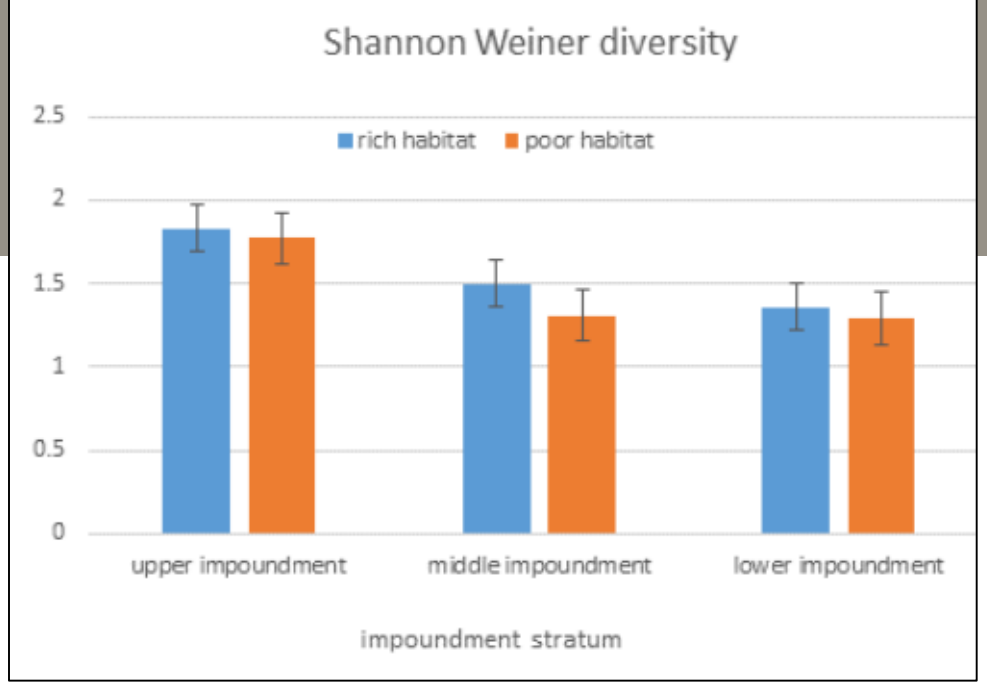
Impoundment

- Early Summer: Spottail shiner (44%), smallmouth bass (16%) & yellow perch (14%) accounted for 74% of the catch.
- Late Summer: Spottail shiner (48%), smallmouth bass (15%), yellow perch (14%) and fallfish (7%) accounted for 76% of the catch.
- Smallmouth bass, fallfish, rock bass, tessellated darter and American eel abundance was greater in the upstream stratum.
- Bluegill, pumpkinseed, largemouth bass, banded killifish, white sucker, & yellow perch tended toward greater abundance in the downstream stratum.

Bypass Reach

- Smallmouth bass (62.5%), American eel (9.7%), & bluegill (8.2%), collectively accounted for 80.4% of the overall catch.

3.3.11- Fish Assemblage



Distribution Relative to River Reaches

- The highest community diversity was associated with rich habitat and the upper TFI stratum.
- In rich habitat, SW scores ranged from 1.36 (lower TFI) to 1.83 (upper TFI).
- In poor habitat, SW scores range from 1.29 to 1.77.
- The highest mean CPUE per stratum was consistently in the lower TFI stratum.
- Habitat complexity (QHEI) correlated positively with diversity; however, diversity was only slightly different between the two categories: 1.57 (rich habitat) vs 1.43 (poor habitat).
- Sites with a QHEI score greater than 60 exhibit relatively high SW index scores of 1.8 or more.

Table 4.2.2.2-5: Turners Falls Project CPUE for 24 Impoundment Boat Electrofishing Samples during Early and Late Summer 2015

June-July Station	CPUE (fish/m)	Mean CPUE (*Standard error*)	September Station	CPUE	Mean CPUE (*Standard error*)
85.5-E	0.08		87.0-E	0.11	
84.5-P	0.05		85.2-P	0.04	
84.0-P	0.02		84.3-P	0.07	
82.0-E	0.06	0.05 (*0.013*)	82.0-E	0.08	0.08 (*0.014*)
80.1-P	0.08		80.8-P	0.04	
76.2-E	0.05		80.1-E	0.05	
74.3-P	0.06		77.0-E	0.13	
73.9-E	0.03	0.06 (*0.010*)	76.1-P	0.05	0.07 (*0.021*)
72.9-E	0.05		71.2-E	0.09	
71.1-P	0.26		70.5-E	0.25	
69.9-E	0.02		70.0-P	0.20	
69.5-P	0.21	0.14 (*0.059*)	69.5-P	0.20	0.19 (*0.034*)

Green-shaded stations are in the upper impoundment; blue-shaded station are in the middle impoundment and yellow-shaded stations are in the lower impoundment.

3.3.11- Fish Assemblage

Comparison to Historical Data

- Resident fish assemblage remained relatively stable within comparable habitats between 2008 and 2015.
- The present study found 28 species; past surveys detected 19-22 species.

Impoundment

- 4 of the 6 most dominant species remained the same between 2008 and 2015.
- YOY of anadromous species were among the 6 most dominant species in both surveys.
- 4 of the 6 most dominant species remained the same between 1970's and 2015.
- Diadromous (YOY) were dominant in 2015, but absent in the 1970's.

Bypass Reach

- 3 of the 6 most dominant species remained the same in both 2009 and 2015.
- Tessellated darter and bluegill were more common in 2015 than in 2009.
- Sea lamprey YOY were evident in both surveys, but not common.

Species listed in declining order of rank score dominan

2008	2015 (*September*)
smallmouth bass	smallmouth bass
sea lamprey	spottail shiner
spottail shiner	bluegill
yellow perch	fallfish
fallfish	American shad
white sucker	American eel
pumpkinseed	yellow perch
rock bass	white sucker
largemouth bass	rock bass
chain pickerel	mimic shiner
bluegill	pumpkinseed
	largemouth bass
	tessellated darter

MDFG (1978)	June-July 2015	September 2015
yellow perch	spottail shiner	smallmouth bass
pumpkinseed	smallmouth bass	spottail shiner
smallmouth bass	yellow perch	fallfish
largemouth bass	fallfish	yellow perch
bluegill	rock bass	bluegill
spottail shiner	white sucker	American shad
white sucker	bluegill	rock bass
walleye	pumpkinseed	white sucker
golden shiner	mimic shiner	pumpkinseed
black crappie	tessellated darter	American eel
white perch	golden shiner	largemouth bass
rock bass	walleye	mimic shiner
brown bullhead	American eel	banded killifish
chain pickerel	common carp	tessellated darter

3.2.1-Water Quality Monitoring Study

Study Objectives

- Characterize water temperature and DO within the TFI, bypass channel, power canal, and below Cabot Station.
- Determine potential impacts of the Turners Falls Project and Northfield Mountain Project on water temperature and DO.
- Compare collected data with applicable state water quality standards.
- Describe water temperature and temperature rate of change in the Connecticut River between Cabot Station and the Holyoke Dam.

3.2.1-Water Quality Monitoring Study

Water Quality Field Methods:

Water Temperature: April – mid-November
Dissolved Oxygen: June - September

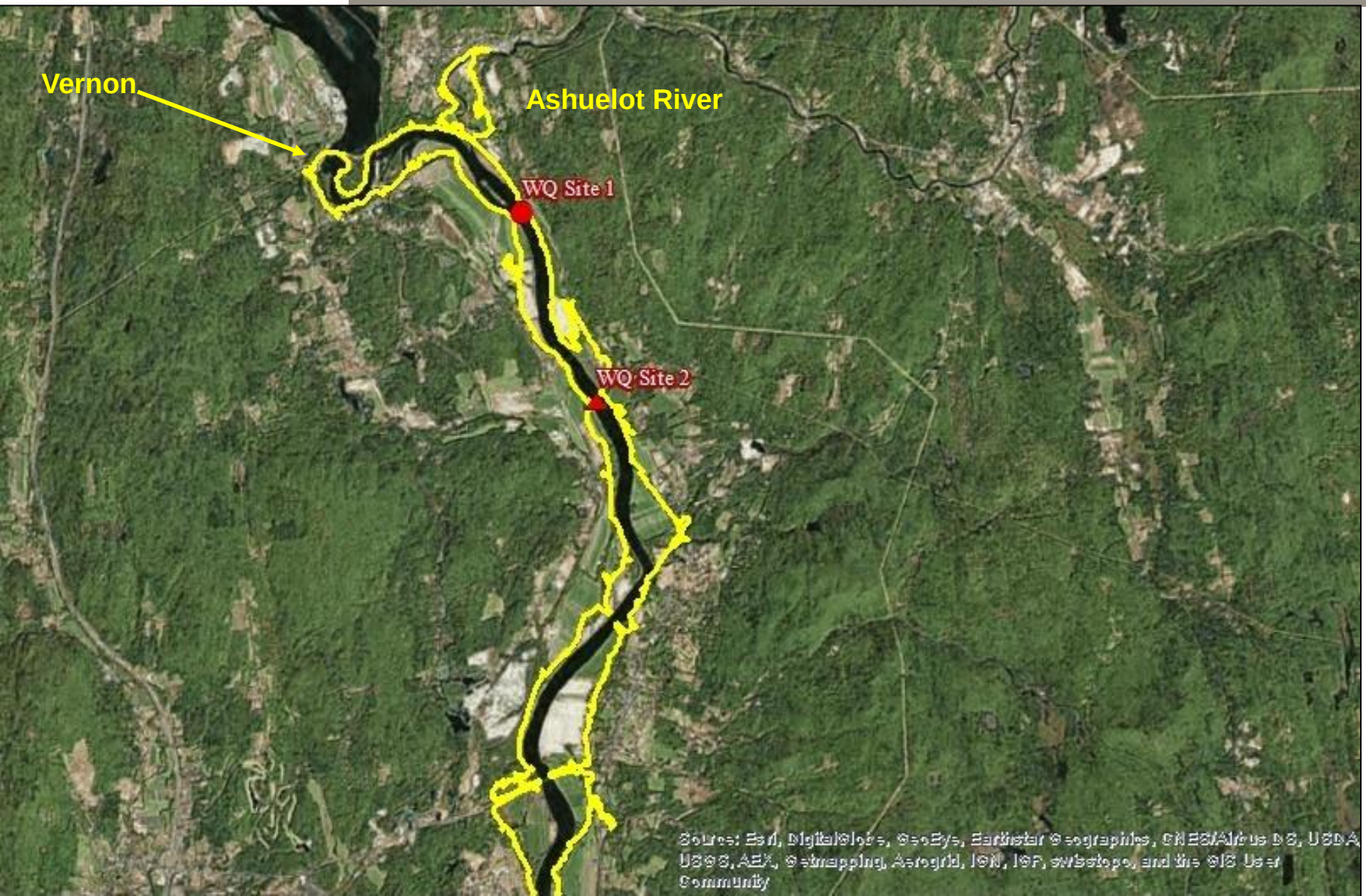
Impoundment Vertical Profiles:

- 3 locations
- Biweekly field visits
- Data in 1 m increments

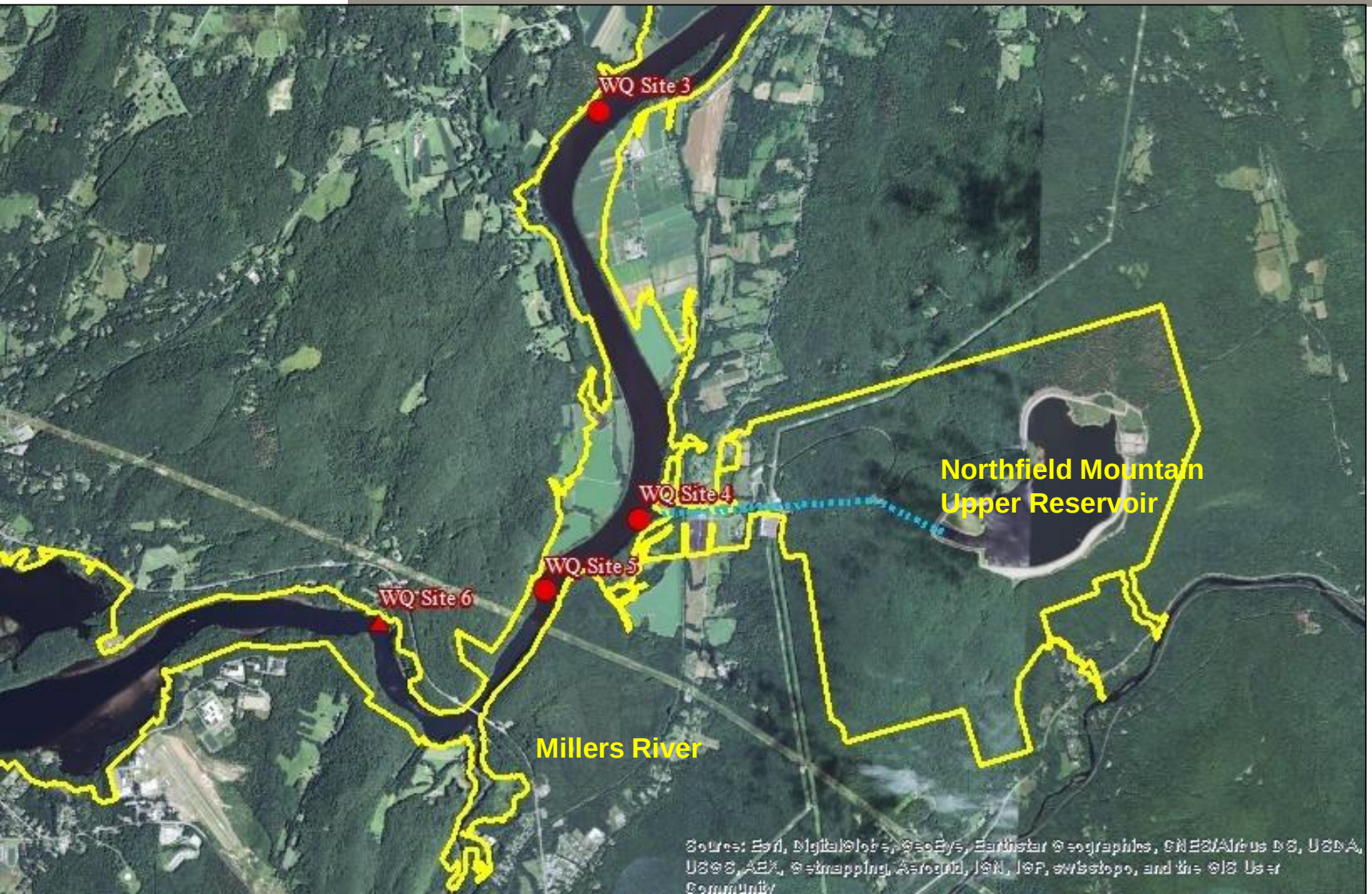
Continuous Data Monitoring:

- 18 locations
- Biweekly field visits
- Data in 15 min intervals
- DO & temperature loggers
  - 11 locations
- Temperature (only) loggers:
  - 7 locations

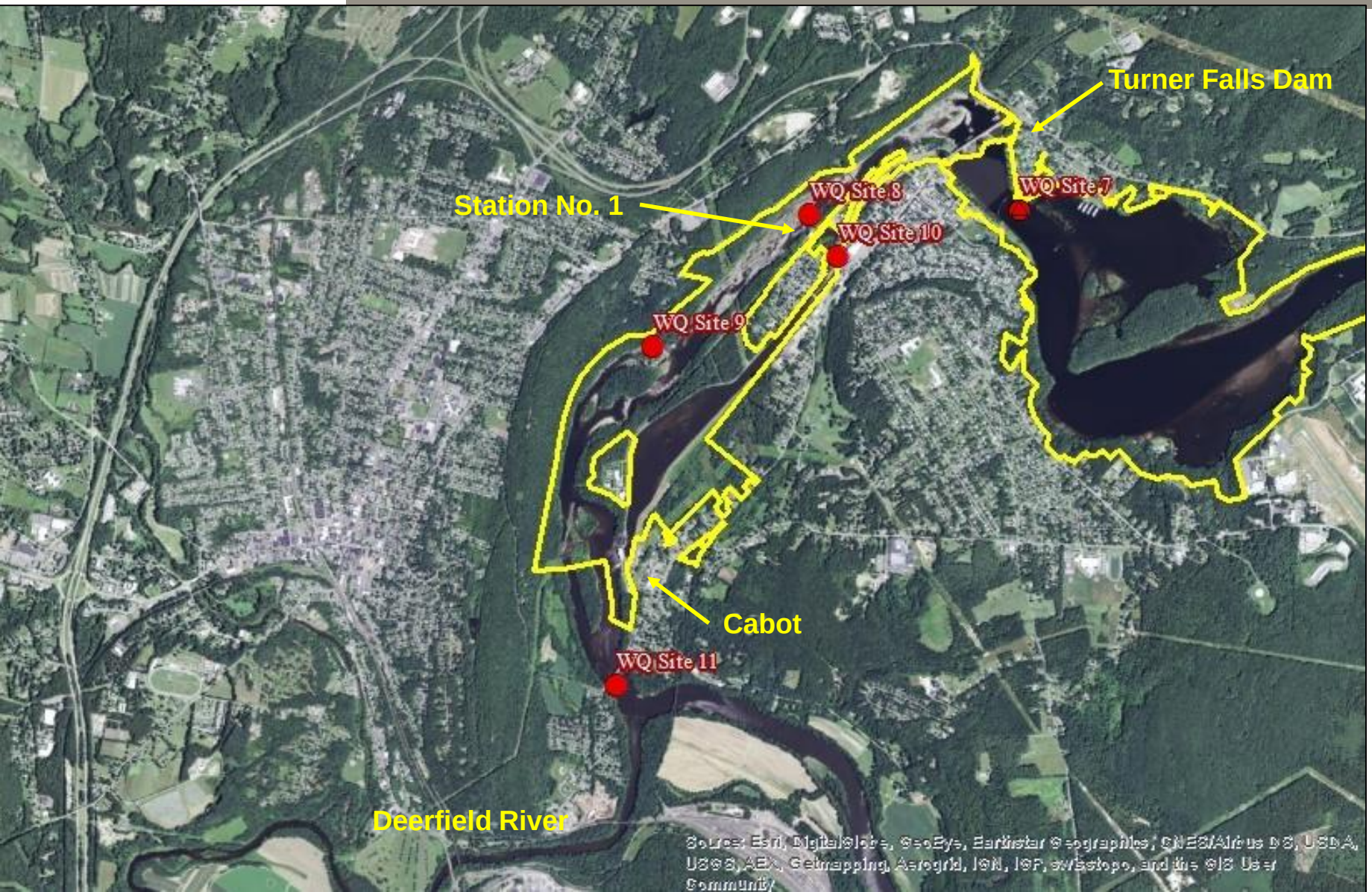
3.2.1-Water Quality Monitoring Study



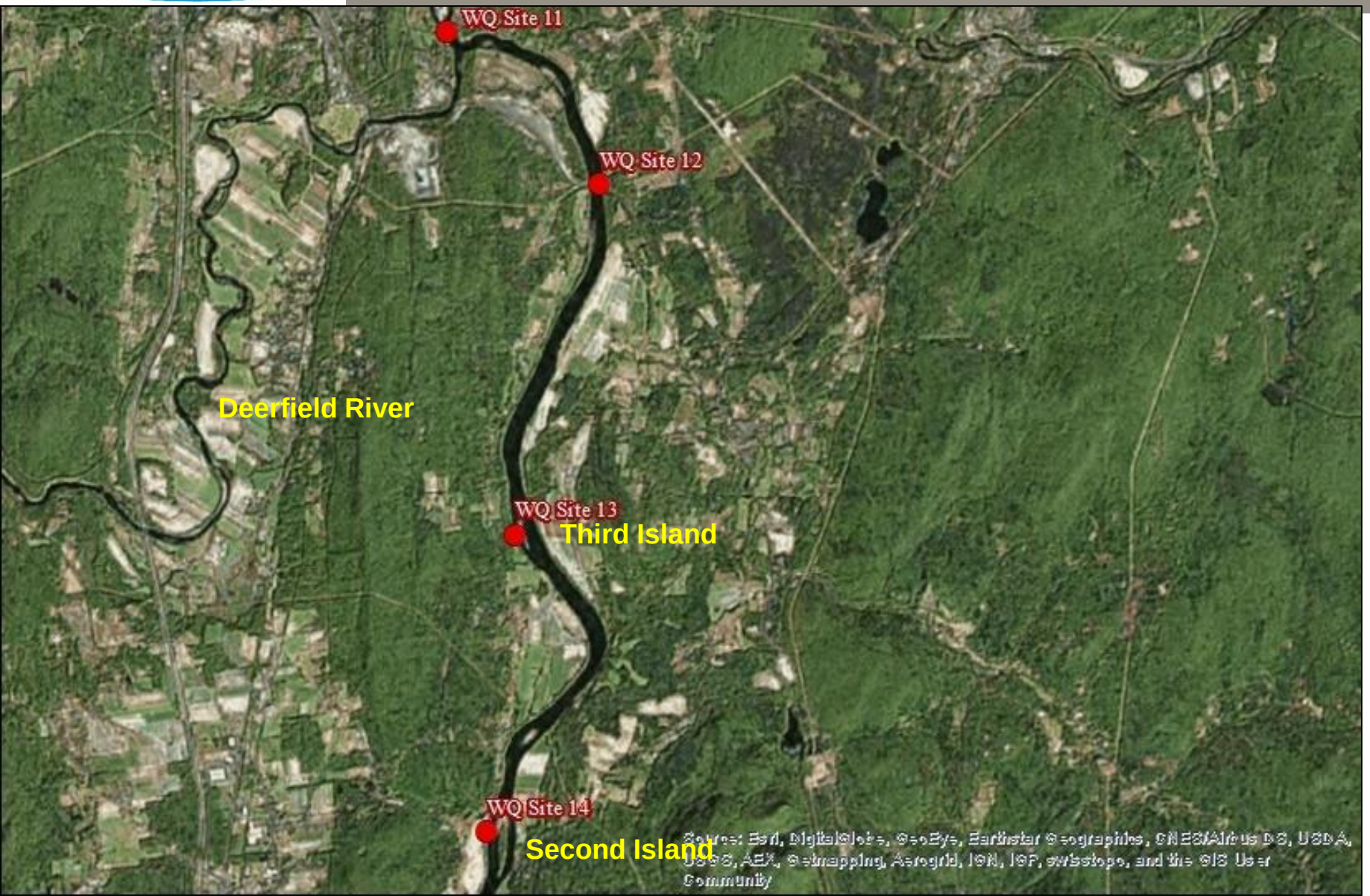
3.2.1-Water Quality Monitoring Study



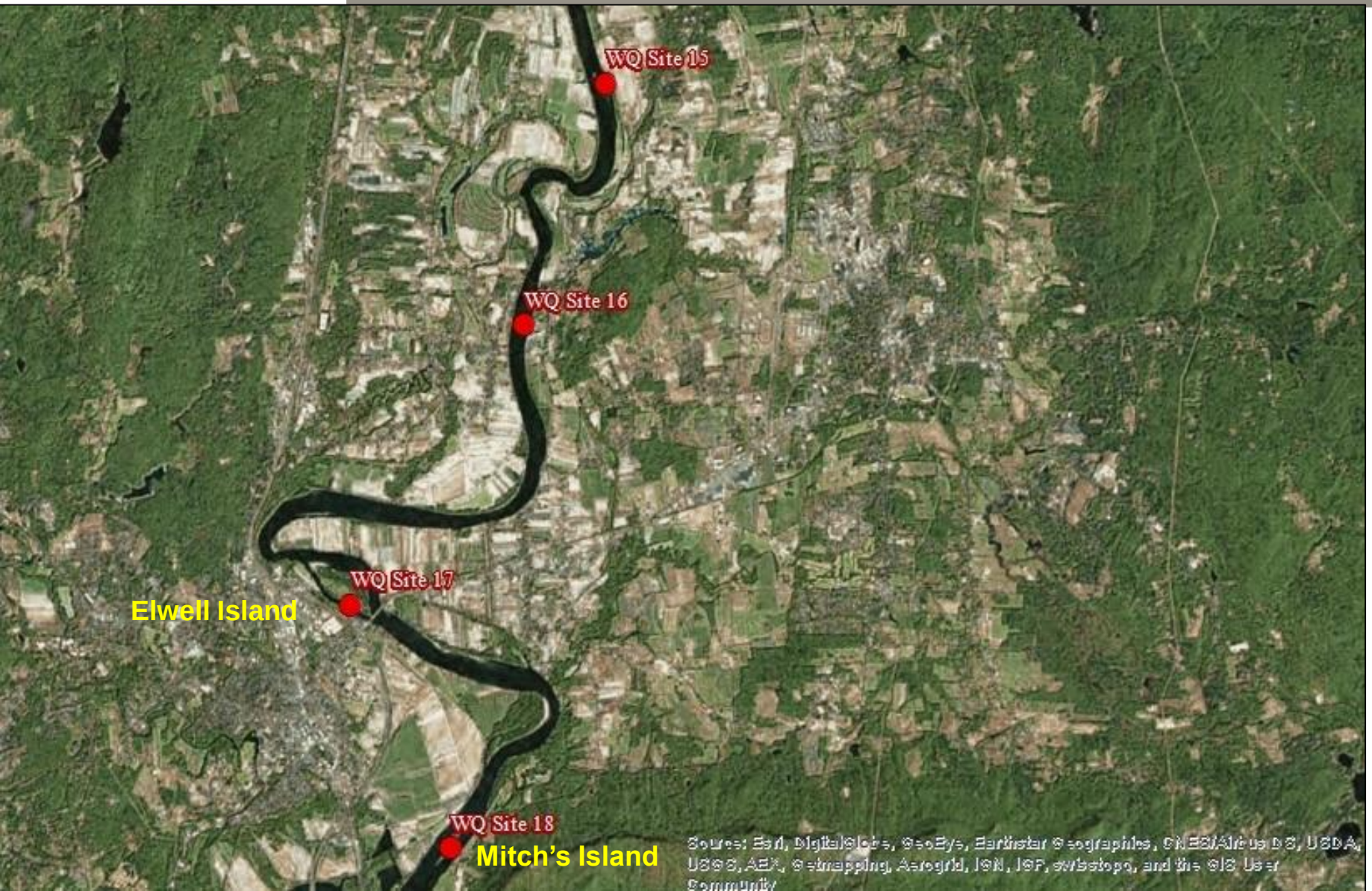
3.2.1-Water Quality Monitoring Study



3.2.1-Water Quality Monitoring Study



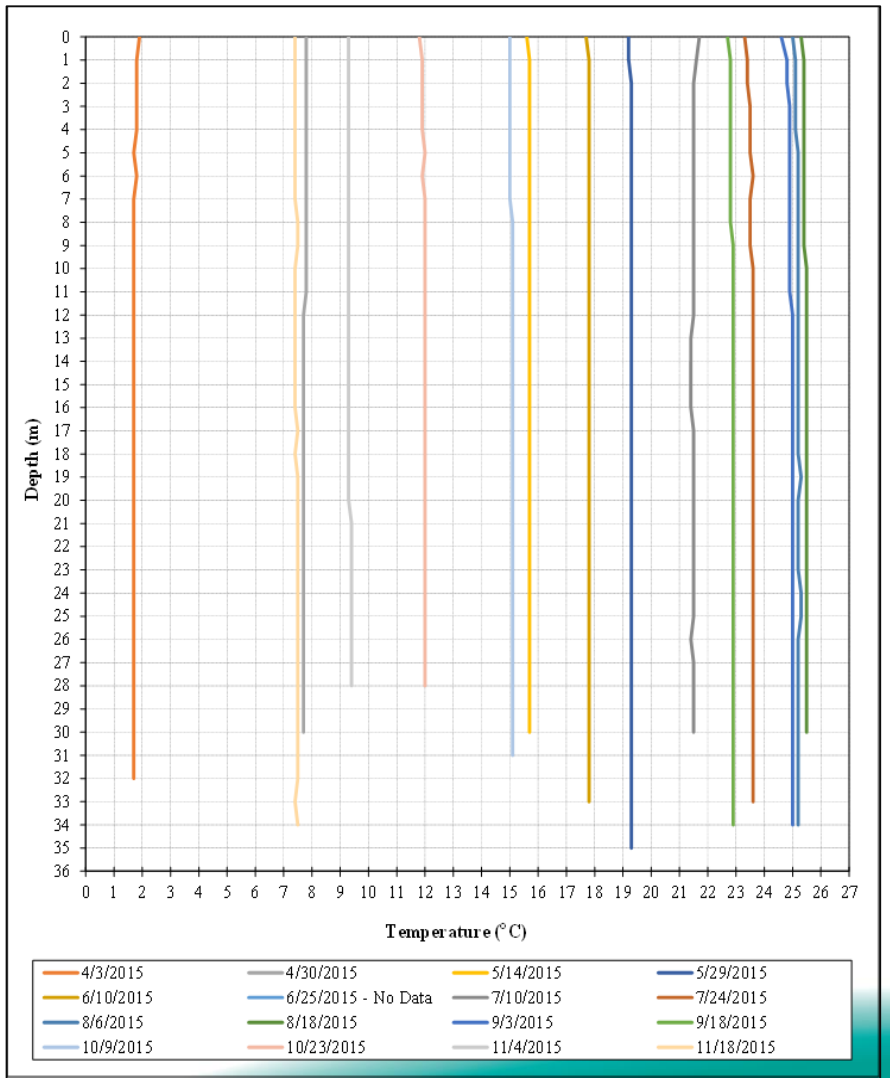
3.2.1-Water Quality Monitoring Study



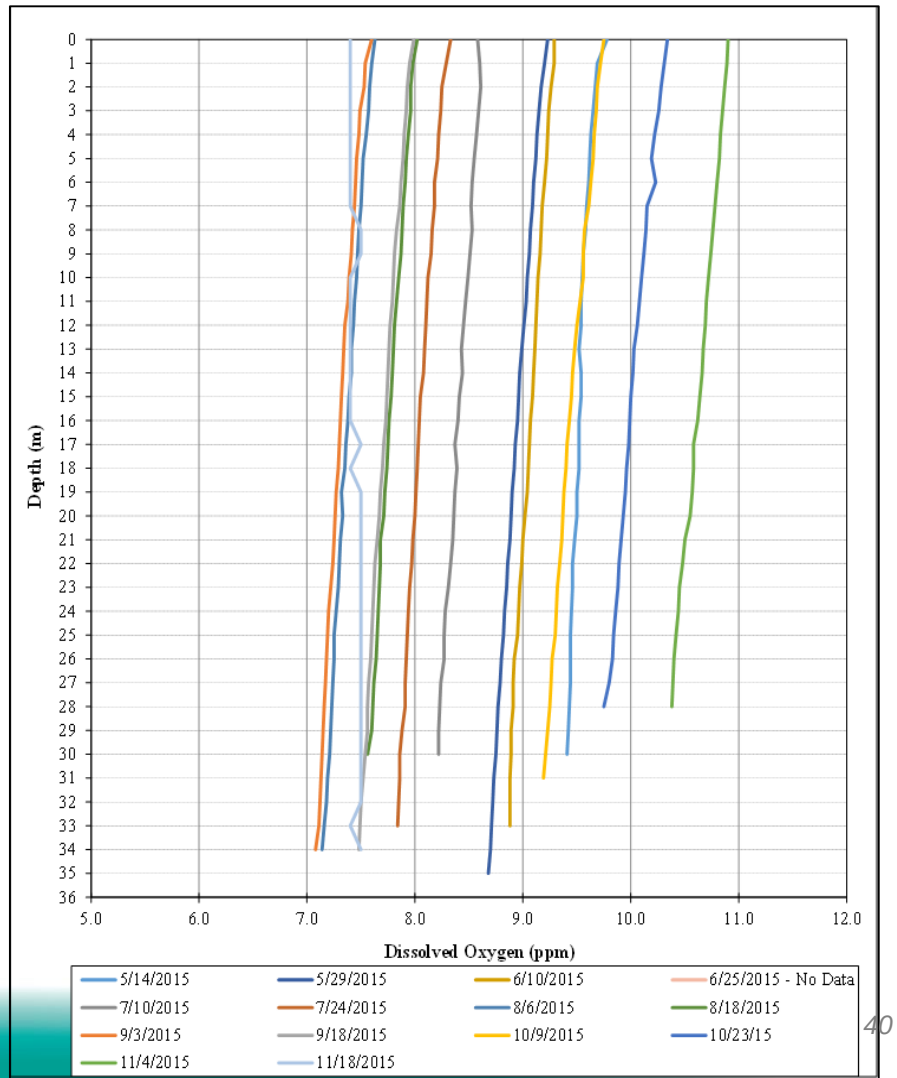
3.2.1-Water Quality Monitoring Study

Site 6 – Deepest area of TFI (up to 35 m)

2015 Temperature Results (ºC)



2015 Dissolved Oxygen Results (mg/L)



3.2.1-Water Quality Monitoring Study

All Class B MA Water Quality Standards were met

State	DO Standard	Temperature Standard
MA	No less than 5.0 mg/L. "Natural variations to be maintained. Where natural background conditions are lower, DO shall not be less than natural background conditions."	Shall not exceed 83° F (28.3° C). Rise in temperature due to discharge shall not exceed 5° F (2.8° C) based on minimum expected flow for the month.
NH	75% DO saturation based on daily average, and an instantaneous minimum dissolved oxygen concentration of at least 5 mg/L.	Related temperature increases shall not interfere appreciably with the uses of this class.
VT	No less than 5 mg/L and 60% DO saturation at all times.	Shall ensure full support of aquatic flora, fauna and habitat uses.

Instantaneous Temperature

Max: 28.1°C at Site 16 (below Cabot Station)

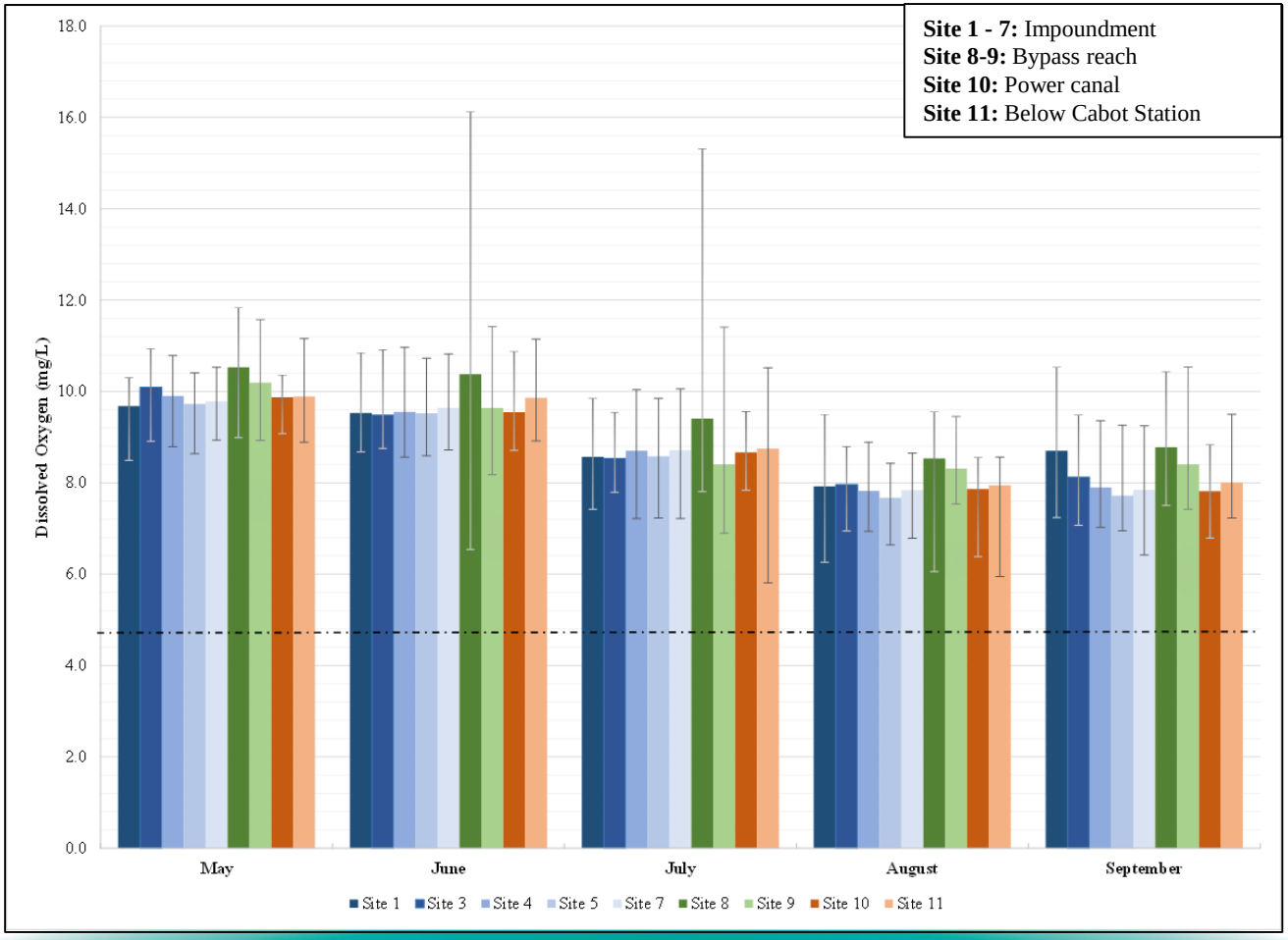
Instantaneous Dissolved Oxygen

Min: 5.8 mg/L (71.1% saturation) at Site 11 (below Cabot Station)
Max: 16.1 mg/L (181% saturation) at Site 8 (upstream of Station No. 1)

3.2.1-Water Quality Monitoring Study

Water Quality Characterization: DO (Sites 1 – 11)

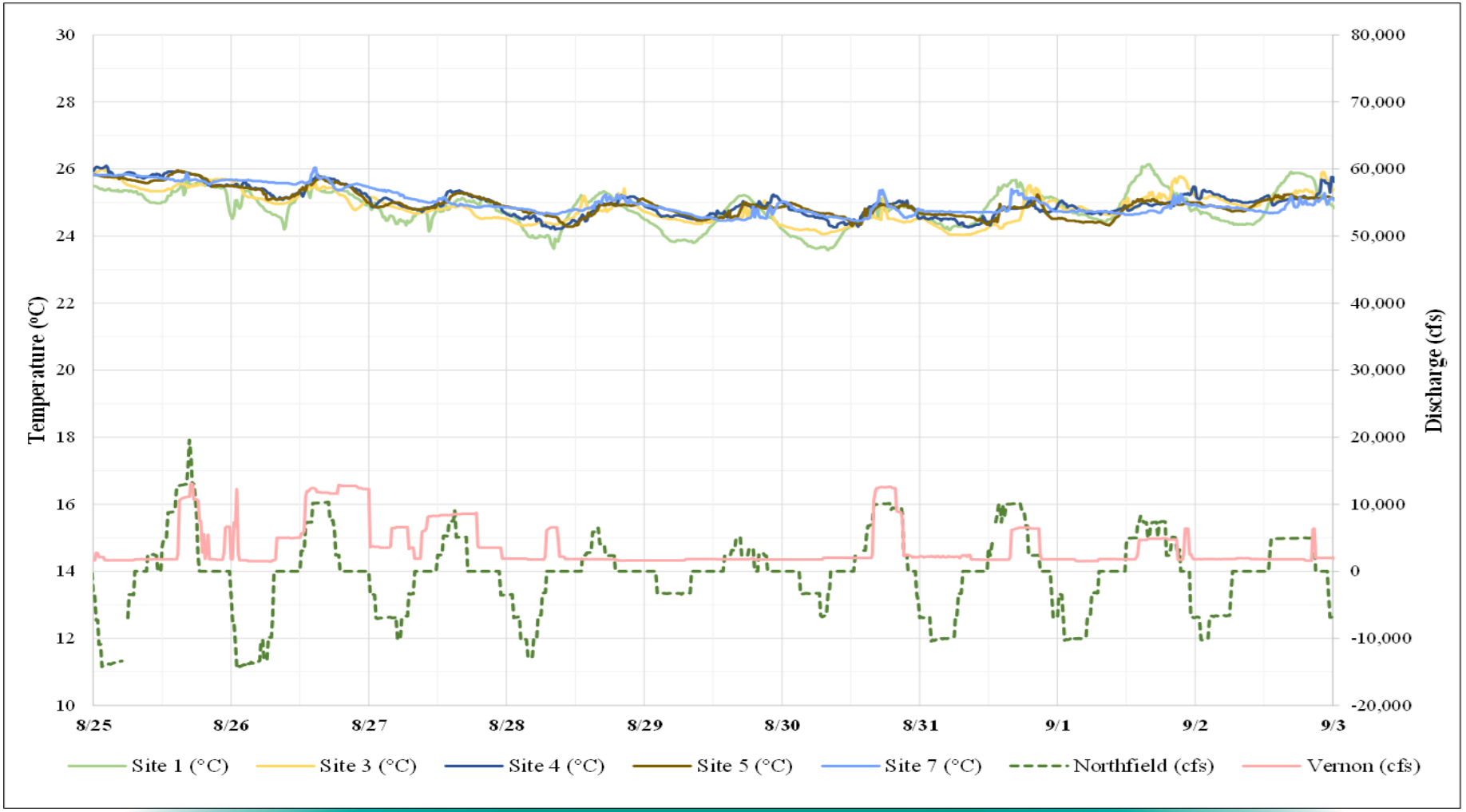
Monthly Average, Minimum and Maximum DO Concentrations (Mid-May – September, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: TFI (Sites 1 – 7)

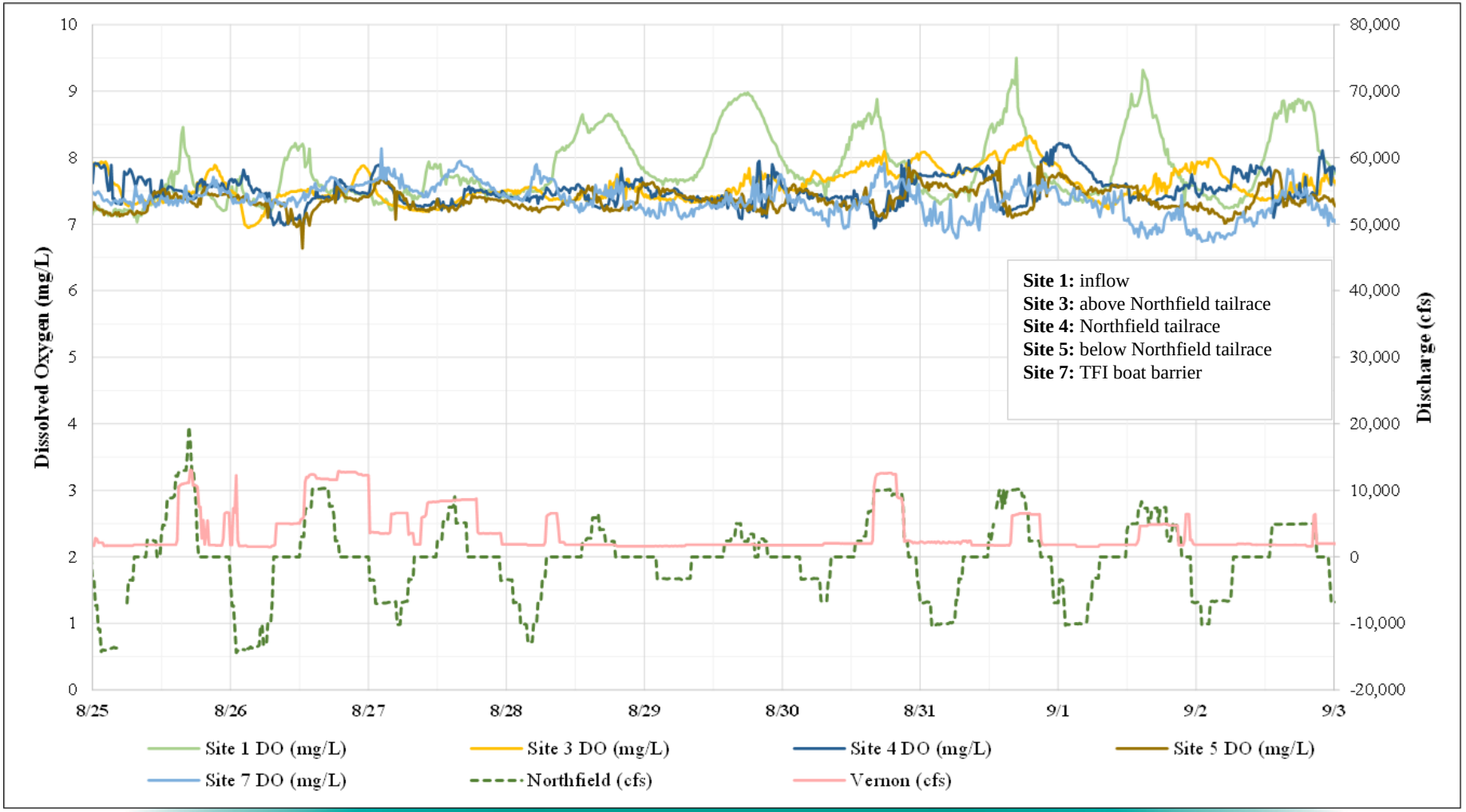
Temperature in TFI in Comparison to Vernon and Northfield Mountain Operations (Aug 25 – Sep 2, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: TFI (Sites 1 – 7)

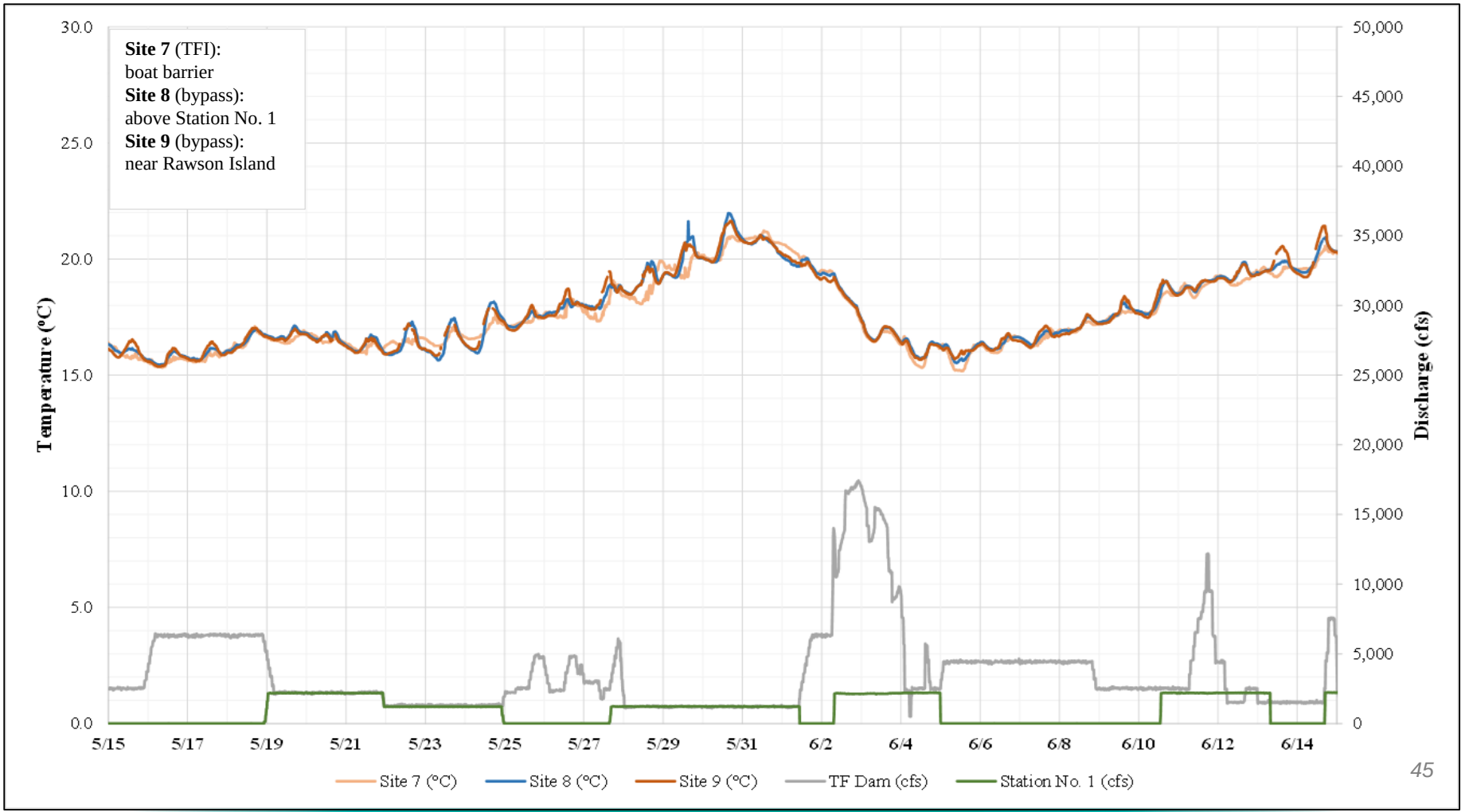
DO Concentration in TFI in Comparison to Vernon and Northfield Mountain Operations (Aug 25– Sep 2, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Bypass Reach (Sites 8 & 9)

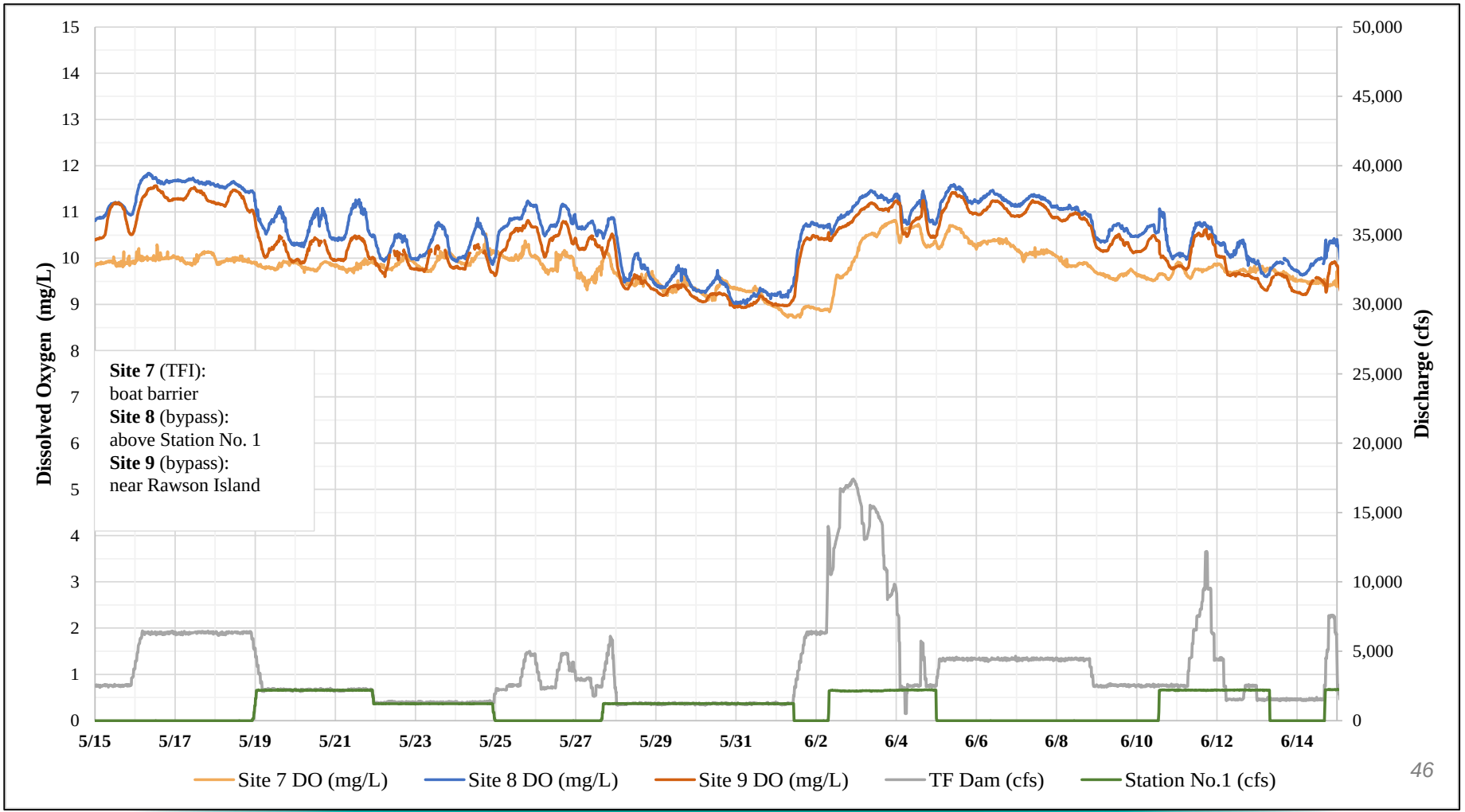
Bypass Reach Temperature compared against Turners Falls Dam Spillage and Station No. 1 Generation (May 15 – June 14, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Bypass Reach (Sites 8 & 9)

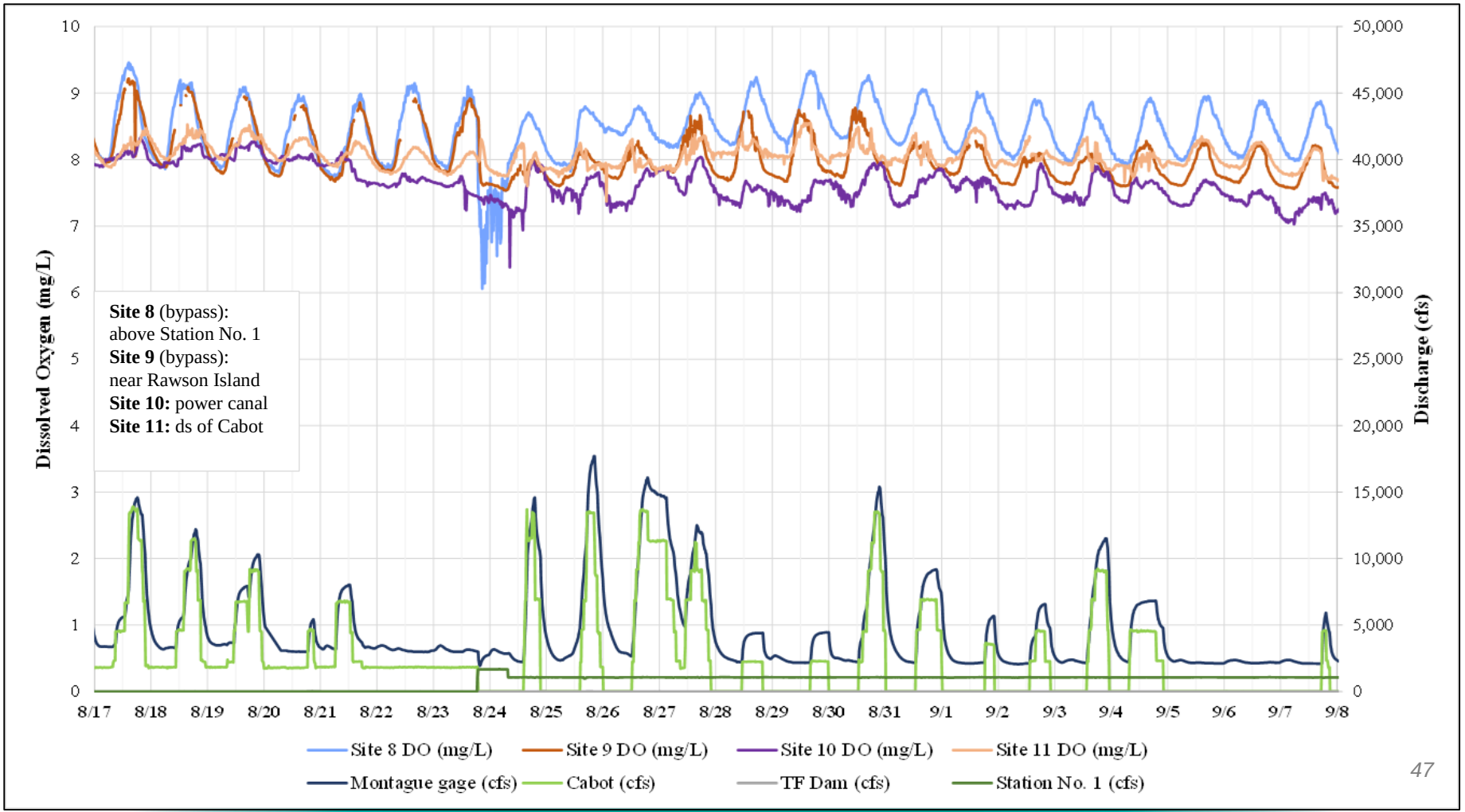
Bypass Reach DO Concentration compared Against Turners Falls Dam Spillage and Station No. 1 Generation (May 15 – June 14, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Bypass reach, power canal and ds of Cabot (Sites 8-11)

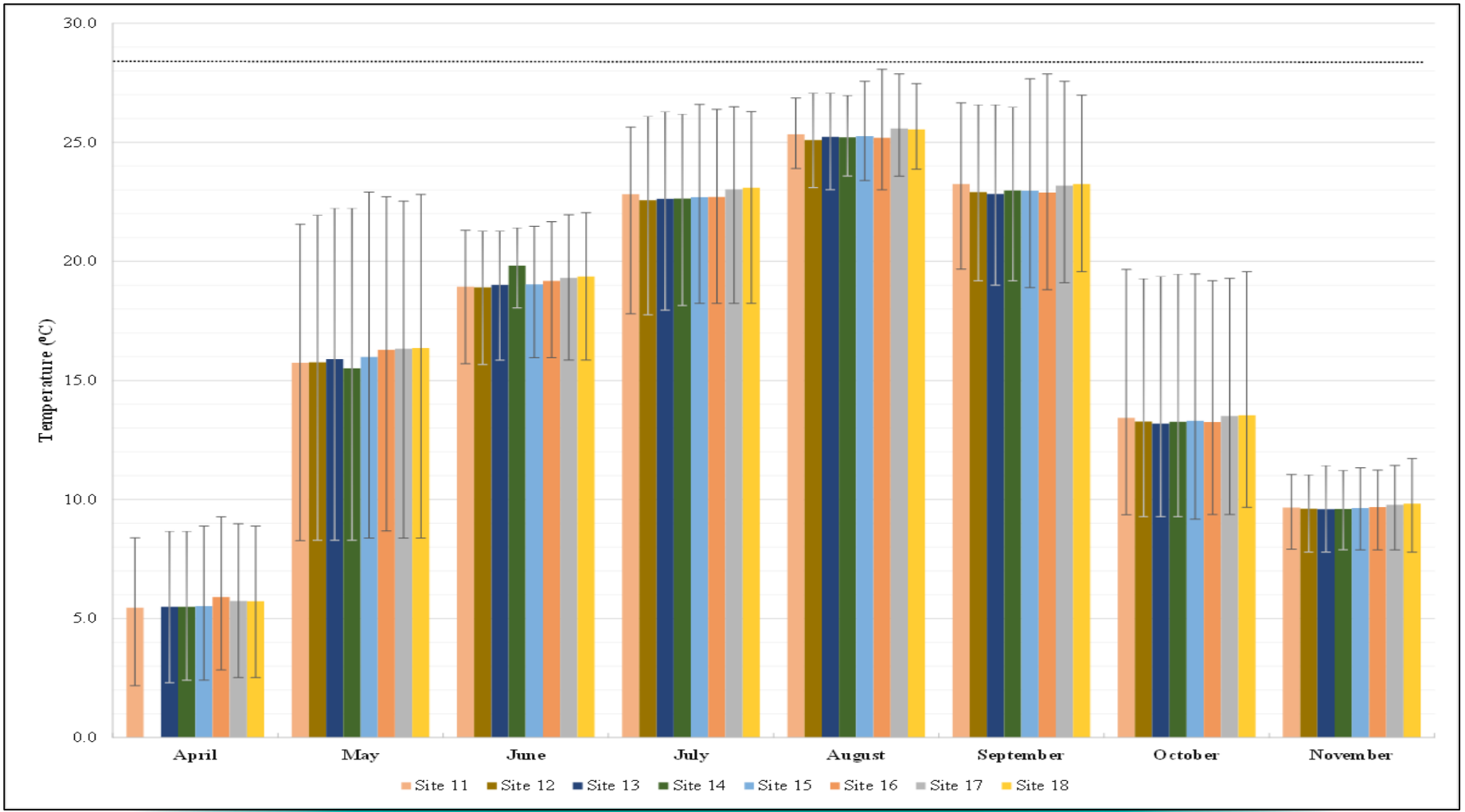
DO Concentration at Site 11 Downstream of Cabot Station (August 17 – September 7, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Downstream of Cabot Station (Sites 11-18)

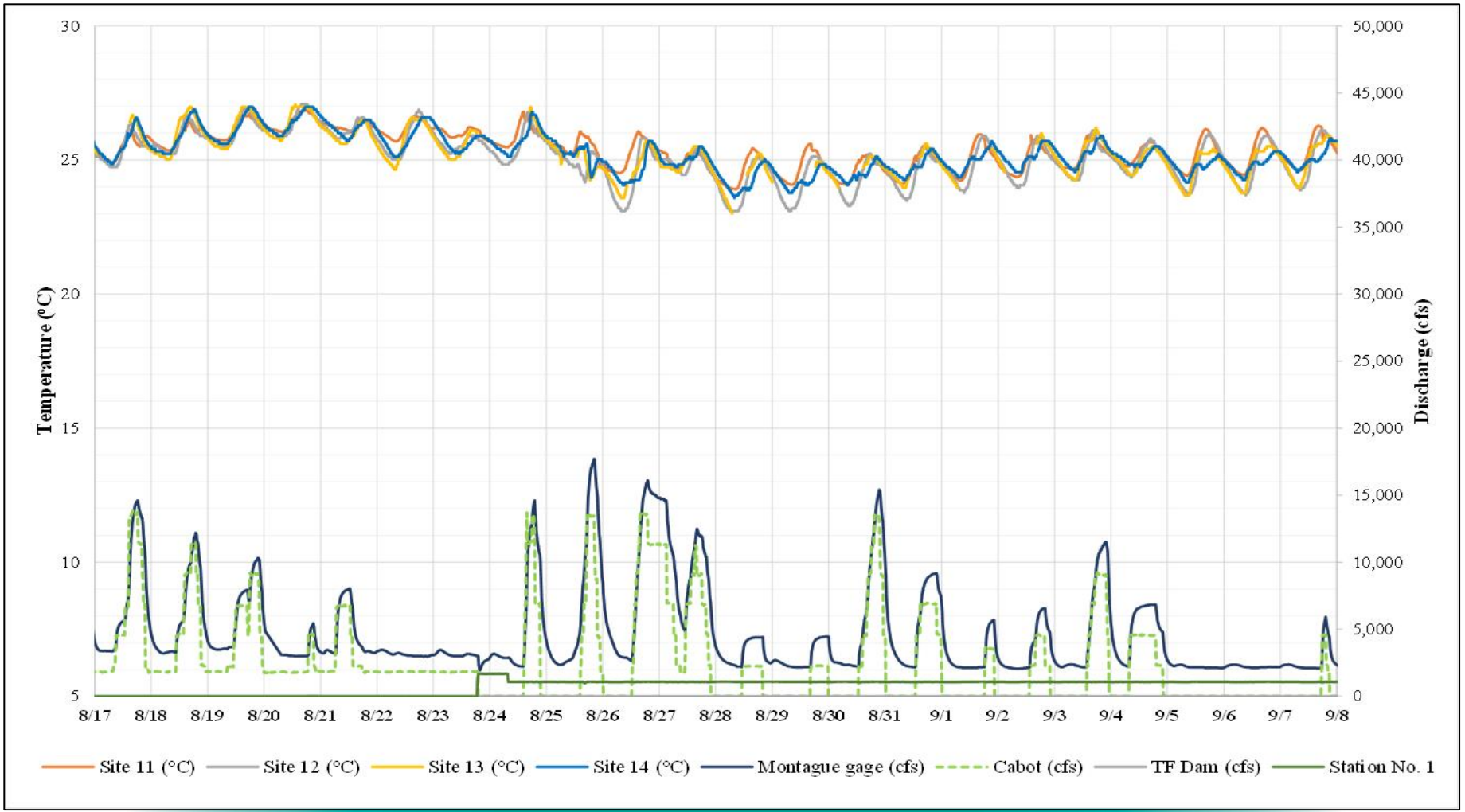
Monthly average, minimum and maximum temperatures.



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Downstream of Cabot Station (Sites 11-14)

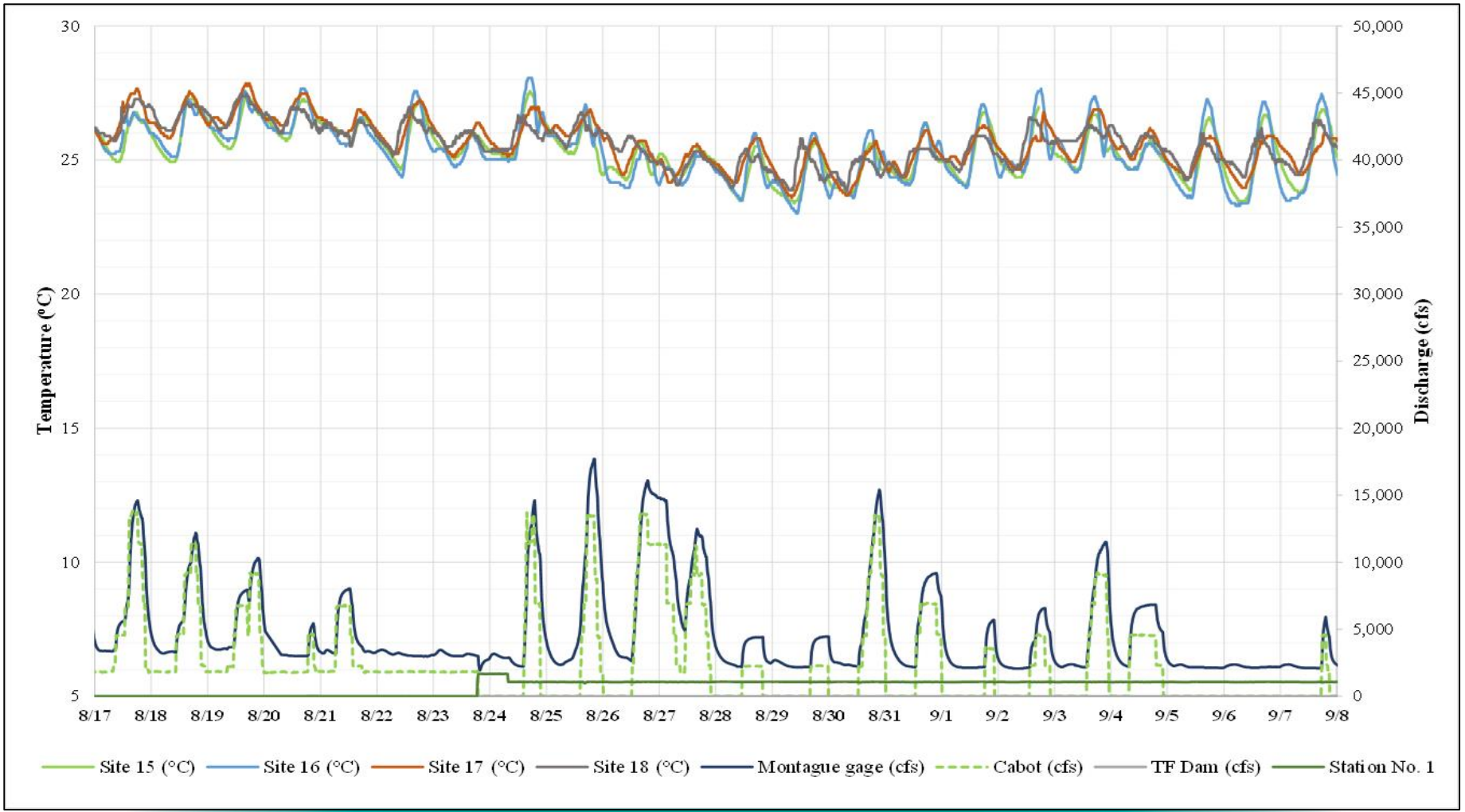
Temperature at downstream locations (August 17 – September 7, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Downstream of Cabot Station (Sites 15-18)

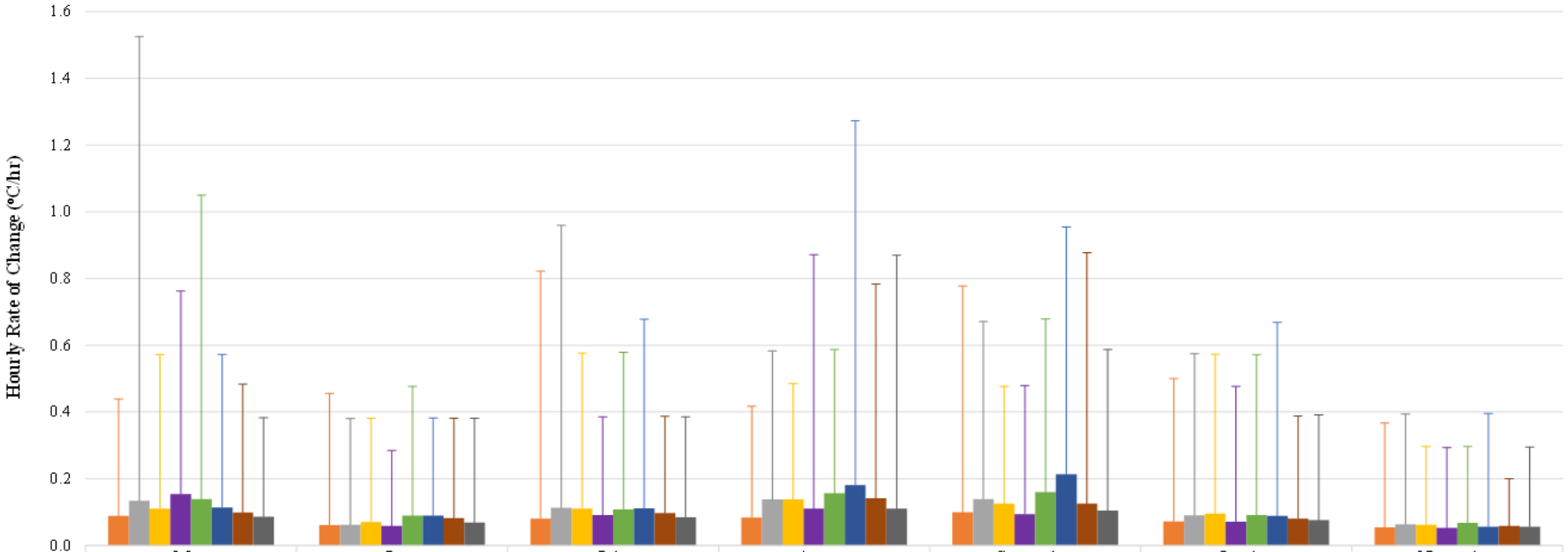
Temperature at downstream locations (August 17 – September 7, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Bypass reach, power canal and d/s of Cabot (Sites 8-11)

Monthly Average and Maximum Temperature Rate of Change (RoC)

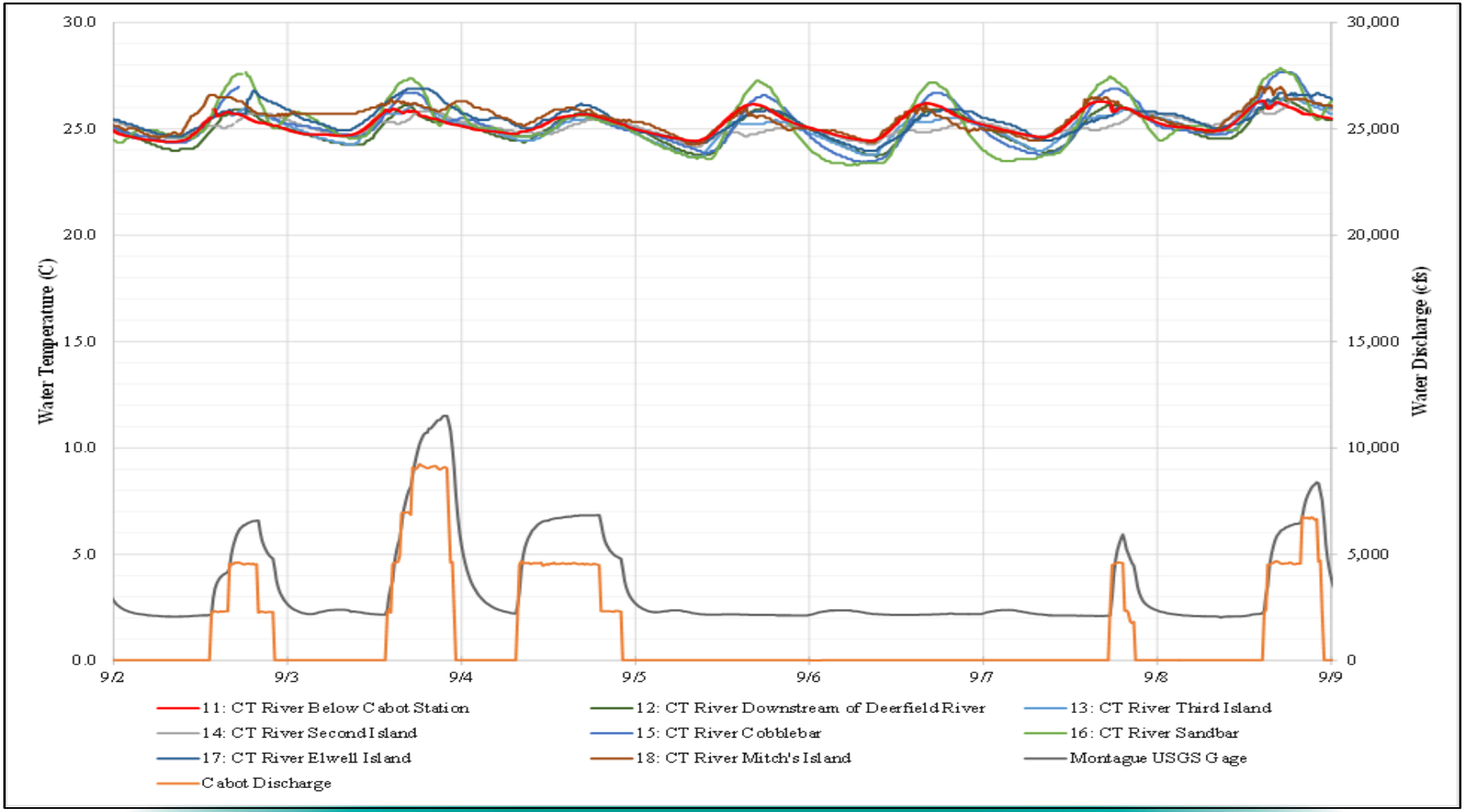


	May	June	July	August	September	October	November
Site 11	0.09	0.06	0.08	0.08	0.10	0.07	0.05
Site 12	0.13	0.06	0.11	0.14	0.14	0.09	0.06
Site 13	0.11	0.07	0.11	0.14	0.13	0.10	0.06
Site 14	0.15	0.06	0.09	0.11	0.09	0.07	0.05
Site 15	0.14	0.09	0.11	0.16	0.16	0.09	0.07
Site 16	0.11	0.09	0.11	0.18	0.21	0.09	0.06
Site 17	0.10	0.08	0.10	0.14	0.13	0.08	0.06
Site 18	0.09	0.07	0.08	0.11	0.11	0.08	0.06

3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Bypass reach, power canal and ds of Cabot (Sites 8-11)

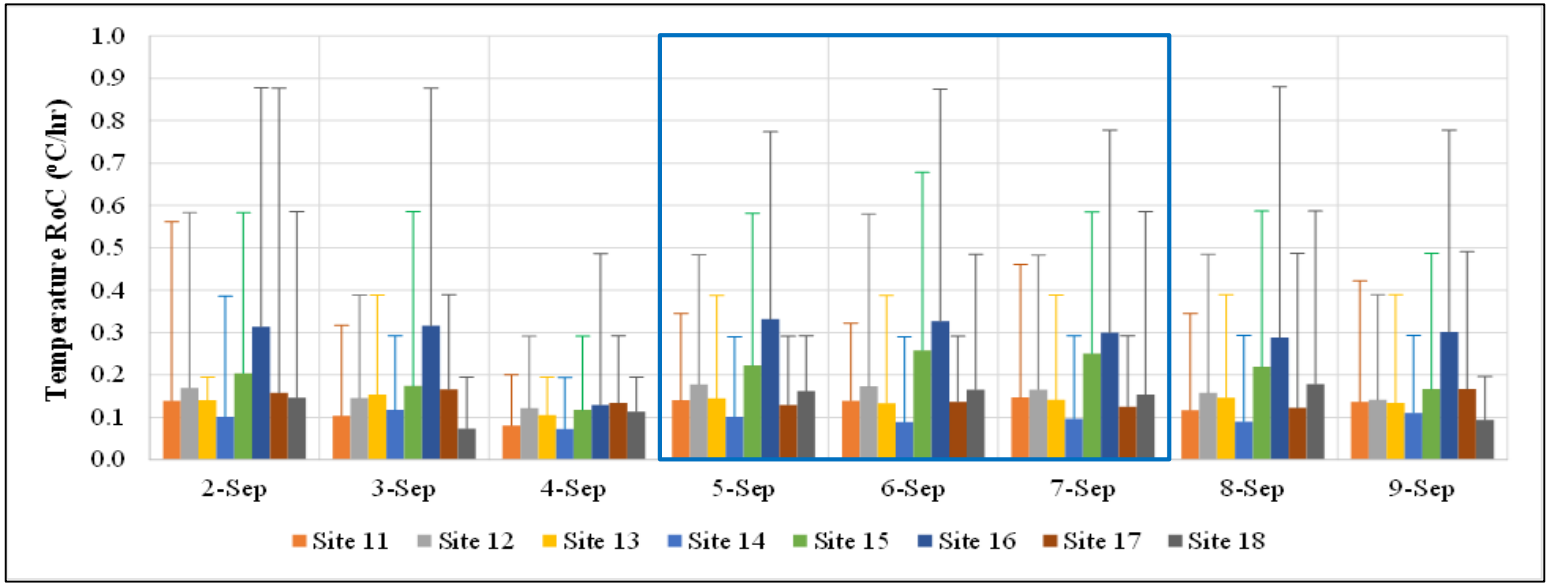
Water temperature RoC at locations below Cabot Station versus Cabot Operation status (Sep 2–8, 2015)



3.2.1-Water Quality Monitoring Study

Water Quality Characterization: Bypass reach, power canal and ds of Cabot (Sites 8-11)

Hourly average and maximum Temperature RoC (September 2 – September 9, 2015)



☐ = No Cabot Station discharge. Stable flow at Montague

3.2.1-Water Quality Monitoring Study

Conclusions

1. Study area weather and flow reflect typical conditions in 2015.
2. Turners Falls Impoundment did not stratify.
3. All MA water quality standards were met.
4. Water quality characterization:
    - Turners Falls Impoundment (1-7): short-term effects from Northfield Mountain
    - Bypass reach (8 & 9): both sites similar at low flow; DO effects from spillage
    - Downstream of Cabot Station (11-18): water temperatures and rate of change were similar site to site

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

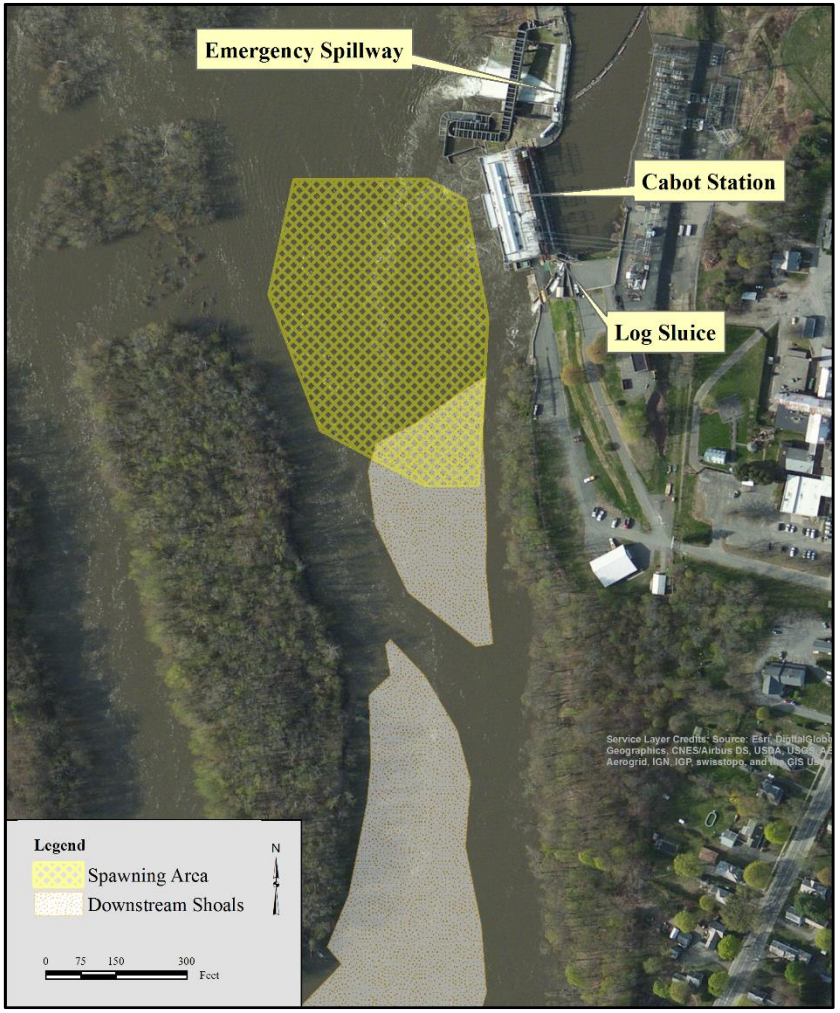
3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Study Objectives:

- Determine the frequency with which the Emergency Spillway gates are operated to discharge large quantities of water.
- Describe the operation of the Log Sluice gate that results in bypass flume spill events.
- Evaluate the impact of these events on sediment transport and bottom velocities within known Shortnose Sturgeon spawning and rearing habitat below Cabot Station

Some data were reported previously (i.e. initial reports; meetings). However, data reported previously have been superseded by data in this report.

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station



3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

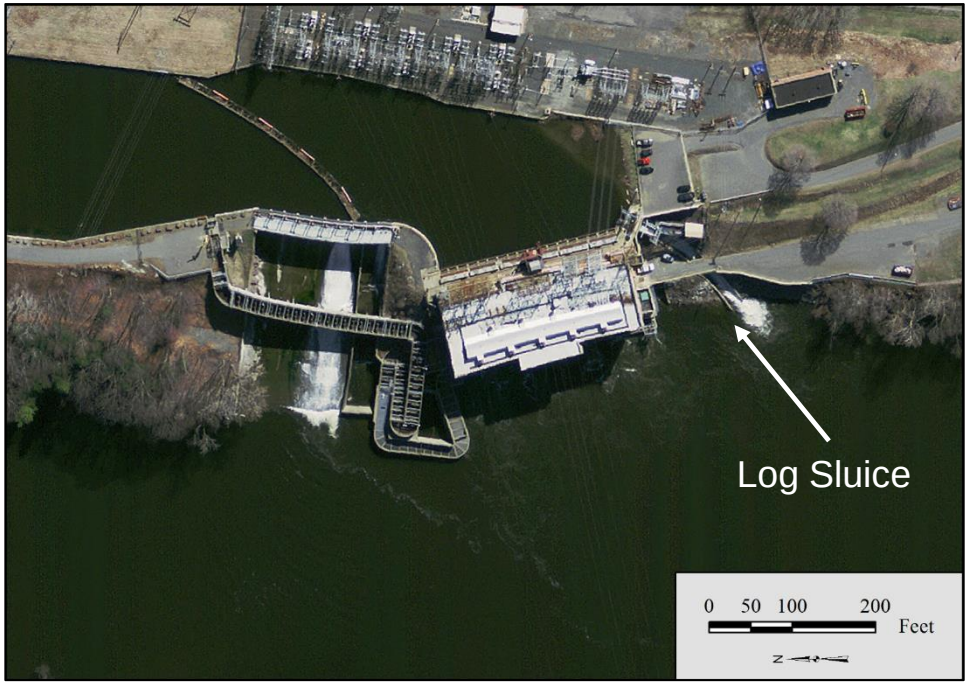
Emergency Spillway

- 10 gates – 12 feet wide by 12 feet high
  - 2 gates supply water to the Cabot Fish Ladder
  - 8 gates discharge water directly to the CT River – ***"Spill Gates"***
- Downward opening
- Discharge capacity for spill gates of ~12,000 cfs
- Used in emergencies and to sluice debris/ice

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Log Sluice (a.k.a. Bypass Flume)

- One gate – ***"Sluice Gate"***
- Downward opening, 16 feet wide
- Weir inserted for downstream fish passage (restricts to 8 feet wide when in place)



Operation

- Downstream Fish Passage
- Sluice Debris/Logs
- Sluice Ice

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

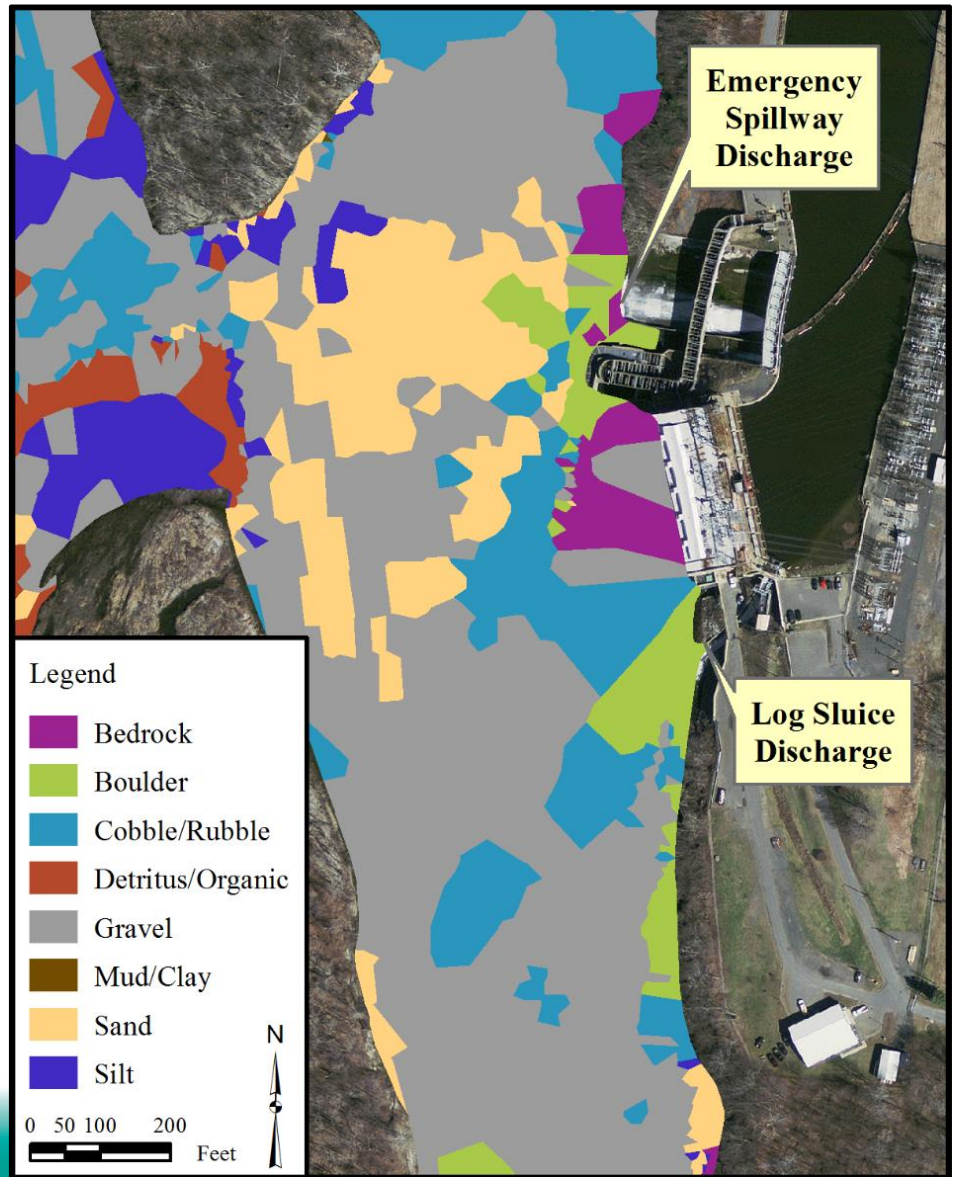
Substrate

Emergency Spillway Discharge

- Hard substrates near entrance
- Sand and gravel further out

Log Sluice Discharge

- Boulder and Cobble/Rubble
- Closed during high flow periods



3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Methods: Flow and Frequency

- Analyzed 10-minute dataset (April 1 – June 30, 2005-2012)
  - Calculated flow at each gate $Q = C * L * H^{1.5}$
  - Frequency Analyses – which flows are most common through the gates, and what other conditions are present during different spill flows through the gates?
- Also used 1-minute dataset to examine high discharge events in more detail

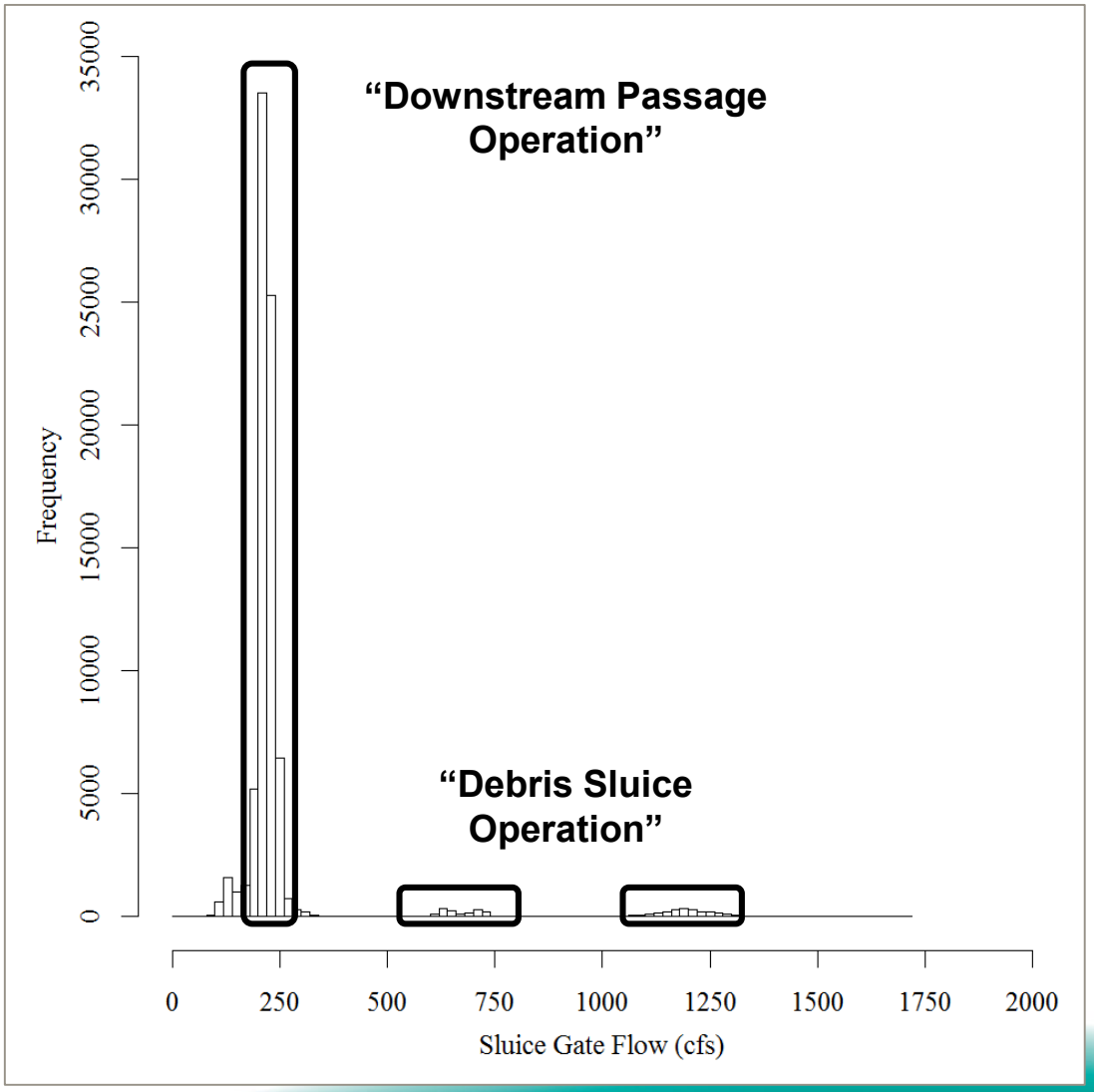
Methods: Velocity and Sediment Mobilization

- River 2D Model from Study No. 3.3.1– Developed Baseline and Scenario Models
  - Velocity
  - Shear Stress
- Potential for Sediment Mobilization
  - Relative Shear Stress (RSS)

$$RSS = \frac{Shear\ Stress\ (Modeled)}{Critical\ Shear\ Stress\ (Value\ based\ on\ Substrate)}$$

RSS = 1 = 50% chance of particle mobilization

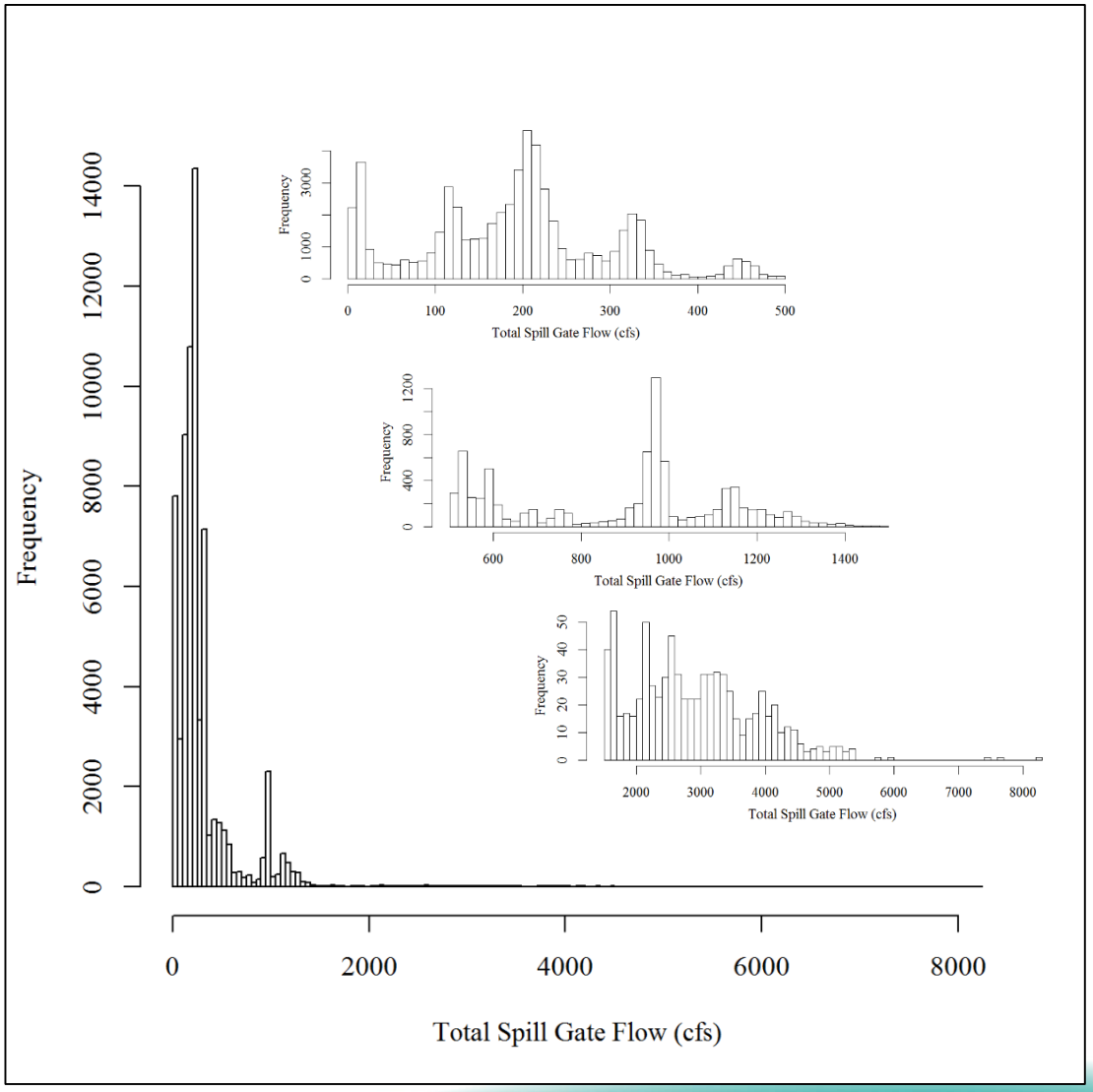
3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station



Log Sluice

- Operates for downstream fish passage during most of the dataset (~219 cfs)
- May operate at higher gate openings to sluice logs/debris, but these periods are brief
- Gate settings are often held constant for long periods of time
- Flow enters river in areas of primarily hard substrate (i.e. rubble/cobble/boulder)

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

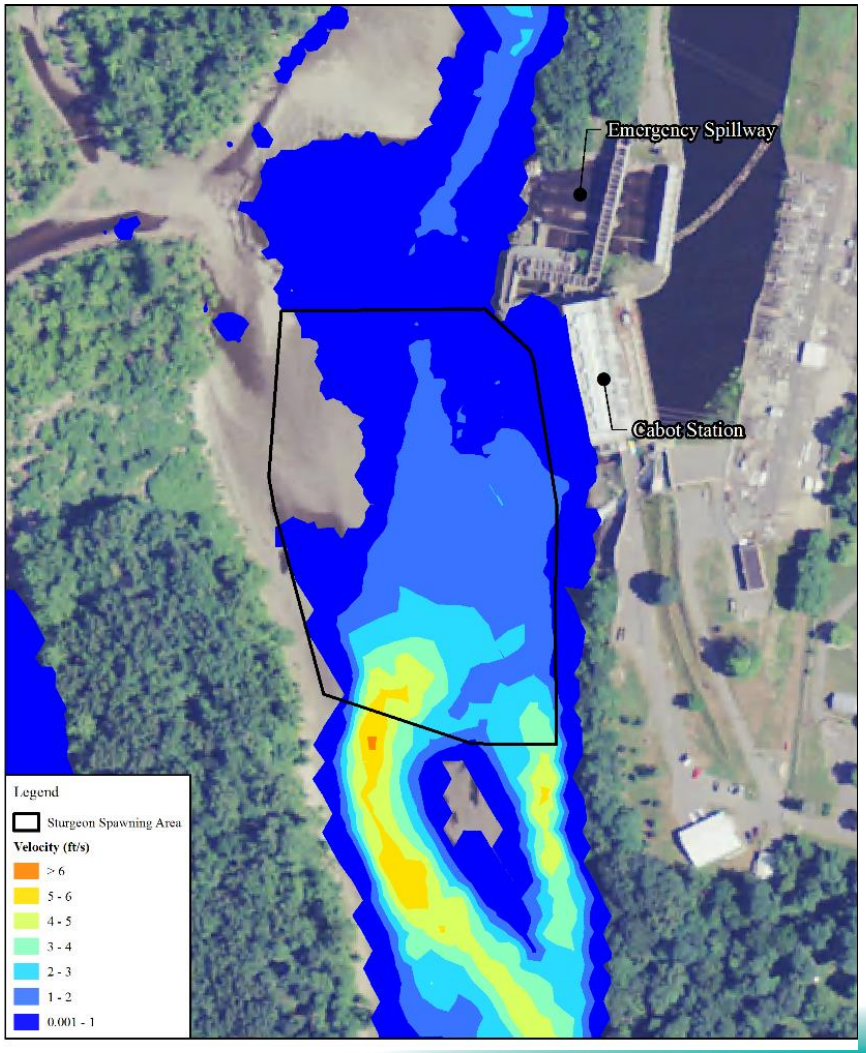


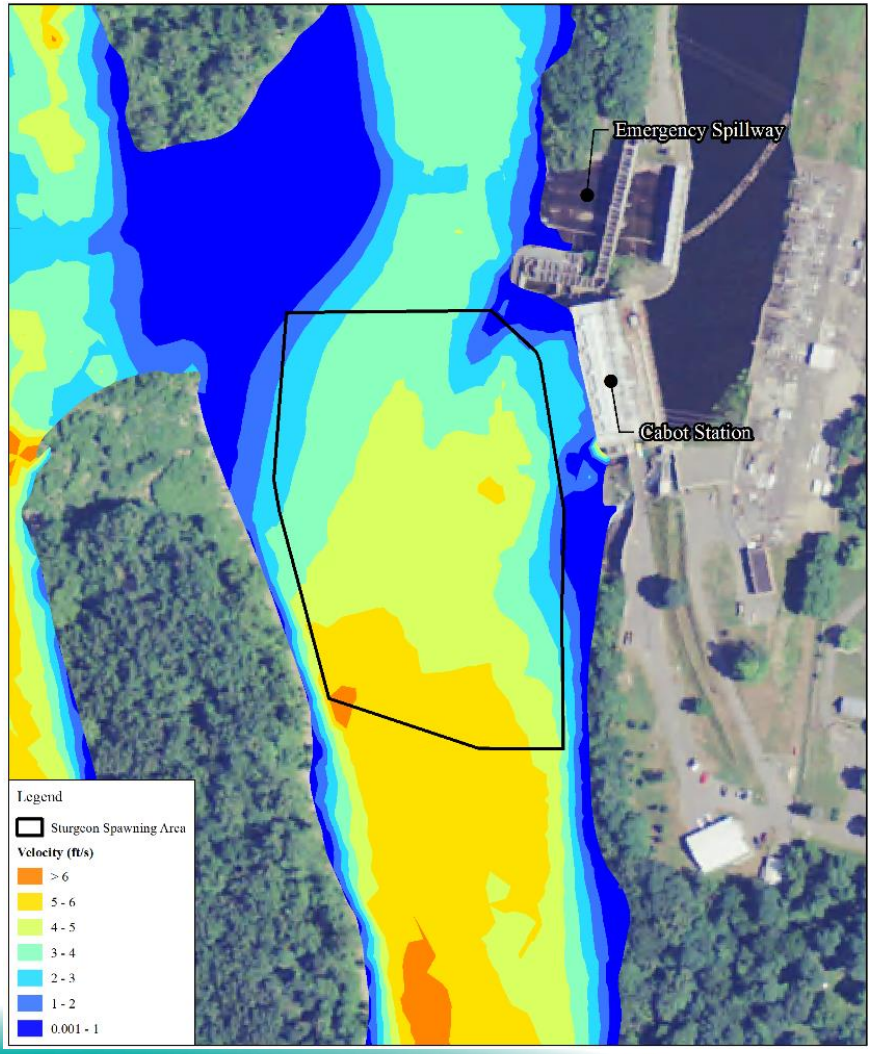
Emergency Spillway

- High frequency of low flows, likely due to keeping a gate open for sluicing ice/debris
- Low frequency of flows > 1,500 cfs
- “Events” with flow > 1,500 cfs occurred during a range of bypass reach flows, and primarily during moderate to high generation at Cabot Station
- Events with spill flow > 1,500 cfs were brief (median = 0.92 hours)
- Emergency spill discharge was only greater than 5,000 cfs when more than four gates were open

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Baseline Velocity Model Examples

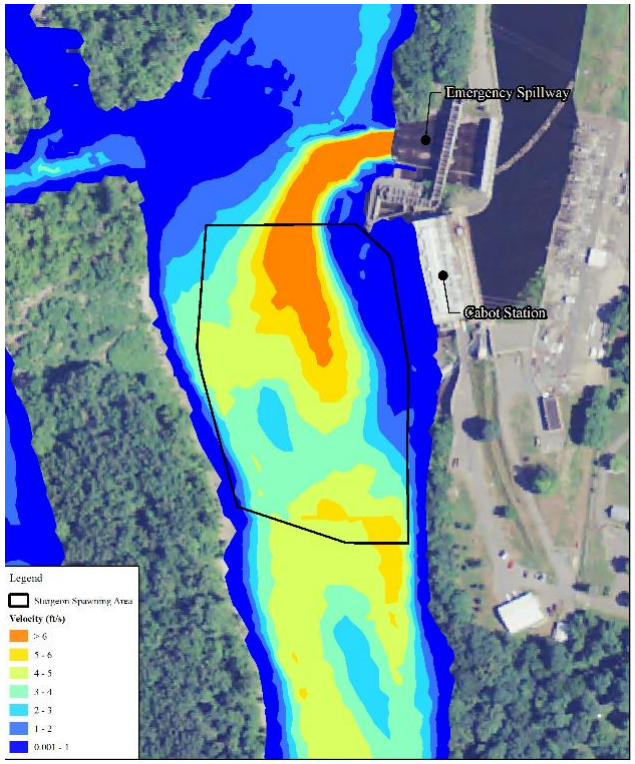




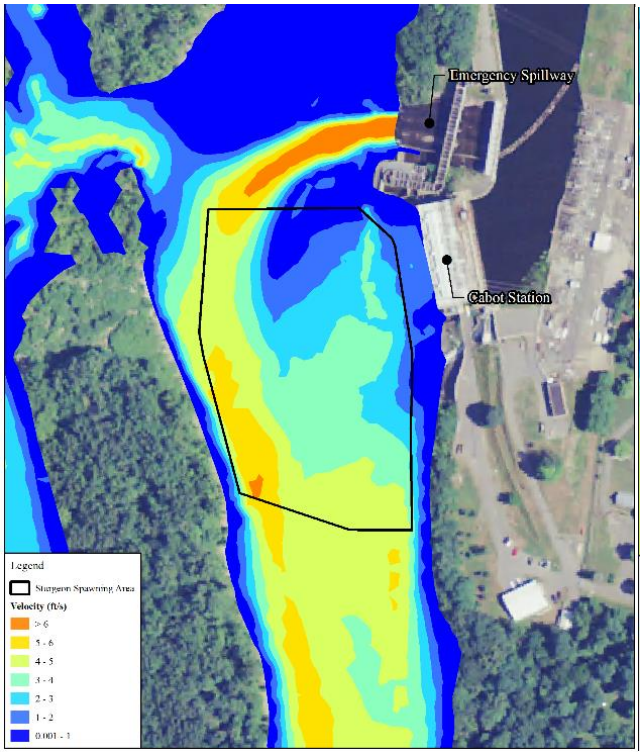
3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

How do operational conditions affect flow from the Emergency Spillway?

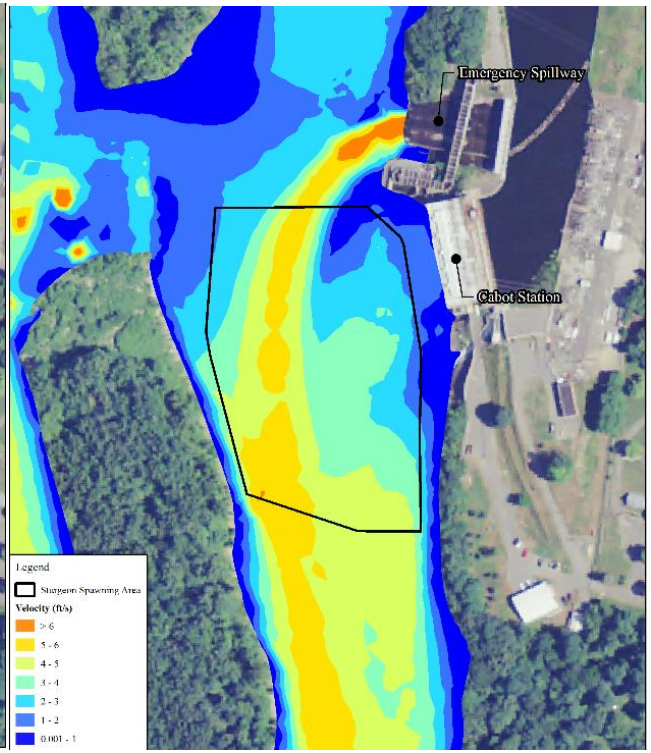
Cabot Off



Cabot On



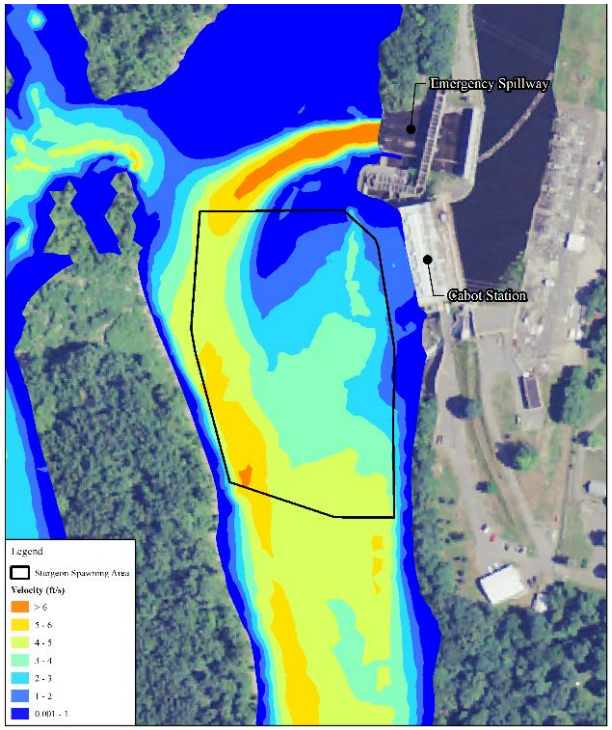
Higher Bypass Flow



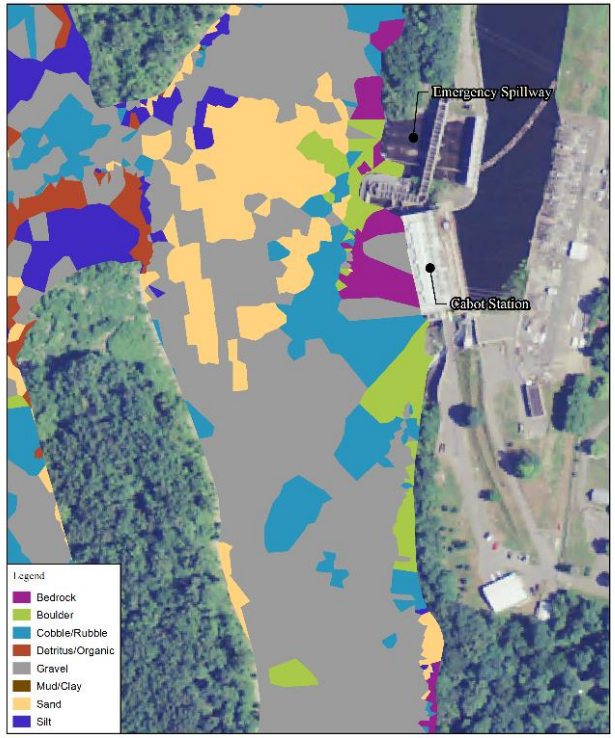
3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Effects on Relative Shear Stress: Velocity and Substrate

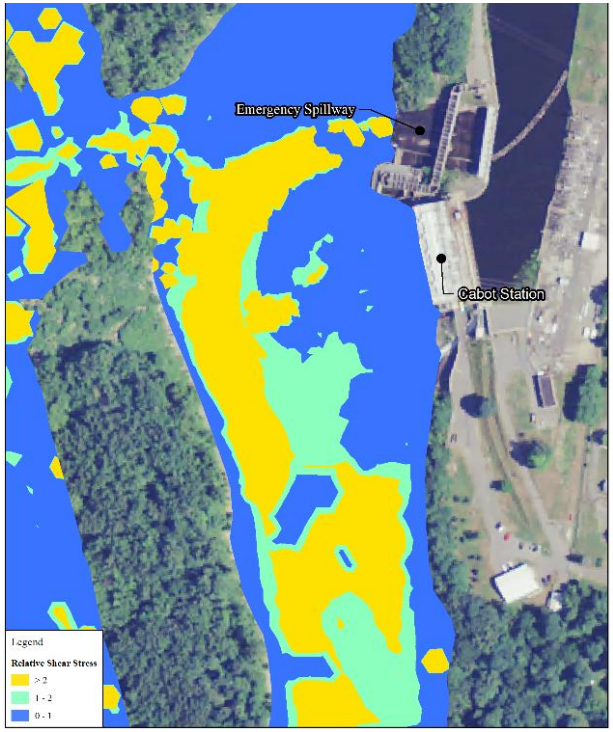
Velocity



Substrate



RSS



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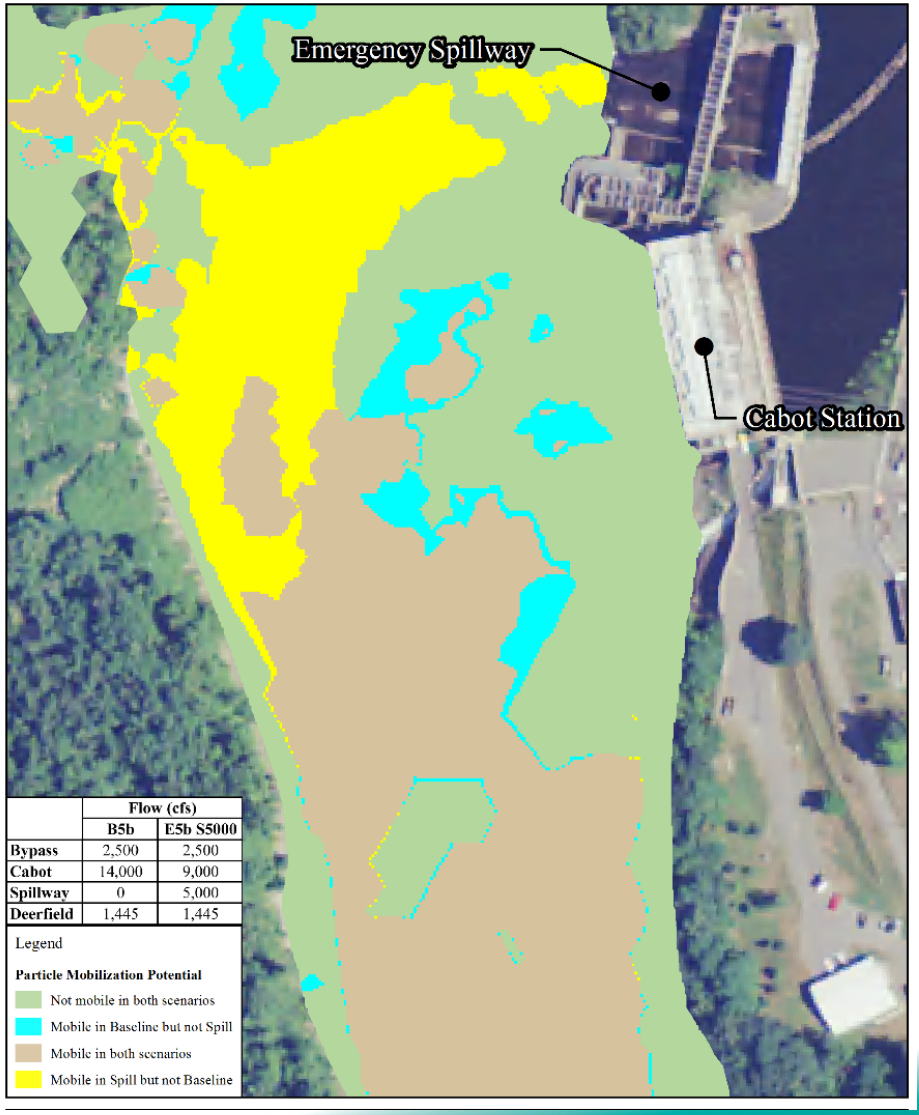


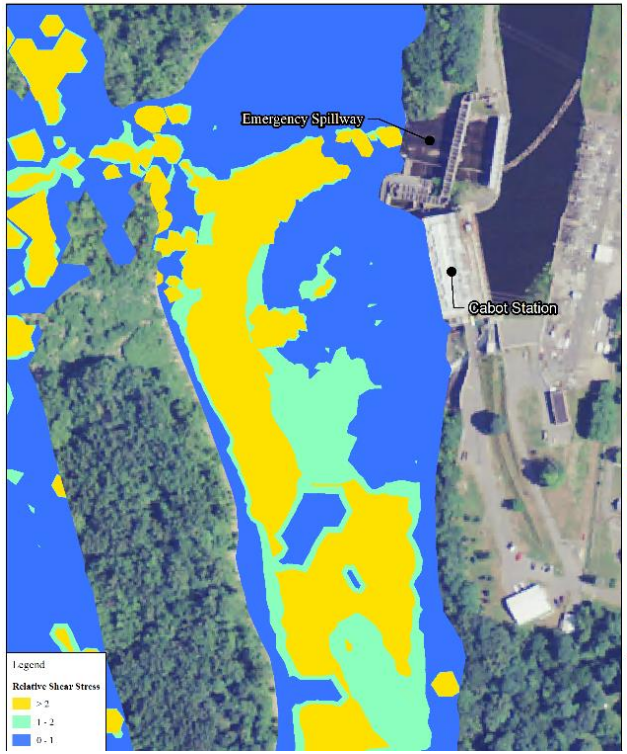
Comparison to the Baseline

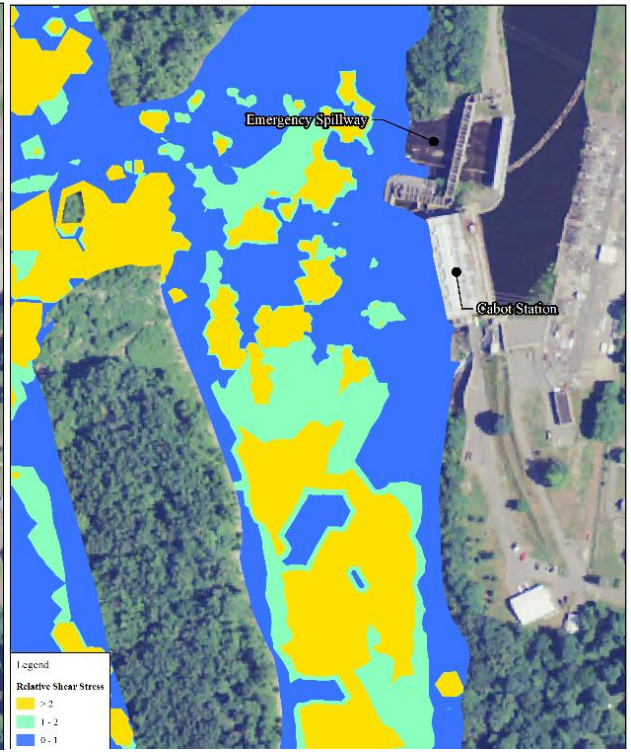
- There are many areas where substrate could be mobilized for **baseline** and **scenario** models
- Increased potential for mobilization in some areas during discharge from the emergency spillway
- Decreased potential for mobilization in some areas during discharge from the emergency spillway

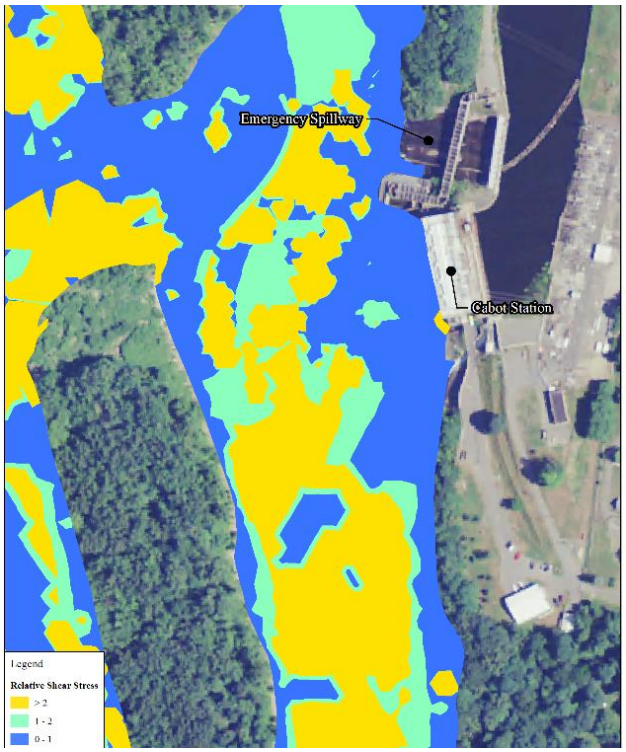
3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Comparison to different baselines

2,500 cfs Bypass + 5000 cfs Em. Spill	10,000 cfs Bypass + Cabot	20,000 cfs Bypass + Cabot



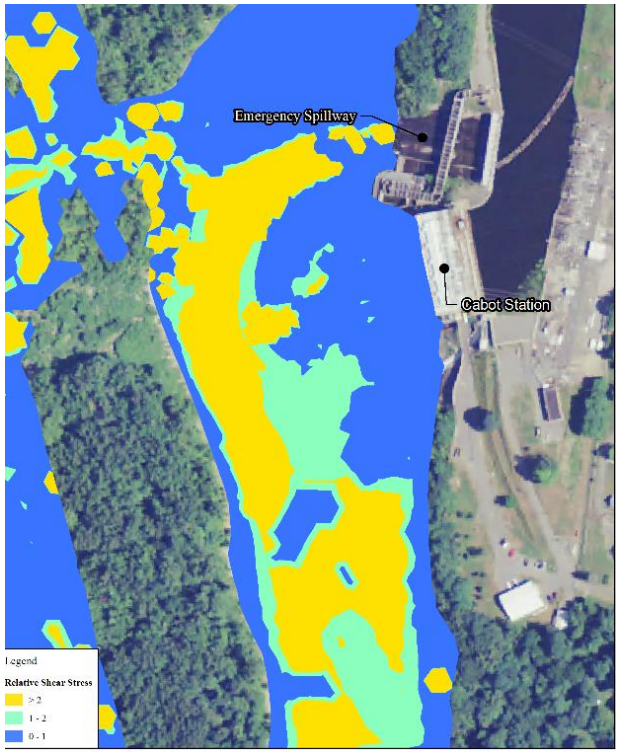


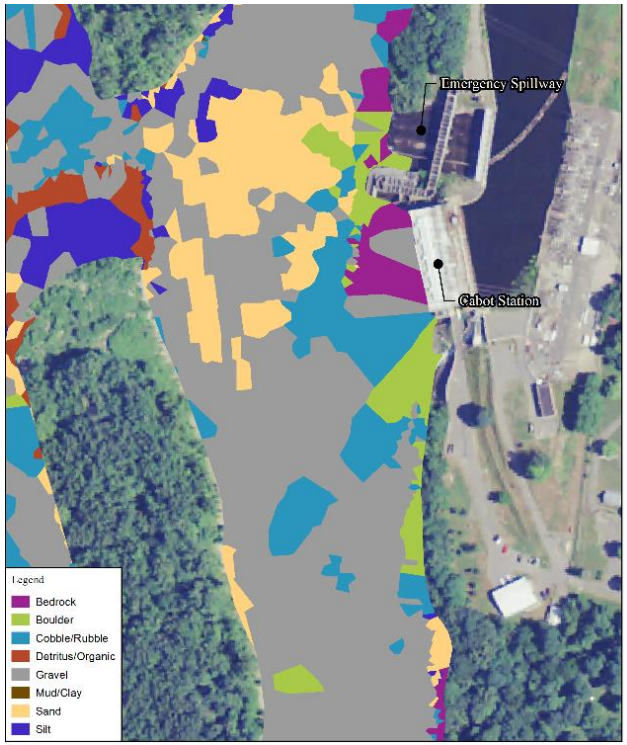


3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

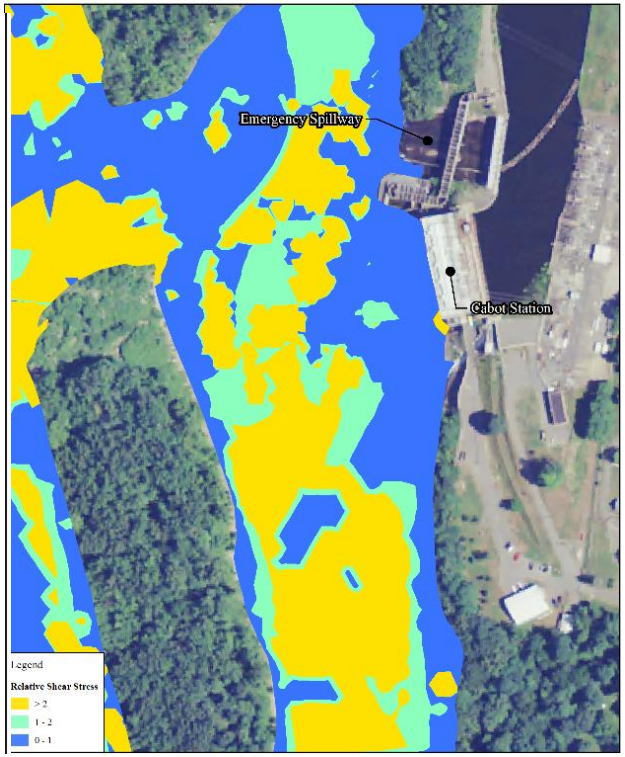
Comparison to other baselines: Location of sandy substrate is important

E5b S5000





B7

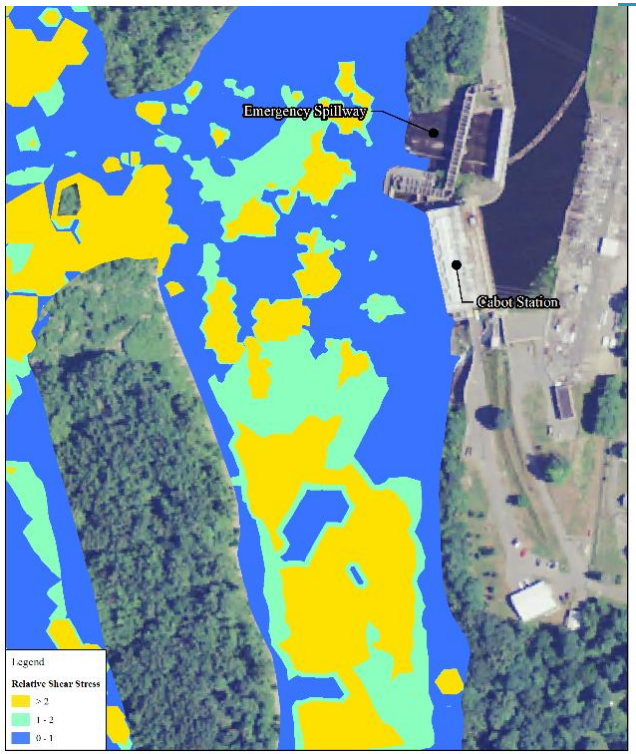


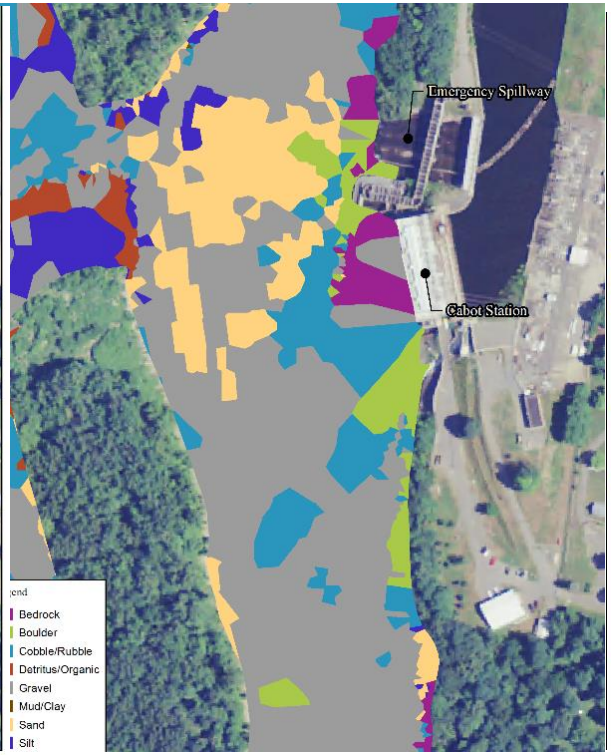
3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Comparison among baselines

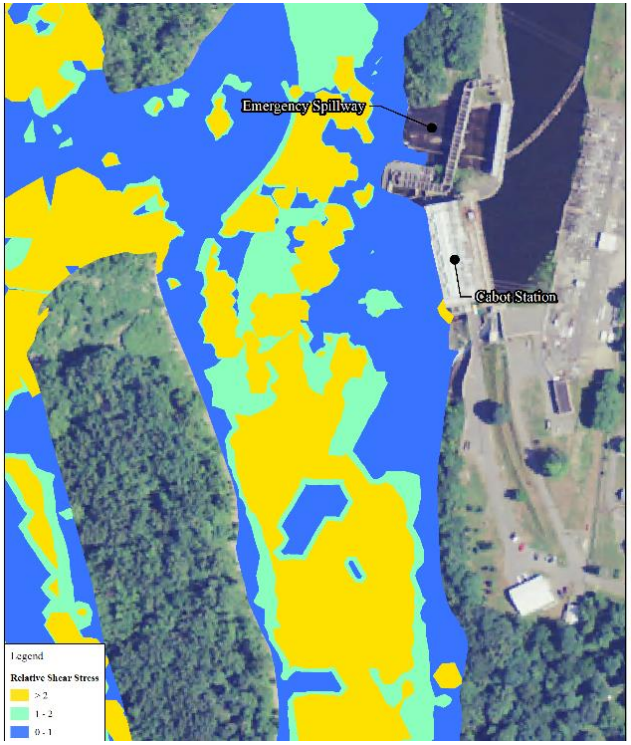
- B6 (10,000 cfs Bypass) and B7 (20,000 cfs Bypass) similar for sand

B6





B7



General Findings

Velocity

- Discharge from the Emergency Spillway can increase velocities within the sturgeon spawning area.
- The exact location of high velocity areas depends on multiple conditions (i.e. bypass flow, Cabot generation).
- Many areas within the sturgeon spawning area could still be considered suitable for spawning.

Potential for Sediment Mobilization

- Discharge from the Emergency Spillway has the potential to mobilize sand in the vicinity of Cabot Station under a variety of operational conditions.
- 1,500 cfs may or may not have much of an effect, depending on operational conditions (i.e. bypass flow or water levels).
- Substrate mobilization potential of gate flow releases appear similar to common springtime bypass reach flows (i.e., 10,000-20,000 cfs).

Potential for Sediment Deposition

- Velocities at ELS shoals are relatively swift with high shear stress, likely preventing deposition.

3.3.12- Evaluate Frequency and Impact of Emergency Water Control Gate Discharge Events and Bypass Flume Events on Shortnose Sturgeon Spawning and Rearing Habitat in the Tailrace and Downstream from Cabot Station

Caveats

- Study and modeling assumes that the distribution of sand will be consistent through time, and that sand is in unlimited supply for mobilization

- Effects on Shortnose Sturgeon can be theorized, but are speculative

Things to Keep in Mind

- Large discharges from the Emergency Spillway are uncommon and brief and necessary for public safety

- Bypass reach flows with similar sand mobilization potential, are common and much longer in duration

- Existing gate operations include:
  - Low flow, continuous operation for debris/ice sluicing at the log boom
  - High flows (more than four gates open) would result from emergency usage– Necessary for station integrity and public safety

Next Steps

- Biological Assessment for NMFS
- Additional information on Shortnose Sturgeon in IFIM Study

Modeling

3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

Study Objectives

- Characterize the hydraulics of current (existing) conditions and any changes to:
  - Fishway attraction flows;
  - Turbine operations; and
  - Log sluice gates
- Develop a series of velocity maps at select discharges showing approach velocities and flow fields that may create a response in fish;
- Characterize the flow field in front of the Cabot Station and Station No. 1 intakes using velocity maps and cross-sectional plots;
- Assess whether fish are directed to the surface bypass weir near Cabot Station;
- Characterize the near-rack “sweeping” velocities at the Cabot Station and Station No. 1 intakes.

Variances

- The RSP called for developing high-resolution sub-models at the face of the Cabot and Station No. 1 intake racks.
- Due to computational limitations, not practical to create/build these models.
- In lieu of separate model, added 1-foot mesh in front of intake racks to calculate approach and sweeping velocities.

3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

Preface

- The CFD study evaluated hydraulics at the Cabot/Station No. 1 intakes and at the Spillway and Cabot fishway entrances.

- 4 other studies are using empirical radio telemetry data to evaluate the effects of Project operations on migratory fish movement including:

  - Study No. 3.2.2 Evaluate U/S and D/S Passage of Adult American Shad
  - Study No. 3.3.3 Evaluate D/S Passage of Juvenile American Shad
  - Study No. 3.3.5 Evaluate D/S Passage of American Eel
  - Study No. 3.3.15 Assessment of Adult Sea Lamprey Spawning within the TF Project and NFM Project Area.

  - The telemetry studies, coupled with CFD model results, will be used to determine the impact of Project operations on upstream and downstream fish passage.

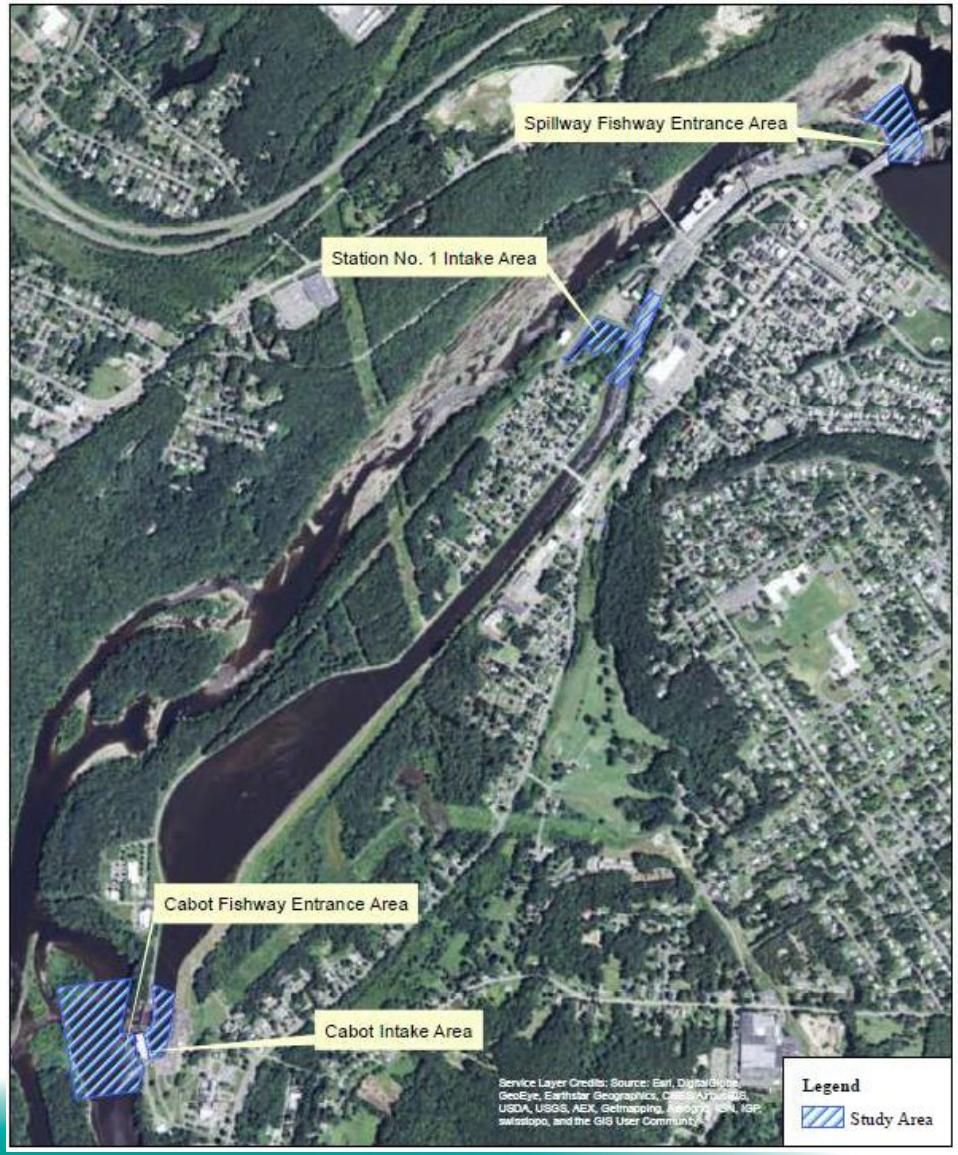
3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

CFD Models

- Spillway Fishway
- Cabot Fishway
- Station No. 1 Intake Area
- Cabot Intake Area

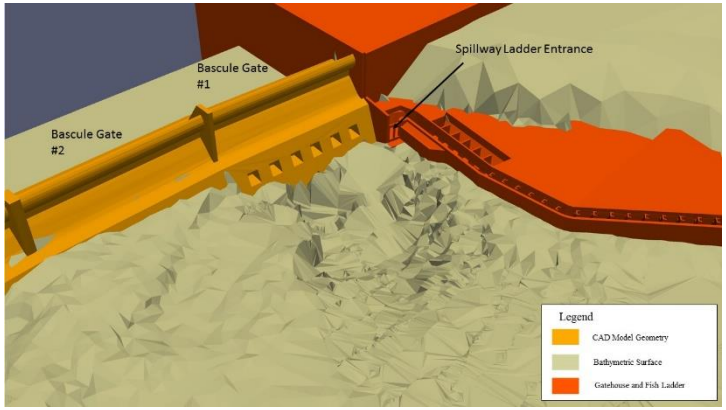
CFD Model Development and Execution

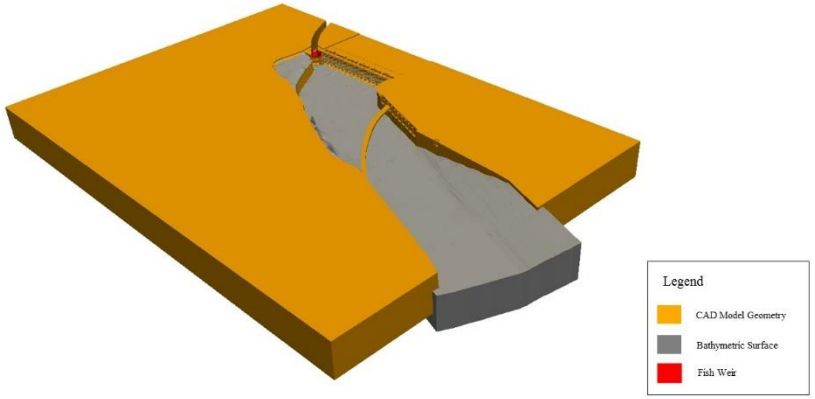
- Field Data Collection and Processing
  - Acoustic Doppler Channel Profiler
  - Topographic and Structure Survey
  - LiDAR Topographic Data
  - Water Level Loggers
- Model Geometry Development
  - CAD Model Development
  - Bathymetric Surface Development
- CFD Model Development
  - Mesh Cell Size
  - Boundary Conditions
- Verification Runs
- Production Runs
- Results

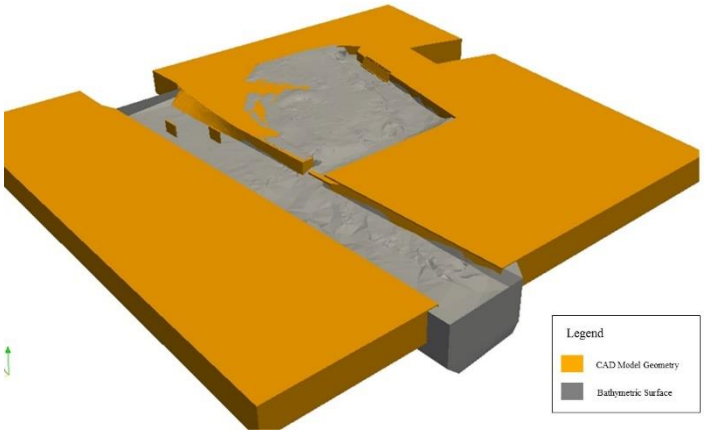


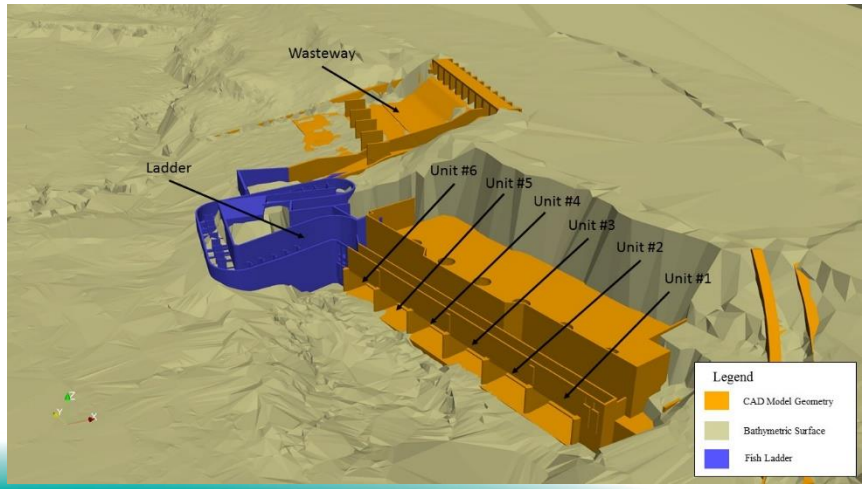
3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

CAD Geometry Development



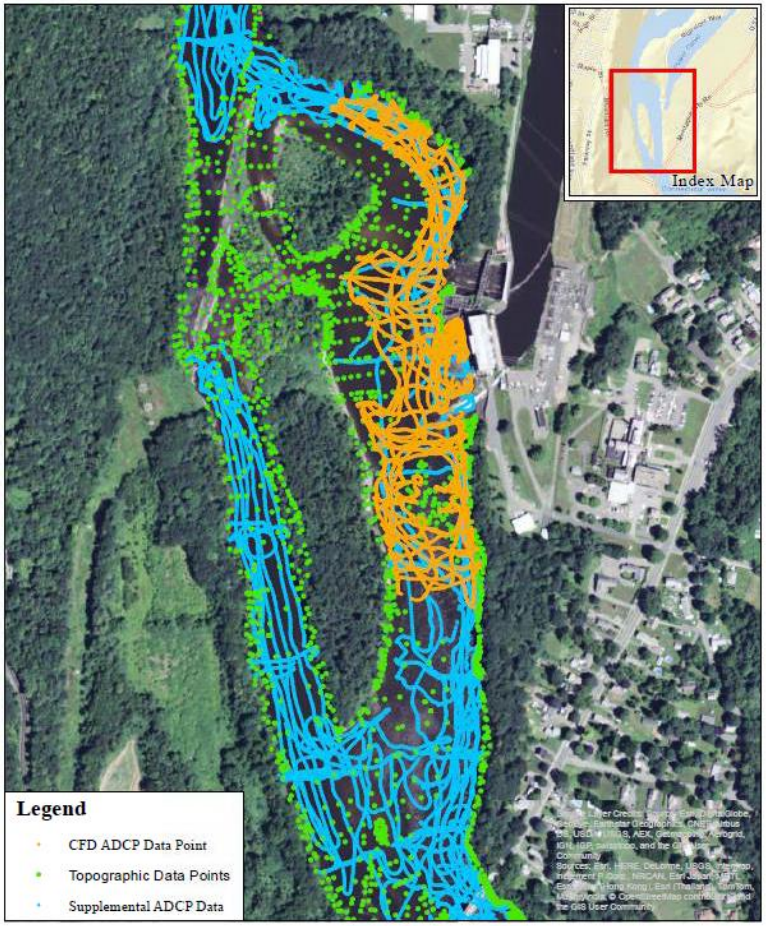






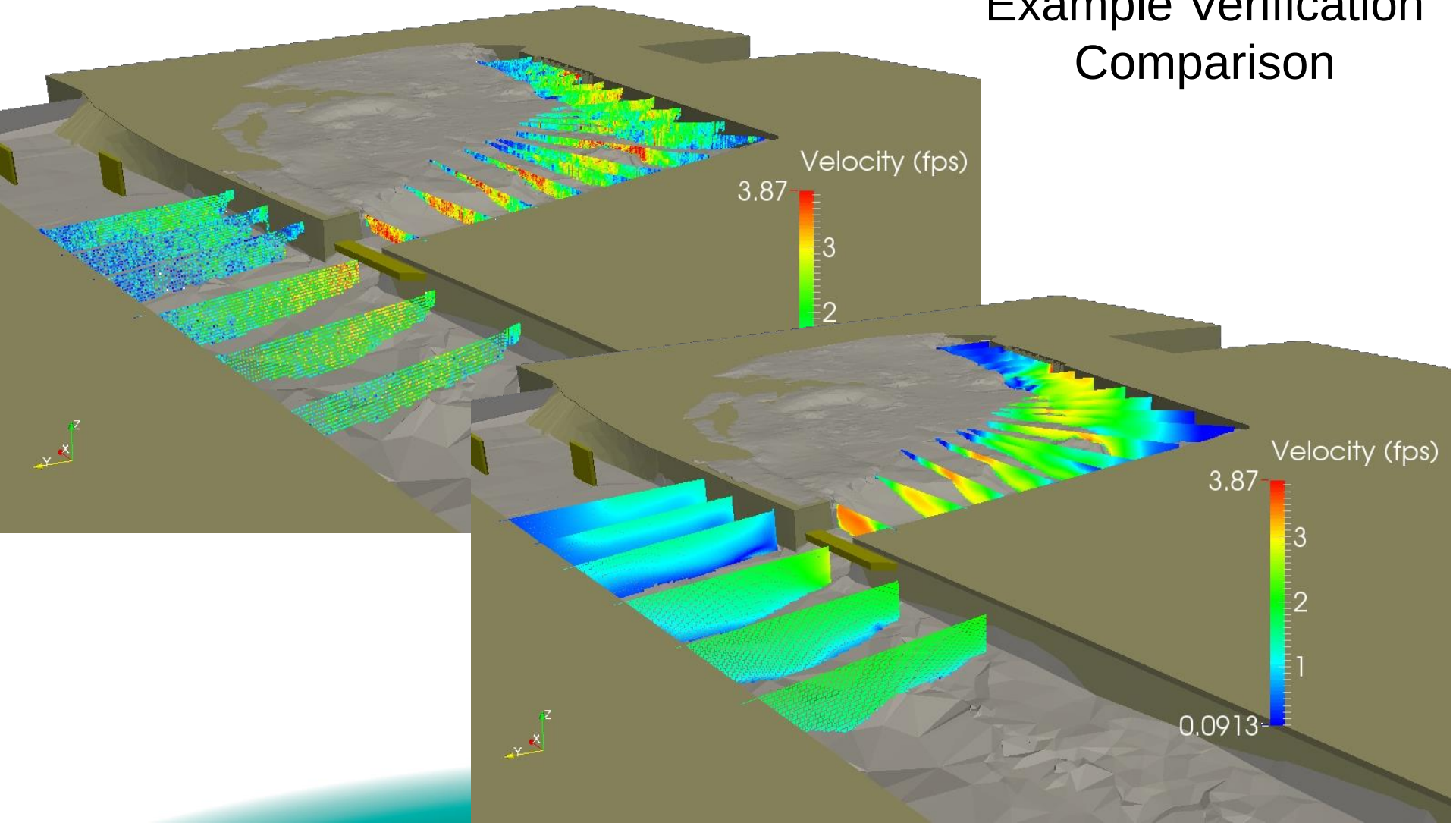
3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

Field Data Collection



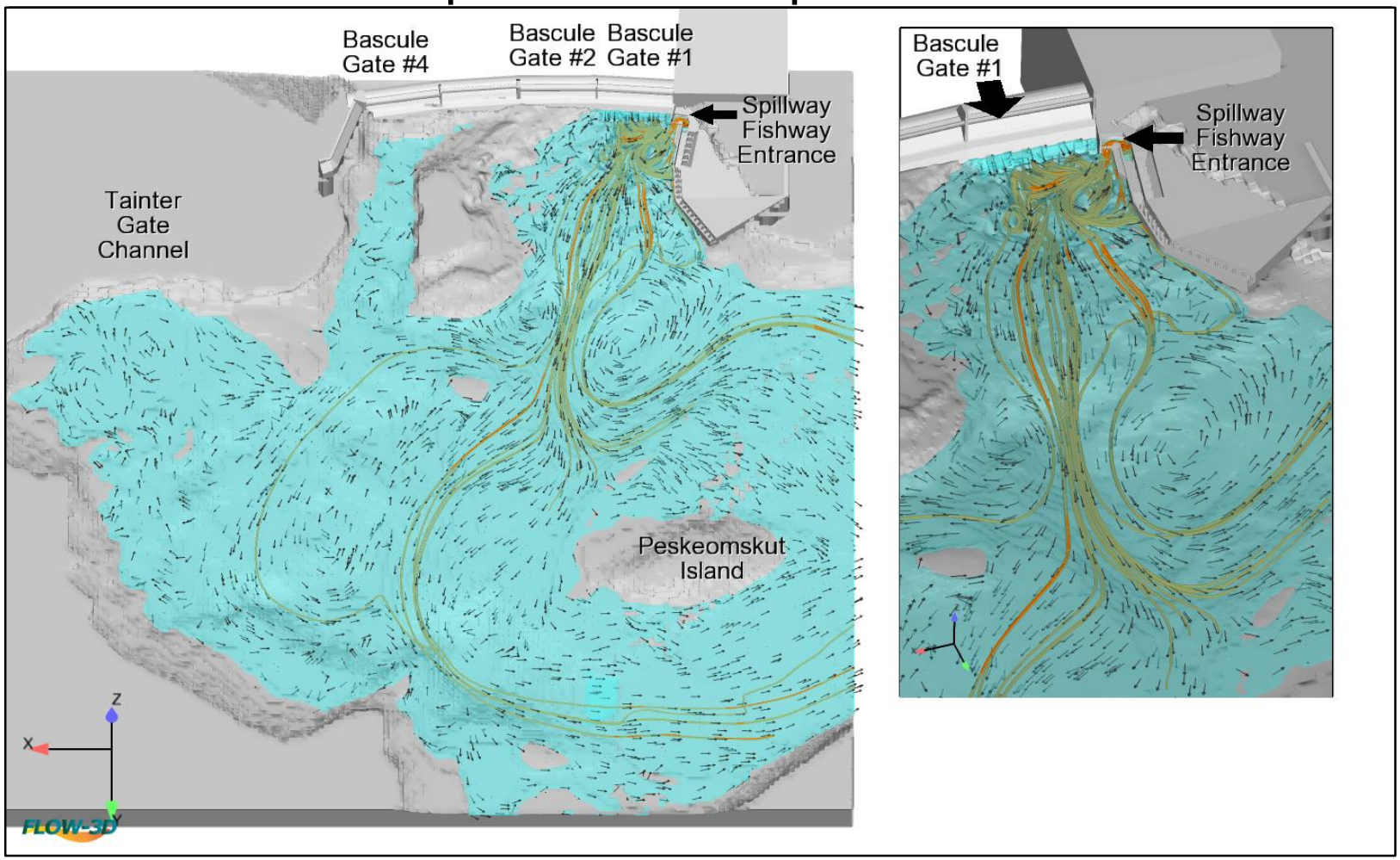
3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

Example Verification Comparison



3.3.8-Computational Fluid Dynamics Modeling in the Vicinity of the Fishway Entrances and Powerhouse Forebays

Example Model Outputs



3.3.9-Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace

Study Objectives:

- Assess velocities and flow fields at, and in proximity to, the Northfield Mountain Project intake/discharge structure, when pumping or generating, and their potential to interfere with fish migration.

- Assess the potential for velocity barriers in the mainstem river to develop from pumping and generation flows at the Northfield Mountain Project, alone or in combination with generation flows from the upstream Vernon Project and downstream Turners Falls Project.

- Characterize water column velocity profiles in the immediate vicinity of the Northfield tailrace (i.e. inside the boat barrier).

- Assess the potential for Northfield Mountain Project operations to create undesirable attraction flows to the intake/discharge area that may result in entrainment or delay of migratory fish.

- Assess potential migratory fish impacts due to flow reversals under:
  - Pumping conditions, such that the river flows from the Turners Falls Dam toward the Northfield tailrace; and;
  - Generating conditions, such that the river flows from the Northfield tailrace toward Vernon Dam.

3.3.9-Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace

Preface:

- Study examined the direction and magnitude of velocities under a range of conditions

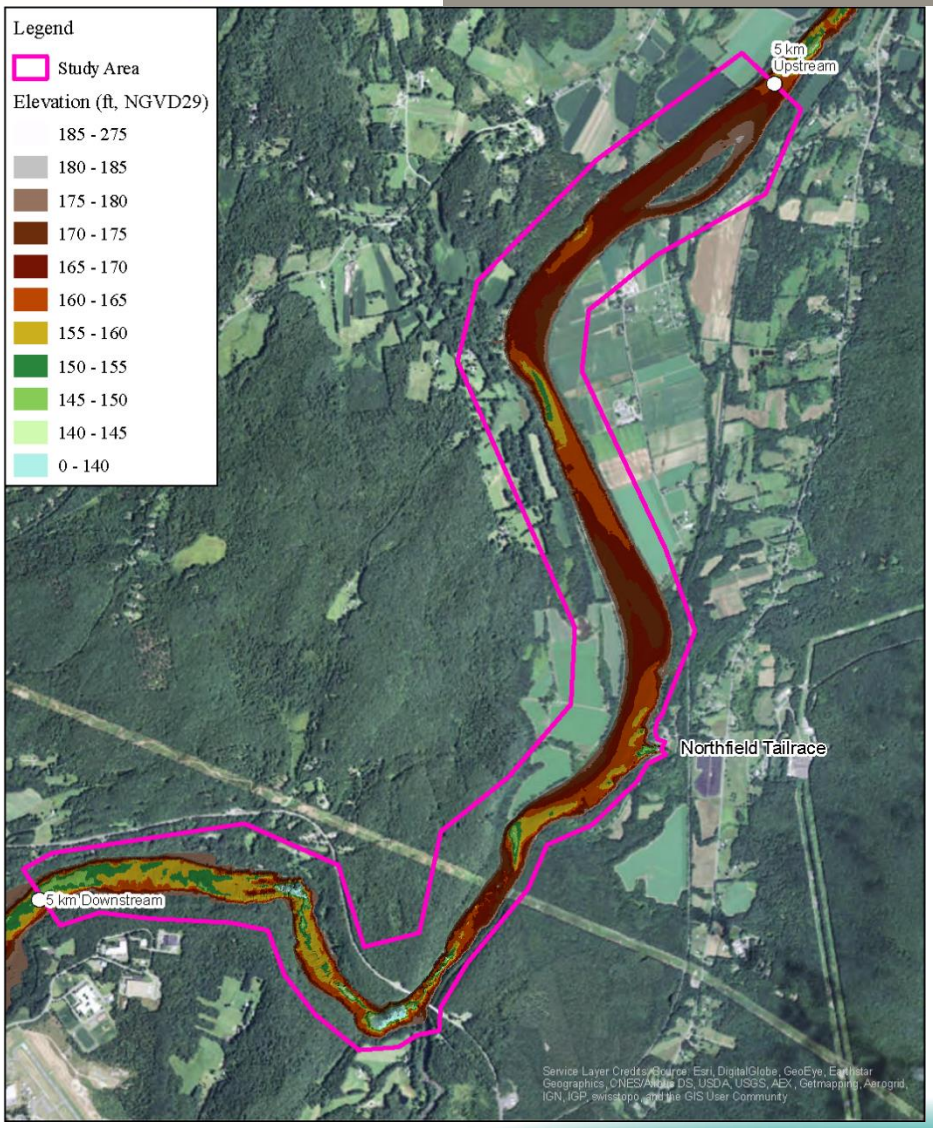
- 4 other studies are using empirical radio telemetry data to evaluate the effects of the NFM Project operations on migratory fish movement including:

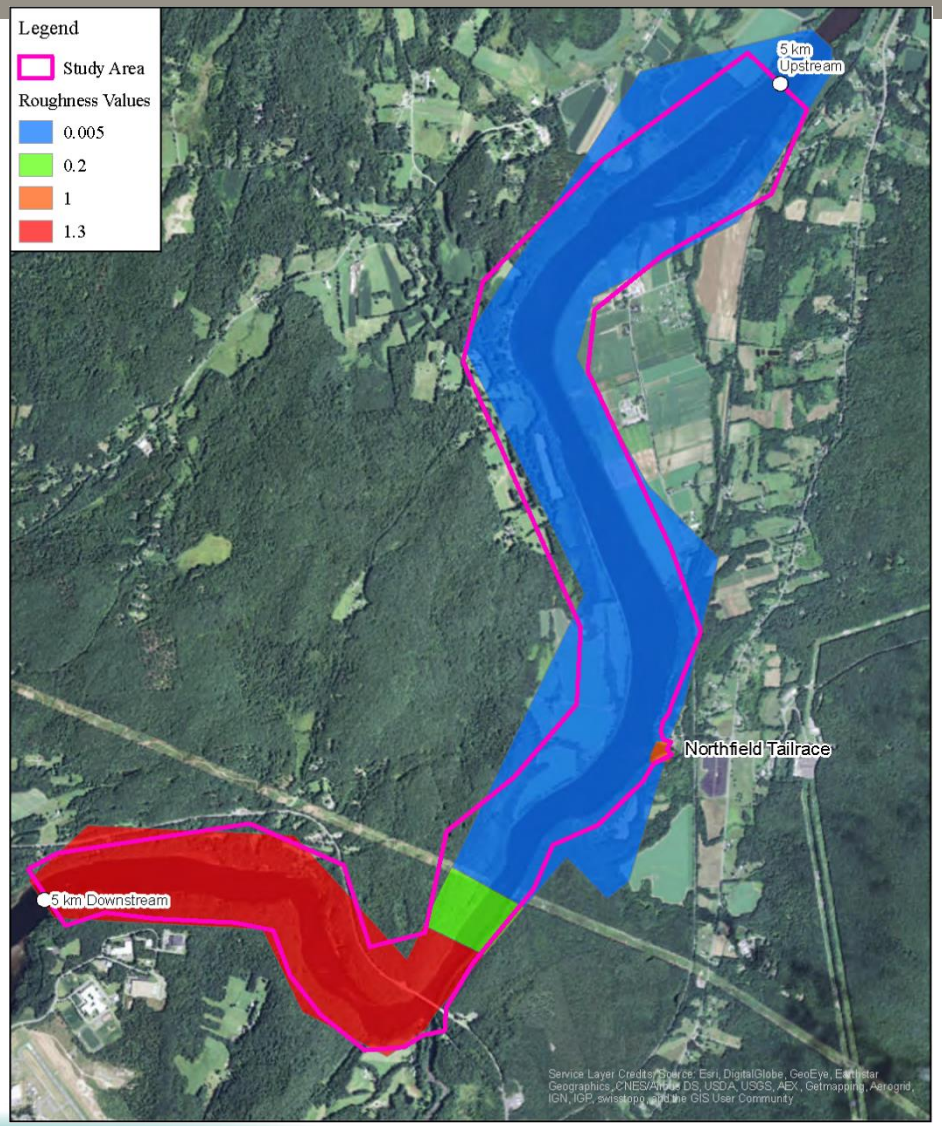
  - Study No. 3.2.2 Evaluate U/S and D/S Passage of Adult American Shad
  - Study No. 3.3.3 Evaluate D/S Passage of Juvenile American Shad
  - Study No. 3.3.5 Evaluate D/S Passage of American Eel
  - Study No. 3.3.15 Assessment of Adult Sea Lamprey Spawning within the TF Project and NFM Project Area.

  - The telemetry studies, coupled with the two-dimensional hydraulic model results, will be used to determine the impact of Project operations on migratory fish movement.

  - For this report, velocity data were compared against fish swim speeds to determine the potential for velocity barriers and entrainment. However, this evaluation is based solely on the hydraulic model; it does not represent how fish will react to in-situ conditions.

3.3.9-Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace





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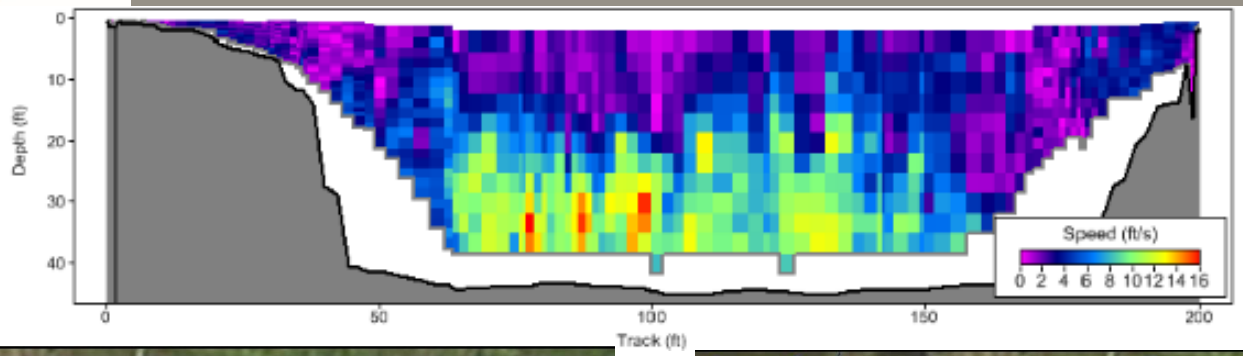
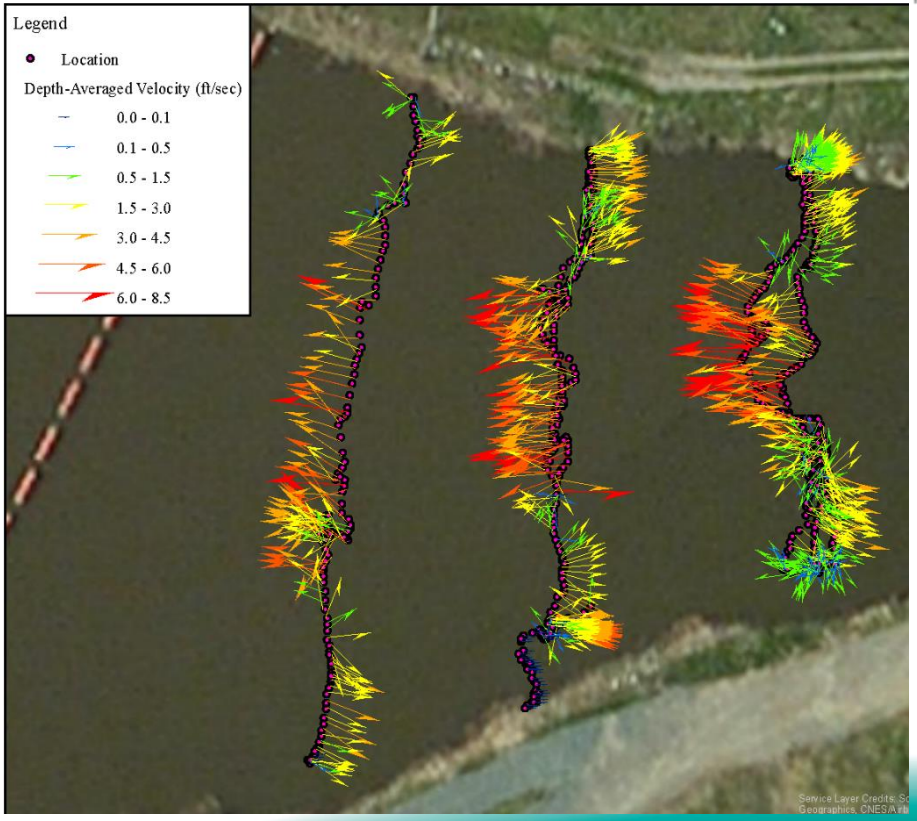
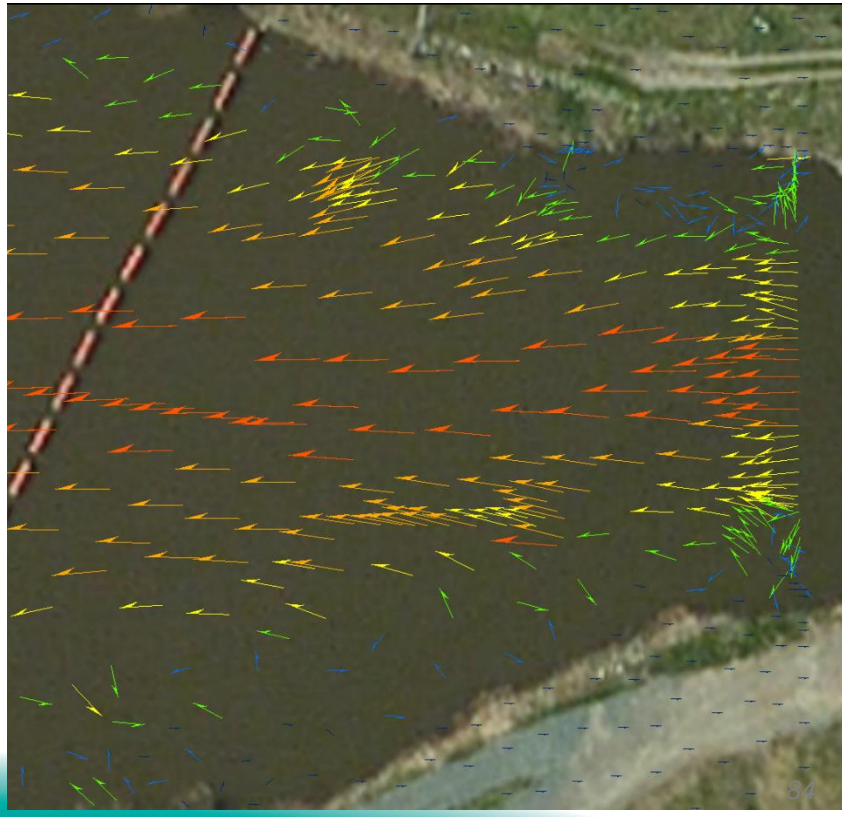






3.3.9-Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace

60 Scenarios Modeled

Connecticut River Exceedance Flows:

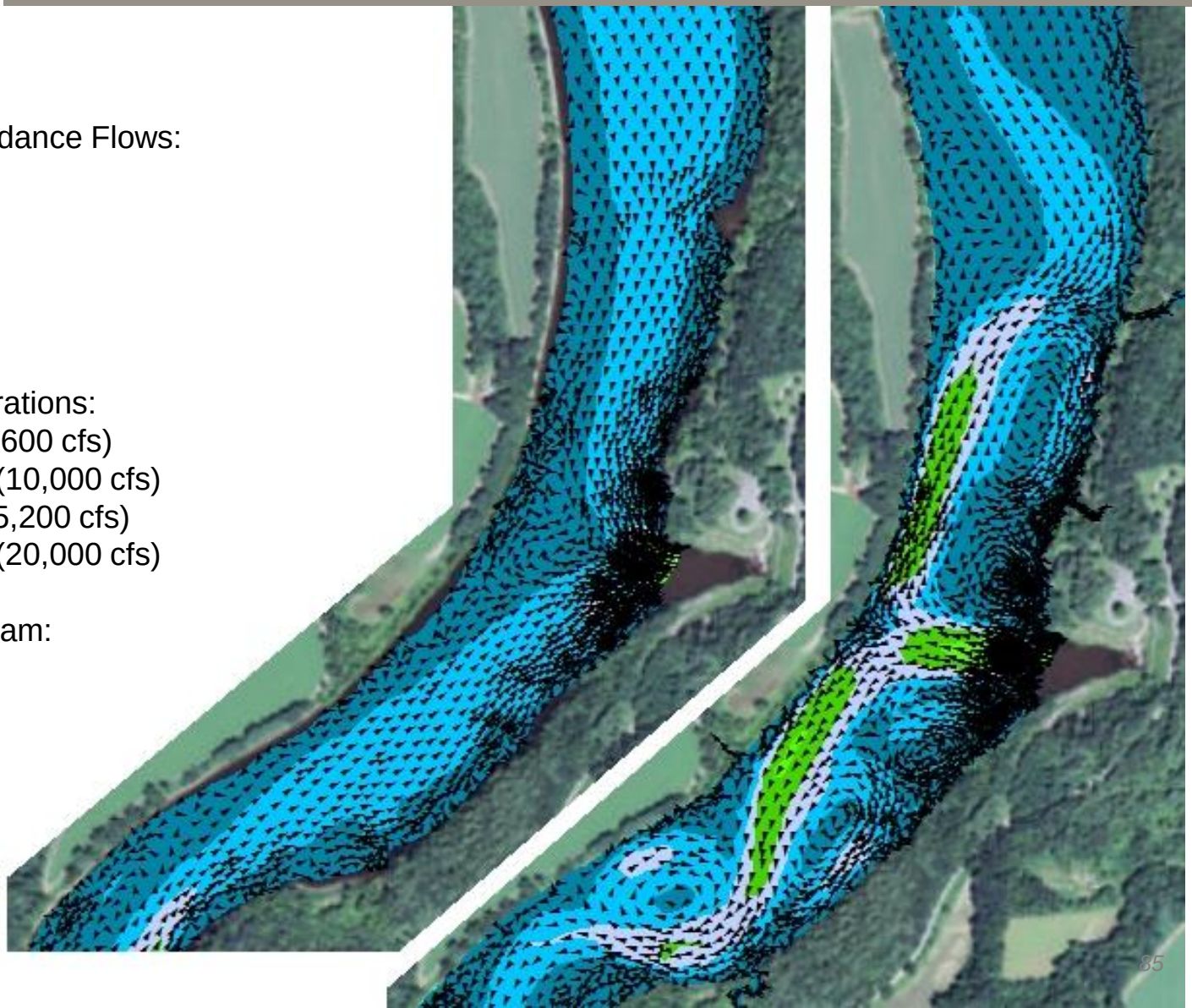
- 95% (1,760 cfs)
- 75% (4,900 cfs)
- 50% (8,440 cfs)
- 25% (15,700 cfs)
- 5% (40,100 cfs)

Northfield Mountain Operations:

- 2-Units Pumping (7,600 cfs)
- 2-Units Generating (10,000 cfs)
- 4-Units Pumping (15,200 cfs)
- 4-Units Generating (20,000 cfs)

WSEL at Turners Falls Dam:

- 176.0 ft
- 181.3 ft
- 185.0 ft



Results Pertaining to Migratory Fish

American Shad, American Eel, Sea Lamprey

Potential Velocity Barriers to Upstream Migration

- French King Gorge area exhibits high velocities during high flow
- Under swift flows that exceed swimming capacities of fish, shoreline areas with lower velocities may be utilized for passage

Flow Reversals and Eddies

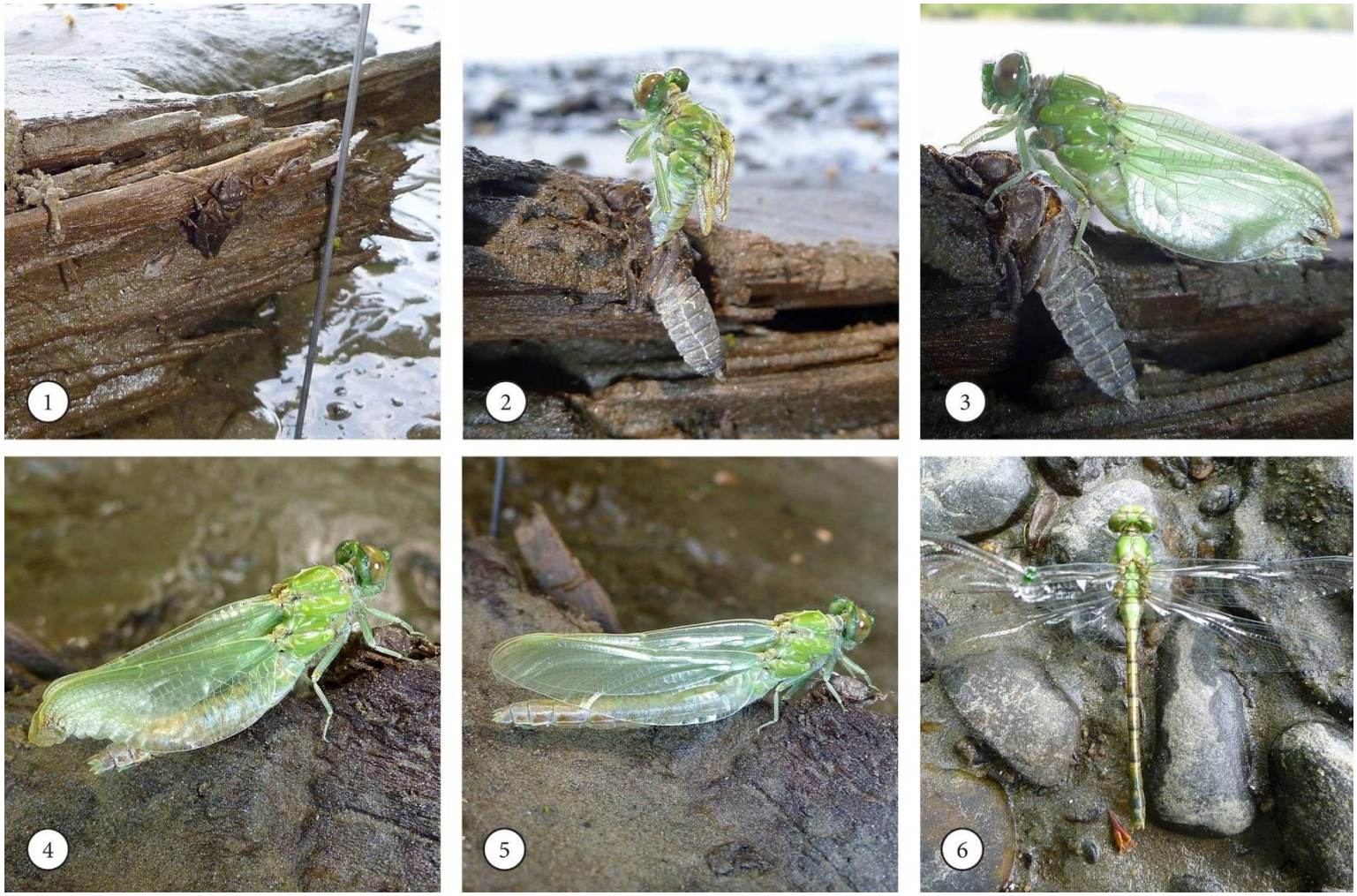
- Pumping – During low incoming flow, flow reversals may occur downstream of Northfield
- Generating – During low incoming flow, flow reversals may occur upstream of Northfield

Effects on Fish (i.e. Passage Failure, Delay, Entrainment)

- Results can be used to predict the conditions that fish encounter, but cannot directly evaluate effects on fish
- Other studies (i.e. telemetry) can use results from this study to better interpret fish behavior by providing better understanding of conditions encountered by fish

Odonates and Mussels

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River



3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Study Objectives

- Conduct field surveys and synthesize existing data to characterize the odonate community and species emergence and eclosure behavior in the Project area.

- Assess the effects of Project operations, especially water surface elevation (WSEL) changes, on the emergence, eclosure, and habitat of state-listed odonate species and the odonate community.

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Phase 1 (2014)

- Qualitative surveys at 8 sites to determine species composition, habitat, and to collect preliminary data on emergence behavior.
- Phase 1 report filed with Updated Study Report (Sept. 2015)

Phase 2 (2015)

- Quantitative surveys at 5 sites to determine species composition, emergence and eclosure behavior, and habitat
- Analysis of the magnitude and rate of change of water surface elevations (WSEL) on a daily and hourly basis during the emergence period (May to September)
- Relate WSEL data to emergence behavior to assess potential operational impacts on odonate species.

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Phase 2 Methods

- Quantitative sampling at 6 transects per site
- Conducted biweekly sampling at each site/transect during 8 sampling periods from late May to early September (2015)
- For every exuvia/teneral: recorded vertical height from the water's surface, horizontal distance from the water's edge, substrate, and other basic information (time, date, etc)
- Specimens were collected, individually labeled, and identified to species.
- Emergence speed was recorded when possible.
- Dataloggers recorded WSEL and water temperature at 15-minute intervals

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Species	Abbreviation	2015 Phase 2 Survey Site					Total	Percent of Total
		1	2	3	4	5		
Arigomphus furcifer	ArFu	0	0	0	0	0	0	0.0
Basiaeschna janata	BaJa	0	0	0	0	2	2	0.3
Boyeria vinosa	BoVi	58	3	11	6	0	78	12.5
Cordulegaster maculata	CoMa	0	0	0	1	0	1	0.2
Dromogomphus spinosus	DrSp	3	10	1	2	2	18	2.9
Epitheca princeps	EpPr	0	0	0	1	101	102	16.4
Gomphus abbreviatus	GoAb	2	4	0	14	0	20	3.2
Gomphus vastus	GoVa	70	129	2	18	0	219	35.2
Gomphus ventricosus	GoVe	0	0	0	0	0	0	0.0
Hagenius brevistylus	HaBr	2	1	1	0	0	4	0.6
Libellula sp.	Lisp	0	0	0	0	6	6	1.0
Libellulinae (unidentified)	Li	0	0	0	0	12	12	1.9
Macromia illinoiensis	MaIl	3	2	6	2	1	14	2.3
Neurocordulia yamaskanensis	NeYa	3	8	4	6	2	23	3.7
Ophiogomphus rupinsulensis	OpRu	5	20	0	0	0	25	4.0
Perithemis tenera	PeTe	0	0	0	0	27	27	4.3
Stylurus amnicola	StAm	3	1	5	0	0	9	1.4
Stylurus spiniceps	StSp	23	25	9	5	0	62	10.0
		172	**203**	**39**	**55**	**153**	**622**	

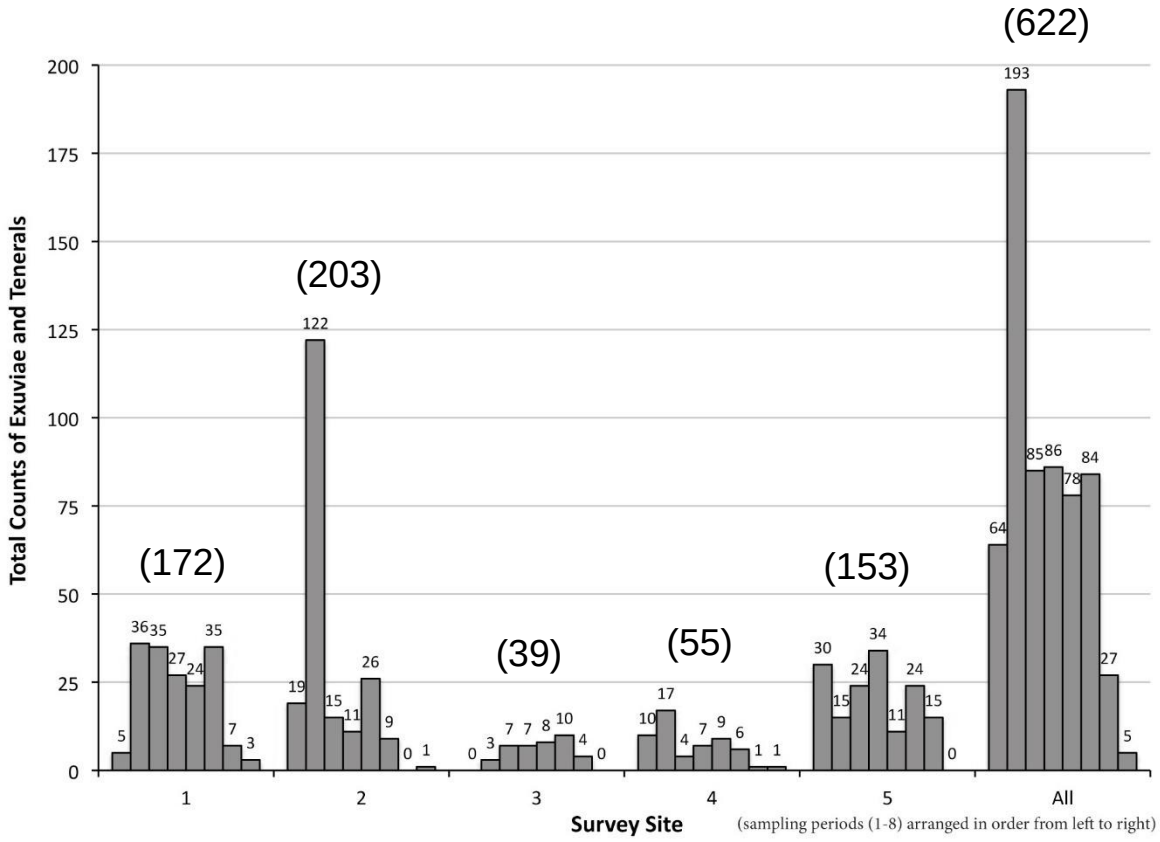
3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Emergence Timing

Counts very low at first, then low, then very low, then very very low...

Overall, much lower densities than what had been observed in 2014

Small sample sizes, especially for Sites 3 and 4



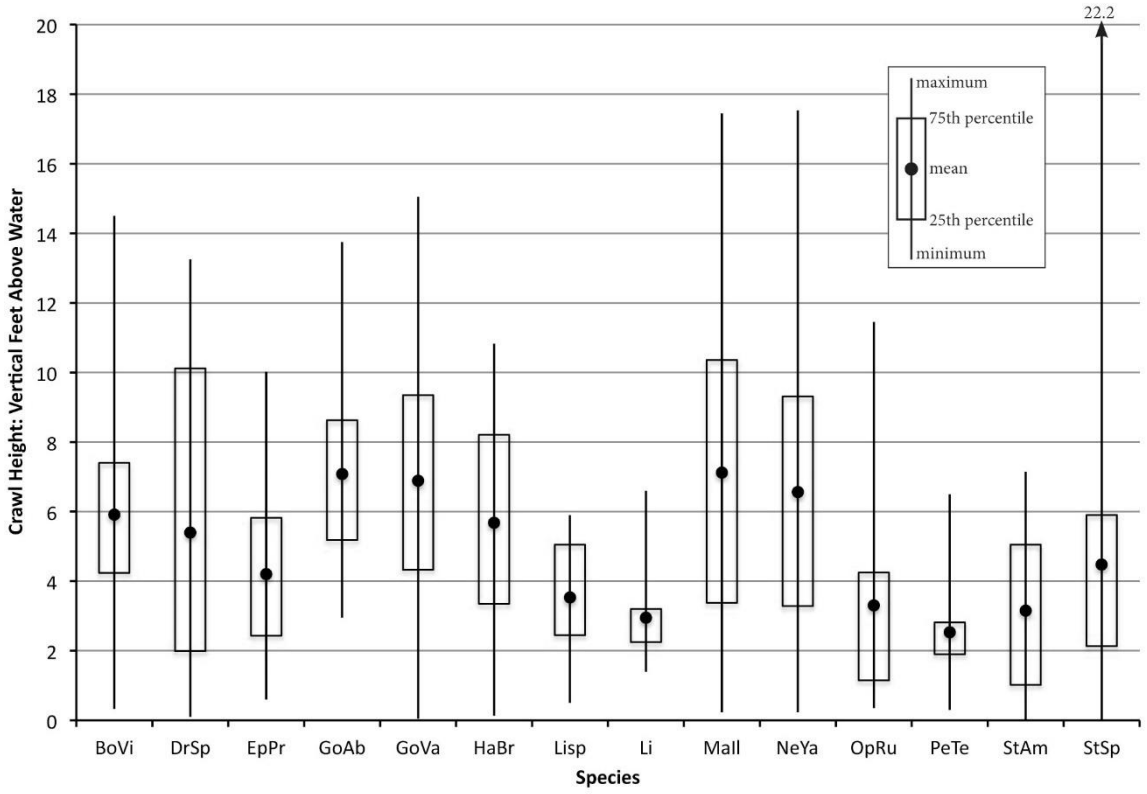
3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Crawl Height

Crawled average 5.0 ft from the water surface

Shorter distances for more lentic species at Site 5

Among riverine species: shortest for *S. amnicola*, *S. spiniceps*, and *O. rupinsulensis*.



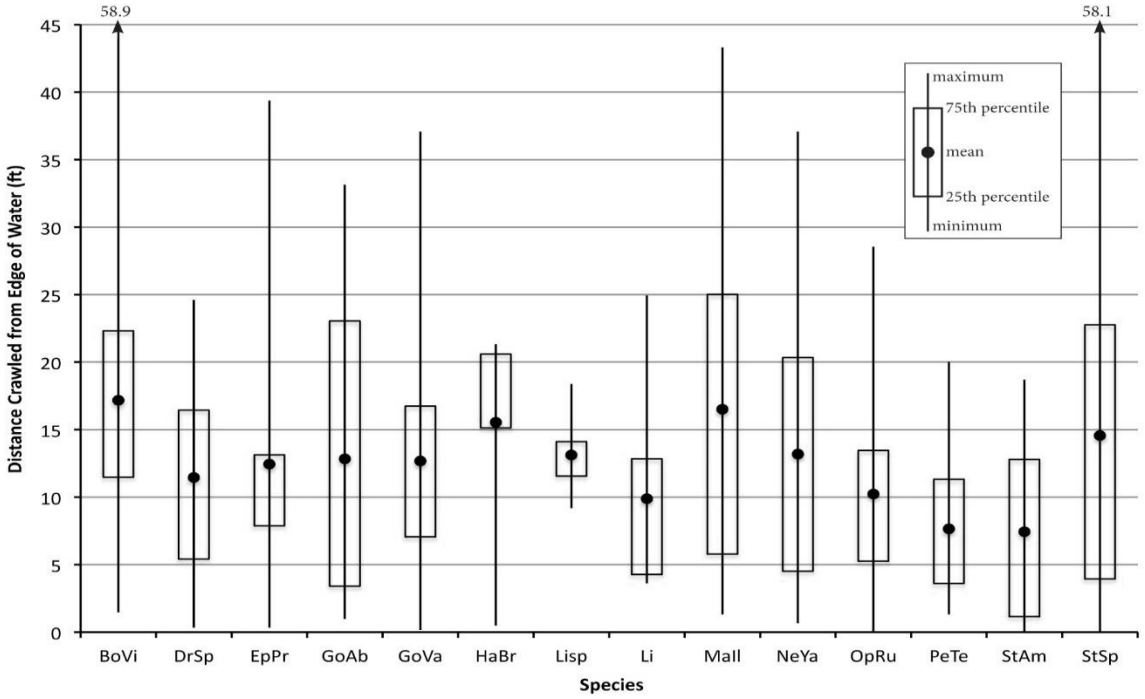
3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Crawl Distance

Crawled average 12.4 ft from edge of water

Shorter distances for more lentic species at Site 5

Among riverine species: shortest for *S. amnicola* and *O. rupinsulensis*.



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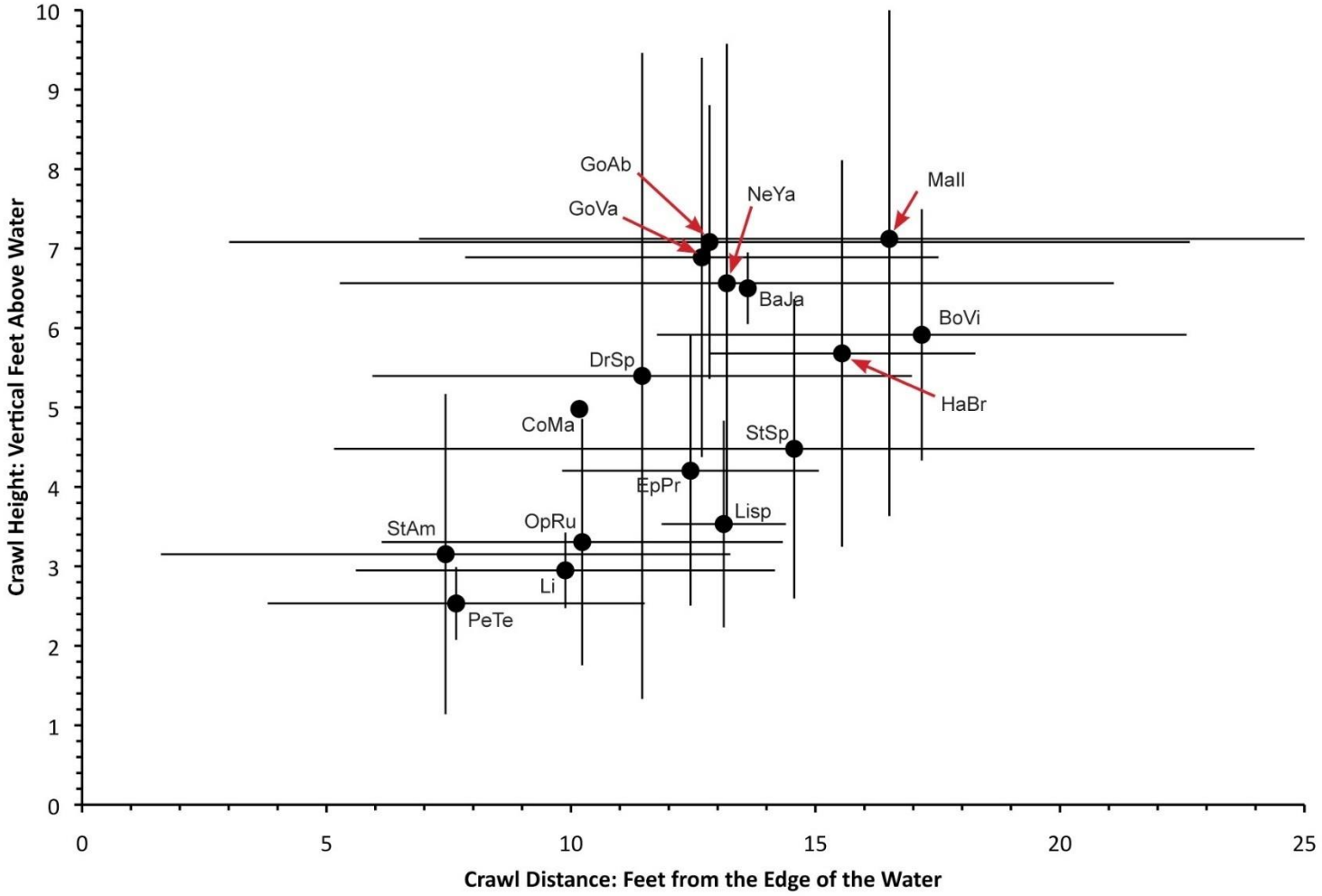


3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Eclosure Speed

Low sample sizes due to low emergence and other factors

Average time from start to end of metamorphosis was 36 minutes (range: 9 to 81)

Average time from end of metamorphosis to flight was 47 minutes (range: 7 to 235)

Observed 9 specimens for entire process: average 70 minutes (range: 54 to 123 mins)

Assessing Effect of WSEL Changes on Odonate Emergence/Eclosure

Assume 2-hr critical eclosure time (start of eclosure to adult flight)

Assume larva begins to eclose at a daily low, just when water levels begin to rise at varying rates (hourly mean, hourly max, highest recorded max)

Assume that only larvae that have begun to eclose are susceptible.

Based on recorded crawl heights, determine percent that would be inundated by rising flows at the three rates before adults flew away (within 2 hours)

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Sites 1 -2

Rate of change rarely exceeded 1.0 ft/hr over the entire period.

Low percent of odonates at risk from WSEL changes.

Site 1	Rate of Change	Height at Risk	% of Odonates
Daily Mean	0.15 ft/hr	<0.30 ft	1.1%
Daily Max	0.41 ft/hr	<0.82 ft	4.0%
Highest Max	1.15 ft/hr	<2.30 ft	8.0%

Site 2	Rate of Change	Height at Risk	% of Odonates
Daily Mean	0.18 ft/hr	<0.36 ft	6.8%
Daily Max	0.51 ft/hr	<1.02 ft	11.2%
Highest Max	1.12 ft/hr	<2.24 ft	22.4%

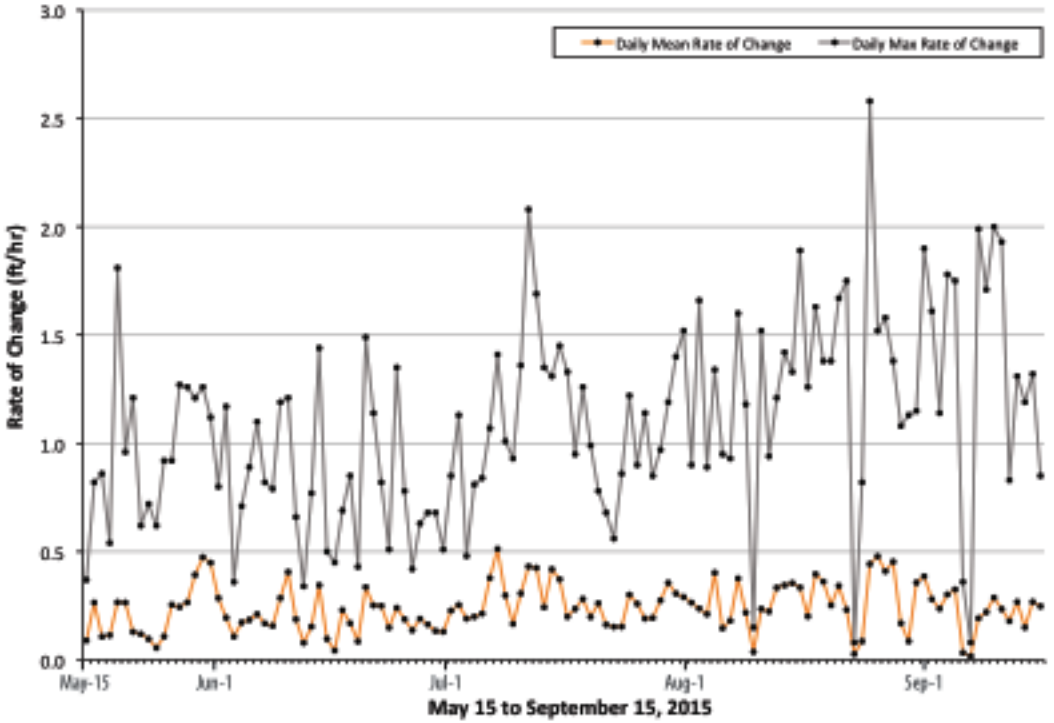
3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Site 3

Daily range in WSEL averaged 3.1 ft. Rates of change affected by operations at Cabot Station.

A higher percent of odonates at risk from WSEL changes at Site 3 compared to other sites.

Site 3 had lowest odonate densities of all sites.



	Rate of Change	Height at Risk	% of Odonates
Daily Mean	0.24 ft/hr	<0.48 ft	9.8%
Daily Max	1.09 ft/hr	<2.18 ft	17.0%
Highest Max*	2.58 ft/hr	<5.16 ft	65.9%

* Highest max = 1.89 ft/hr when bypass flows were stable (July 25-Aug 22, 2015).

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Site 4: Above and Below Rock Dam

Site 4 had the second lowest odonate densities of all sites; transects below Rock Dam had very low density.

Downstream: Daily range in WSEL averaged 1.9 ft. Rates of change affected by operations at Cabot Station and Station 1.

Upstream: Rates of change affected by Station 1 and spill over dam. Fairly stable WSEL and minimal effects on odonates during normal operations.

Upstream	Rate of Change	Height at Risk	% of Odonates
Daily Mean	0.07 ft/hr	<0.14 ft	0%
Daily Max	0.55 ft/hr	<1.1 ft	0%
Highest Max*	2.8 ft/hr	<5.6 ft	50.0%
Downstream	**Rate of Change**	**Height at Risk**	**% of Odonates**
Daily Mean	0.15 ft/hr	<0.30 ft	0%
Daily Max	0.99 ft/hr	<1.98 ft	4.8%
Highest Max**	1.91 ft/hr	<3.82 ft	19.0%

*One time event when Station No. 1 came on-line. **For stable bypass flow period (July 25-Aug 22, 2015)

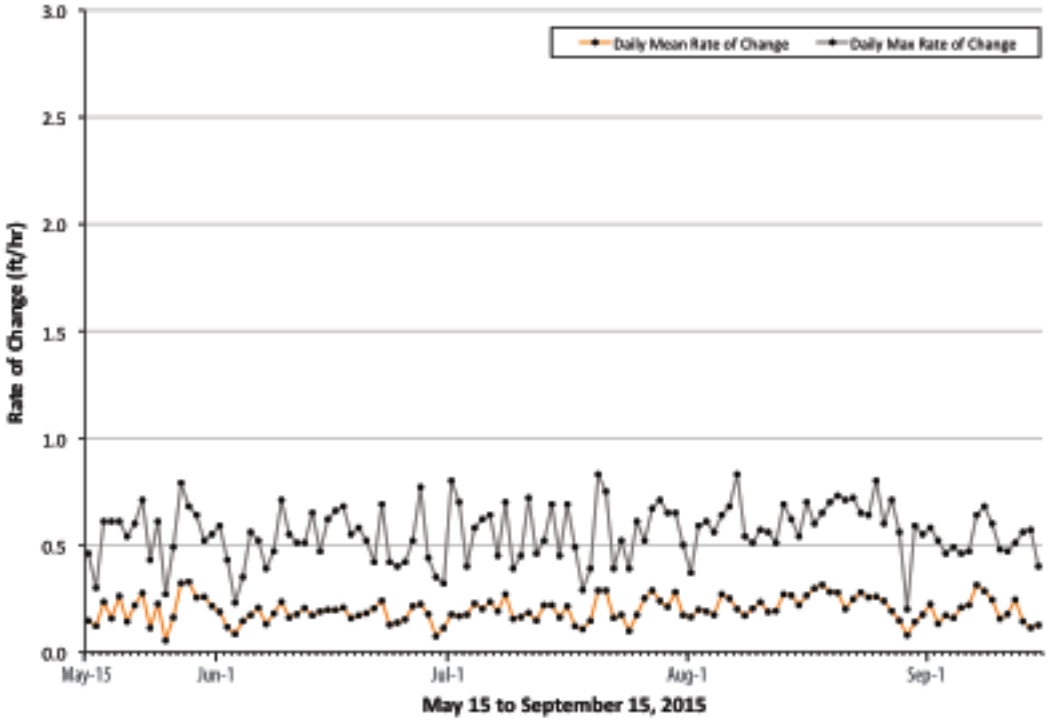
3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Site 5: Barton Cove

Daily range in WSEL averaged 2.5 ft.

Fairly stable WSEL and low rate of change compared to other sites.

Minimal effects on odonate emergence or eclosure.



	Rate of Change	Height at Risk	% of Odonates
Daily Mean	0.20 ft/hr	<0.40 ft	1.3%
Daily Max	0.56 ft/hr	<1.12 ft	8.5%
Highest Max	0.83 ft/hr	<1.66 ft	13.1%

3.3.10-Assess Operational Impacts on Emergence and Eclosure of State-Listed Odonates in the Connecticut River

Summary of Potential Effects

Near Cabot Station and the Bypass Reach

•Water level fluctuations and rates of change resulting from Project operations may affect odonate emergence in areas of the Connecticut River closest to Cabot Station.

•Depends on the timing and magnitude of flows through Cabot Station, Station No. 1, and spill over the Turners Falls Dam.

Downstream from Cabot Station

•Effects of Project operations on hourly/daily changes in WSEL and rates of change diminish with increasing distance downstream from Cabot Station.

•Neither hourly/daily changes in WSEL nor rates of change appeared to have a strong effect on odonate emergence at Sites 1 and 2.

Barton Cove

Neither the hourly/daily changes in WSEL or rate of change in Barton Cove appear to affect odonate emergence.

3.3.16-Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the Connecticut River below Cabot Station

Study Objectives

1. **Identify and map potential habitat for state-listed mussel species based on habitat preferences.**

   - Delineate through field surveys, populations of state-listed mussels and suitable habitat downstream from Cabot Station

   - Characterize distribution, abundance, demographics and habitat use of these populations.

2. **Develop binary HSI curves for all state-listed mussel species found to occur in the 35-mile reach downstream from Cabot Station**

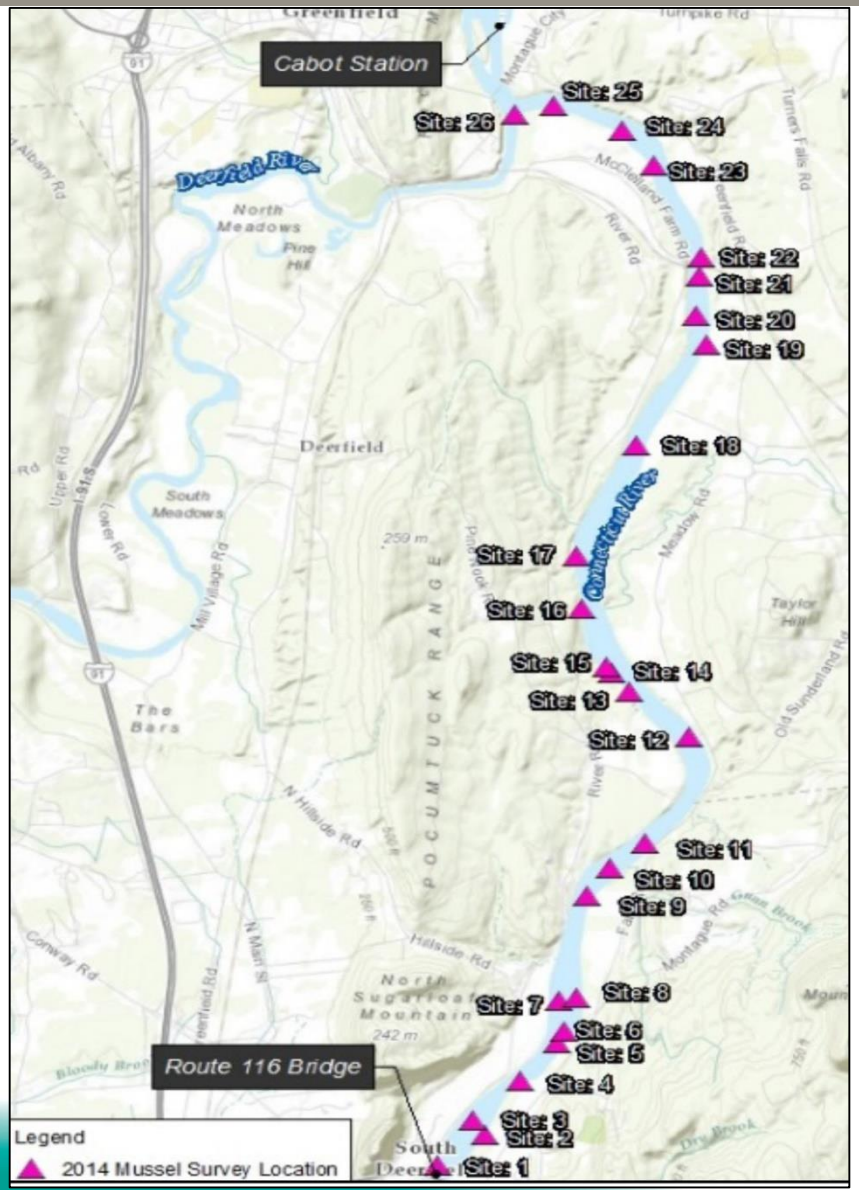
   - Use species-specific data from the CT River and others in Northeast, along with relevant publications and expert review (Delphi Panel).

   - HSI curves to be used in Study No. 3.3.1 *Instream Flow Studies in Bypass Channel and below Cabot Station*

3.3.16-Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the Connecticut River below Cabot Station

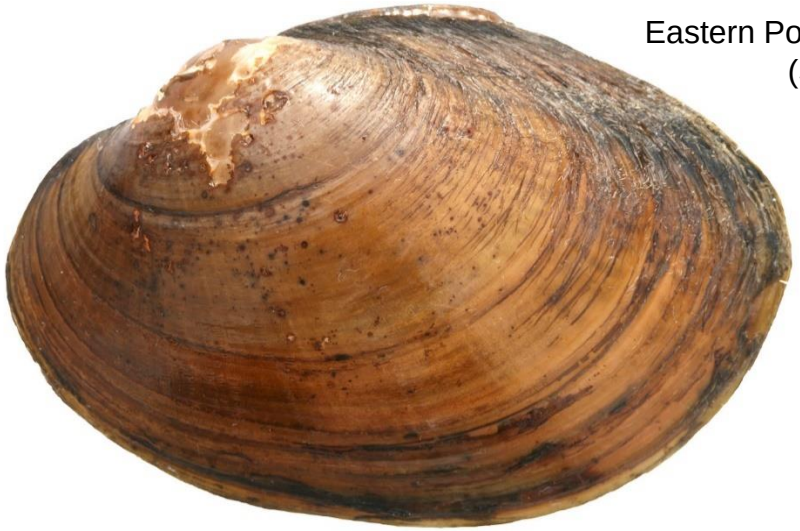
Objective 1: Mussel Survey and Habitat Assessment (Complete)

- In June 2014, a habitat assessment and survey was completed throughout the 13-mile reach of the Connecticut River between Cabot Station and the Sunderland Bridge. A summary report of these findings was posted to the relicensing website in January 2015.
- The mussel community in the reach from Cabot Station to the Route 116 Bridge is dominated by a single species, Eastern Elliptio.
- No live state-listed mussels were found in the survey areas. One relic *Lampsilis cariosa* shell was found.
- As part of FERC-required studies for Holyoke Gas & Electric, three state-listed mussel species were documented in the lower end of Holyoke Dam impoundment (Reach 5 of FirstLight's study area).

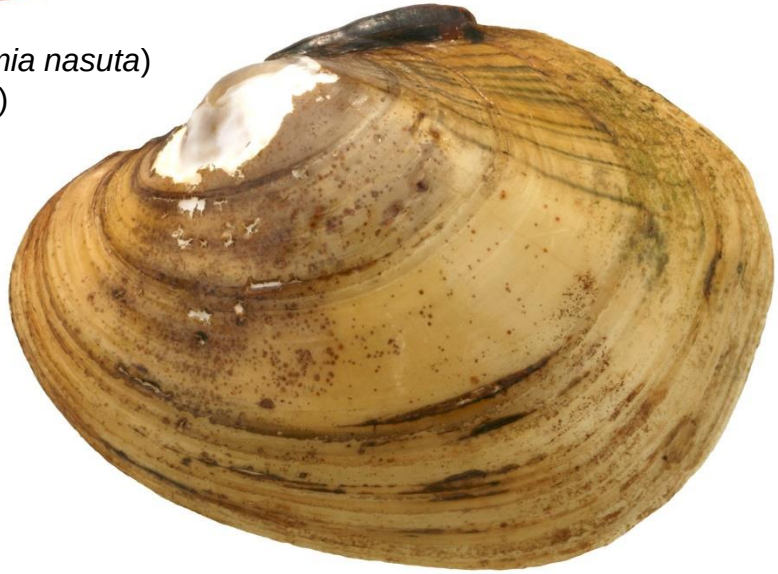


3.3.16-Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the Connecticut River below Cabot Station

Eastern Pondmussel (*Ligumia nasuta*)
(Special Concern)



Tidewater Mucket (*Leptodea ochracea*)
(Special Concern)



Yellow lampmussel (*Lampsilis cariosa*)
(Endangered)

3.3.16-Habitat Assessment, Surveys, and Modeling of Suitable Habitat for State-listed Mussel Species in the Connecticut River below Cabot Station

Objective 2 (in progress)

Task 3: Develop Binary HSI Curves for Target Species

1. A Delphi panel was established.
2. HSI criteria for water depth, flow velocity, substrate, cover, and shear stress are being developed using Delphi technique for juveniles and adults of the three target species
3. Round 1 Delphi questionnaire sent out November 2015, round 1 responses compiled and summarized, round 2 Delphi questionnaire sent out February 2016, and round 2 responses are being evaluated.
4. Concurrence reached on water depth, flow velocity, substrate, and cover. Shear stress and relative shear stress more challenging, and expert opinion is being sought in a third round of the Delphi panel.

Task 4: Assess Effects of Flow Regime on State-Listed Mussels

This task will occur once the HSI criteria are complete. HSI criteria will be used in the IFIM study (Study No. 3.3.1) to model the potential effects of flow regime on state-listed mussels.

Task 5: Report

Terrestrial and Rare, Threatened & Endangered Species

3.4.1-Baseline Study of Terrestrial Wildlife and Botanical Resources

Study Objectives:

- Survey and inventory overall upland wildlife habitats;
- Note the occurrence of wildlife sighting during the course of the surveys;
- Survey and inventory vegetation communities and land use;
- Survey and evaluate the presence of targeted RTE species or associated habitats; and
- Survey and inventory the nature and extent of upland invasive, exotic vegetation species.

3.4.1-Baseline Study of Terrestrial Wildlife and Botanical Resources

Findings- Terrestrial Wildlife

A field survey of wildlife species was conducted concurrently with other botanical and wetland studies.

- 15 mammals directly or indirectly observed including beaver, black bear, coyote and gray fox.
  - Total of 36 mammals likely to exist in study area
- 15 reptiles and amphibians directly or indirectly observed
  - 23 amphibians and reptiles are likely to occur within the study area including nine frogs and toads, four salamanders, three turtles, and seven snakes.
- 64 species of birds were observed within the study area
  - Three occupied Bald Eagle nests were located within the study area, downstream on Third Island, Barton Island in Barton Cove, and along the east bank of the TFI across from Stebbins Island located just downstream of Vernon Dam.

3.4.1-Baseline Study of Terrestrial Wildlife and Botanical Resources

Finding- Botanical Resources

- Botanical surveys were completed to determine the distribution of vegetation communities within the study area.

- An overall census list of all plant species identified within the study area
  - over 335 plant species were identified

- Vegetation communities were identified based on aerial photos or other imagery and classified using the NHESP Classification of the Natural Communities of Massachusetts (Swain & Kersey, 2011) and subsequently ground-truthed.
  - 8 vegetation communities were identified

3.4.1-Baseline Study of Terrestrial Wildlife and Botanical Resources

Habitat Type	Dominant Overstory	Dominant Shrub	Dominant Herbaceous	Acres	Percent of Area
Floodplain Forest	silver maple (51-75%), cottonwood (6-25%), red maple (6-25%)	silver maple (trace), cottonwood (trace) red maple (trace)	wood nettle (6-25%), ostrich fern (6-25%), sensitive fern (6-25%)	547.9	7.8
Northern Hardwoods-Hemlock-White Pine	hemlock (75-100%), yellow birch (10-15%), American beech (5-10%)	hemlock (trace), hobblebush (trace), elderberry(trace)	Christmas fern (trace), Canada mayflower (trace), club moss (trace)	1,107.9	15.7
Successional Northern Hardwoods	aspen (26-50%), white birch (6-25%), red maple (6-25%)	arrowwood (5-10%), staghorn sumac (trace),willow (6-25%)	common clotsbur (6-25%), symphyotrichum spp. (trace), carex spp (6-25%)	2.9	.05
Agricultural Lands	N/A	N/A	Agricultural crops (76-100%)	1,624.7	23.0
High Energy Shore	N/A	silky dogwood (trace), sandbar willow (trace), sandbar cherry (trace)	beggartick (6-25%), dogbane (6-25%)	5.17	.07
Development	white pine (trace)	N/A	Kentucky bluegrass (76-100%)	317.3	4.5
Right of Way	N/A	white pine (6-25%), glossy buckthorn (6-25%)	sensitive fern (6-25%), Joe pye weed (6-25%), bracken fern (6-25%), mullein (6-25%)	4.8	.07
Wetlands	See Study 3.5.1	See Study No. 3.5.1	See Study No. 3.5.1	342.2	4.8
Water	N/A	N/A	N/A	3,112.4	44.1
Total				7,065.2	100.0

3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Study Objectives:

- Quantitatively describe and field verify NWI mapped wetland types, describe and map shallow water aquatic habitat, including SAV and EAV, substrate type, invasive species, and associated wildlife in the TFI and up to 200 feet from the TFI shoreline.

- Obtain baseline information, through field surveys, on the locations and population parameters of Massachusetts state-listed rare plant species in TFI and the 13+ miles of riverine habitat below Cabot Station to the Route 116 Bridge in Sunderland.

- Analyze how the Project operations affect botanical and wildlife resources with an emphasis on how Project operations influence habitat of state-listed plant species and state-listed invertebrate species including the cobblestone tiger beetle and the Puritan tiger beetle.

3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Task 2: Riparian and Littoral Zone Botanical Survey

- Riparian habitats mapped and described as part of Study 3.4.1
- Submerged Aquatic Vegetation (SAV):
  - No SAV mapped within the bypass reach
  - No Exotic/Invasive species identified downstream of the Turners Falls Dam

Scientific Name	Common Name
*Cabomba caroliniana**	Fanwort
Ceratophyllum demersum	Coontail
Chara Sspssp.	Muskgrass
Elodea nuttallii	Waterweed
*Myriophyllum spicatum**	Eurasian milfoil
*Myriophylum heterophyllum**	Variable leaf milfoil
Myriophylum Sppspp.	Milfoil
Potamogeton amplifolius	Large-leaf pondweed
Potamogeton perfoliatus	Clasping leaf pondweed
Potamogeton Sspspp.	Pondweed
*Potomageton crispus**	Curly-leaved pondweed
*Trapa natans**	Water chestnut
Vallisneria americana	Wild celery (Eelgrass)

*Exotic Species

Density Class	Estimated Density (%)	Number of Beds	Area (Sq. Ft.)	Area (Acres)
Dense	51-100%	25	12,878,374	295.6
Medium	26-50%	42	5,758,854	132.2
Sparse	0-25%	56	2,713,116	62.3
Total		**123**	**21,350,344**	**490.1**

3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Task 3: Rare, Threatened, and Endangered Plant Transect Survey

- Mapping of RTE plants occurred in 2014
- Survey transects within occupied/unoccupied habitats were surveyed in August of 2015.
  - A total of 18 habitat transects were established
    - In the TFI: Transect 10, 9A, 9B, 8, 11D, 11C, 11B, 11A, 6A, 6B, 6C 5A, and 5B (total of 13 transects);
    - in the bypass channel: Transect T-3 (total of 1 transect); and
    - in the Montague USGS Gage to Sunderland Bridge reach: Transect 4, 3, 2 and 1 (total of 4 transects).

3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Task 4: Invasive Plant Survey

- Mapping and description of invasive species included in Study 3.4.1
- Commonly occurring species along the impoundment and downstream of Turners Falls Dam are black swallowwort, Oriental bittersweet, and Japanese knotweed.
- Common reed was not widespread.

Task 5: Mapping of Wetlands and Waters of the U.S.

- NWI wetlands verified (~1,400 acres) and new (~ 56 acres) wetlands mapped in 2014
- Most common wetlands are emergent or forested wetlands

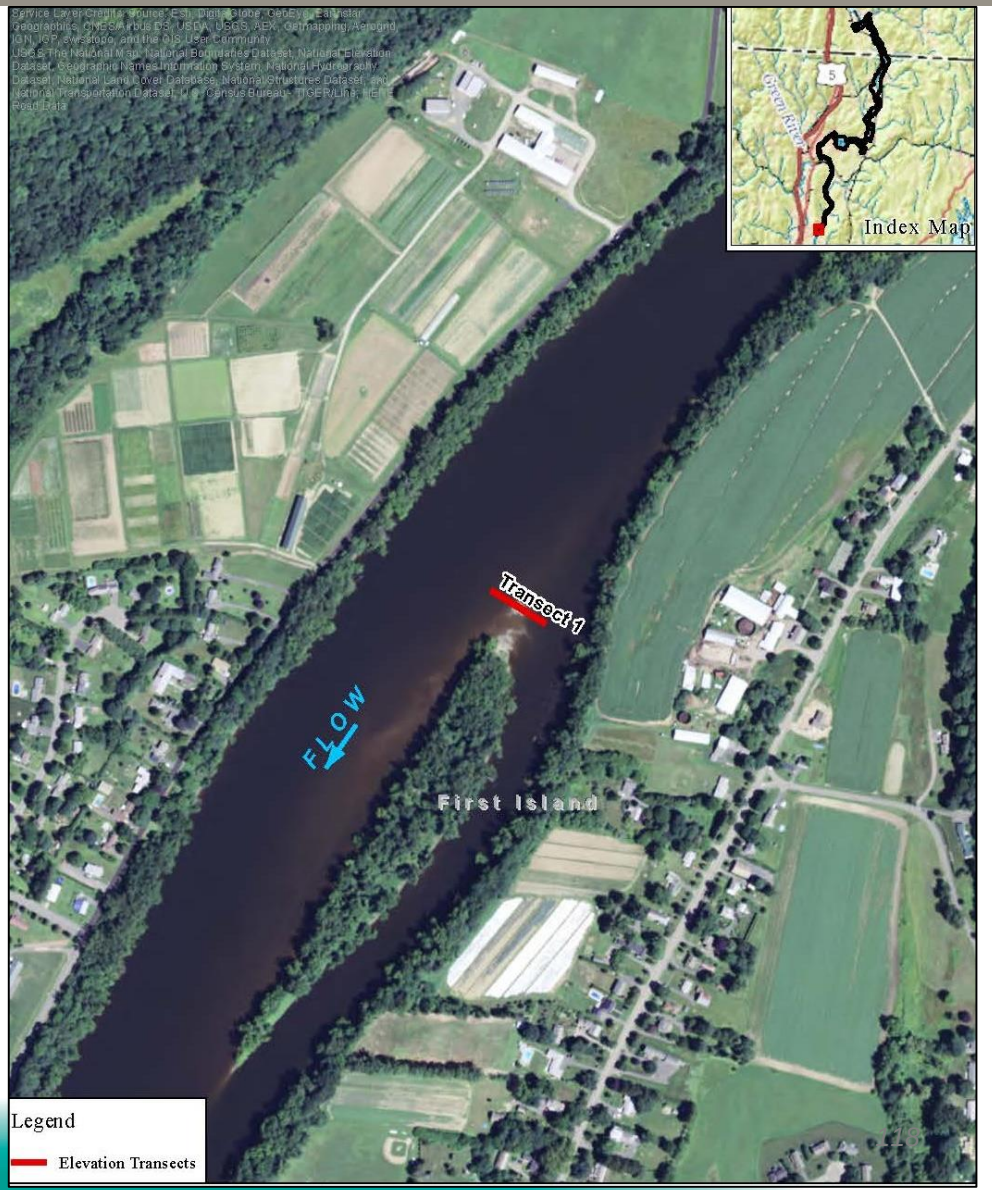
Verified Wetland Type	Area (Acres)
Palustrine Emergent Wetland	457.4
Palustrine Forested	872.8
Palustrine Scrub-Shrub	2.4
Palustrine Pond	49.7
Total	**1,382.3**

New Wetland Type	Area (Acres)
Palustrine Emergent	55.7
Total	**55.7**

3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Task 6: Project Water Level Fluctuation Assessment-RTE Plants

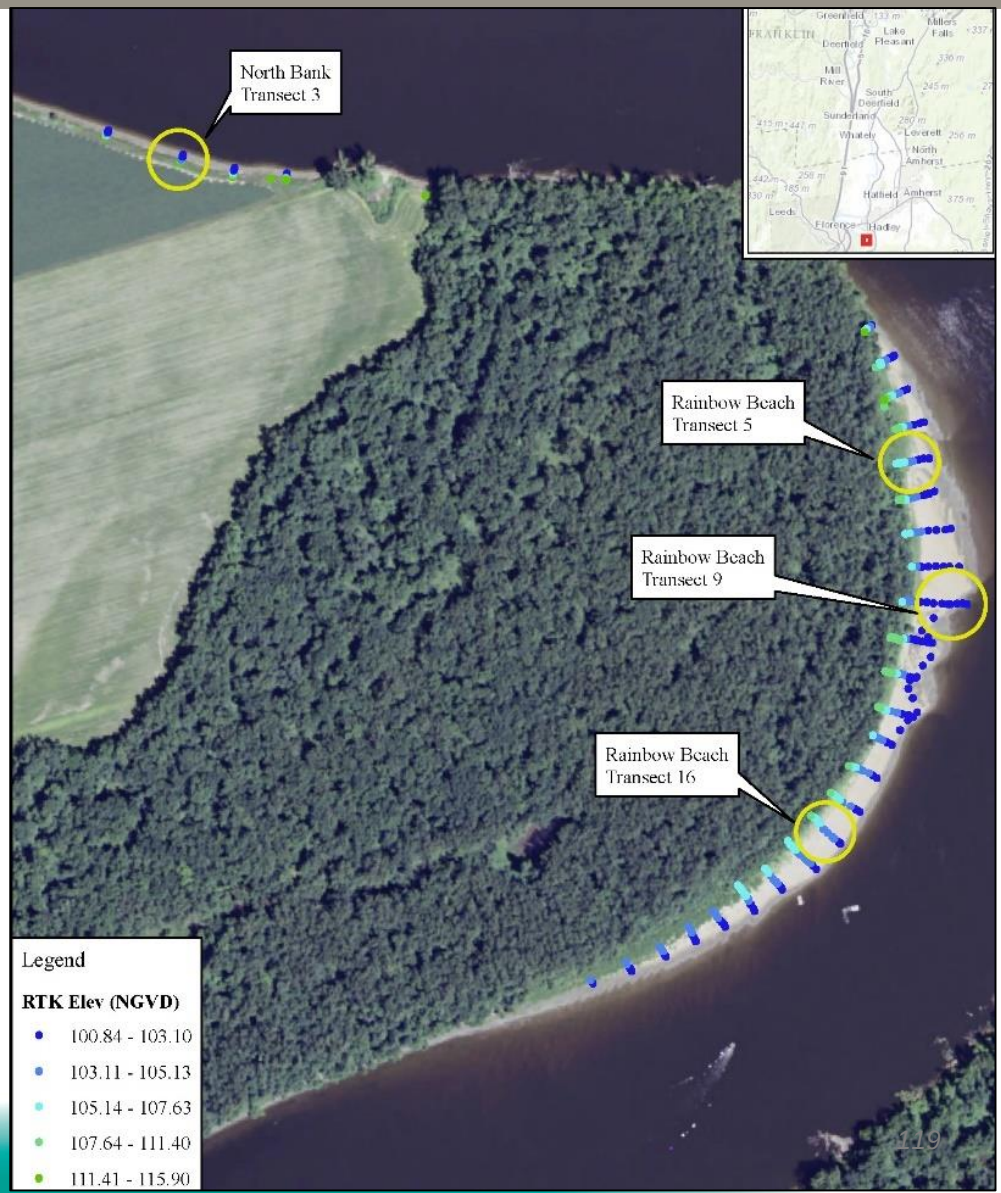
- Transect 1 (First Island, near the Sunderland Bridge)
- Sandbar Willow transect
- Transect length 230 feet
- Nine individual willows identified on the transect
- Willows occur between elevation 104.0 feet and 105.1 feet
- Majority of willows occur above the July median flow (9,500 cfs)



3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Task 6: Project Water Level Fluctuation Assessment-Beetles

- Tiger beetle survey completed from the Vernon Dam downstream to Holyoke, MA in August of 2014.
- No cobblestone tiger beetles were located in 2014.
- Elevation survey at Rainbow Beach was completed in 2014
  - Total of 28 transects (four at North Bank and 24 at Rainbow Beach)



Task 7: Data Analysis

- Riparian habitat in the study area is dominated by northern hardwood forests with some mixed softwood species
- Submerged Aquatic Vegetation (SAV)
  - SAV beds occur within the impoundment and downstream of the Turners Falls Dam, but are not identified within the bypass reach.
  - Invasive SAV is located within the Impoundment and most commonly observed in the area immediately upstream of the Turners Falls Dam.
  - Project operations may result in a loss of SAV establishment in a small band along the shoreline where water fluctuations are most common; however, this does not limit the establishment of SAV within deeper areas away from the shoreline.

3.5.1-Baseline Inventory of Wetland, Riparian and Littoral Habitat in the Turners Falls Impoundment, and Assessment of Operational Impacts on Special-Status Species

Task 7: Data Analysis

RTE Plants

- 18 Transects were surveyed to examine RTE plant species.
- Mountain alder generally occurs within the TFI above the April median WSEL and outside the more commonly observed changes in WSEL.
- Within the bypass, the mountain alder was not inundated during the flow demonstration.
- The mountain alder appears to prefer elevations which are generally drier and more removed from project operations.
- Upland white aster and sandbar cherry also occur, primarily, above the median April WSEL, and in all cases occur above the May median WSEL.
- Tradescant's aster and the sandbar willow are most commonly observed below the April median WSEL.
- Botanical RTE species within the project do not appear to be greatly affected by project operations, in fact the variable water levels may be creating a desirable environment for these species which are adapted to dynamic river systems.

Task 7: Data Analysis

Wetlands

- Wetlands within the study area include a mixture of forested, scrub-shrub, and emergent wetlands. The most commonly observed wetlands within the study area include forested floodplain wetlands and shoreline emergent wetlands.

Invasive Species

- Several areas are dominated by Japanese knotweed, black swallowwort, and Oriental bittersweet, which are the most common invasive plant species along the shoreline. These species do occur in patches, and, occasionally, Japanese knotweed forms dense monocultures.

Task 7: Data Analysis

Tiger beetles

- Elevation surveys of known occupied habitat at Rainbow Beach were completed in 2014. Survey data were used in conjunction with modeling developed from Study No. 3.2.2
- Project operations may impact available habitat and disperse individuals, primarily at the lower range of elevations, at higher elevations the operations may result in similar effects, but less frequently.
- Impacts from recreation at Rainbow Beach are likely to affect both adult and larval beetles. Boat wakes may temporarily and rapidly disperse individuals along the water line, and foot traffic from recreators may result in mortality or dispersal.

Recreation and Land Use

3.6.1-Recreation Use/User Contact Survey

Work Completed

Task 1: Study Preparation
Task 2: Field Work
Task 3: Data Entry and Statistical Analysis
Task 4: Report Writing

- All of the above tasks are complete. Report was posted to the website on 12/31/15 and filed with FERC on 3/1/16.

Findings (if any)

- See next pages.

Variances (if any)

- As we reported at the USR meeting in September 2015, there were no variances from the study plan or schedule in the second year of the study.

Work Remaining

- None.

3.6.1-Recreation Use/User Contact Survey Study Objectives

1) Determine the amount of recreation use and demand at the Turners Falls and Northfield Mountain recreation sites.

2) Interview the recreating public to determine user opinions and goals with regard to the recreation sites, including the perceived adequacy of recreation facilities and access at the Project.

3.6.1-Recreation Use/User Contact Survey Methodology

Recreation Use

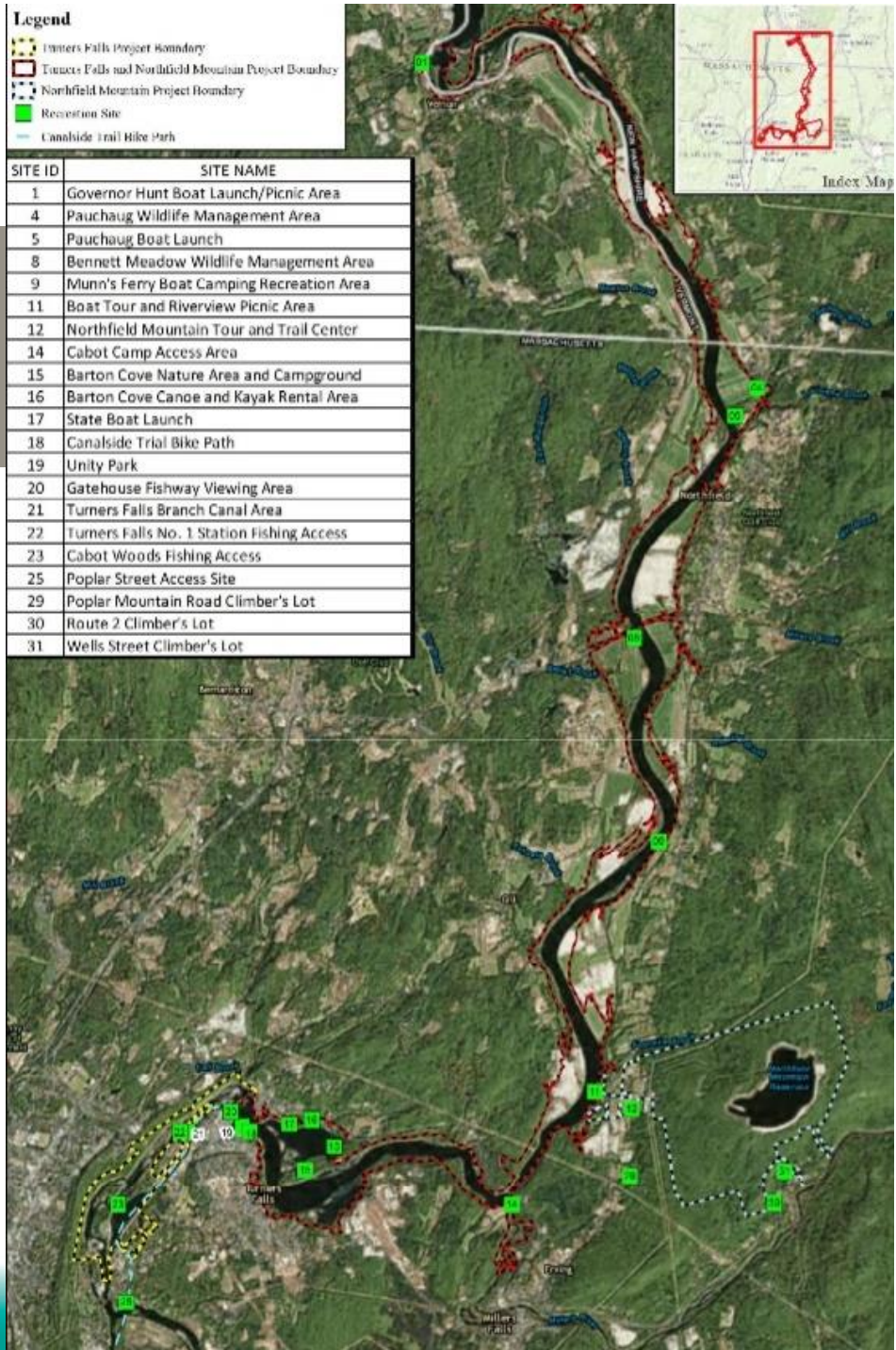
- Spot counts (1,273) and calibration counts (1,226)
  - Conducted at 20 recreation sites located throughout the Projects.
  - 5 days per month: 3 randomly selected weekdays and 2 randomly selected weekend days
- Traffic counters at 11 sites
  - Spring – Fall, 2014
- Actual Recreation Site Use Records and Registrations

Recreation User Surveys

- User Contact Survey
  - Recreation User Survey (733 original, 211 modified)
  - Northfield Mountain Trail User Survey (84 original, 31 modified)
- Residential Abutters Survey
  - 95 returned surveys of 211 mailed
- Phone Survey of Private Recreation Groups within the Projects
- Phone Survey of Law Enforcement
- Review of Open-Space Planning Information

3.6.1-Recreation Use/User Contact Survey - Methodology

Figure: Recreation Use and User Survey Study Area



SITE ID	SITE NAME
1	Governor Hunt Boat Launch/Picnic Area
4	Pauchaug Wildlife Management Area
5	Pauchaug Boat Launch
8	Bennett Meadow Wildlife Management Area
9	Munn's Ferry Boat Camping Recreation Area
11	Boat Tour and Riverview Picnic Area
12	Northfield Mountain Tour and Trail Center
14	Cabot Camp Access Area
15	Barton Cove Nature Area and Campground
16	Barton Cove Canoe and Kayak Rental Area
17	State Boat Launch
18	Canalside Trial Bike Path
19	Unity Park
20	Gatehouse Fishway Viewing Area
21	Turners Falls Branch Canal Area
22	Turners Falls No. 1 Station Fishing Access
23	Cabot Woods Fishing Access
25	Poplar Street Access Site
29	Poplar Mountain Road Climber's Lot
30	Route 2 Climber's Lot
31	Wells Street Climber's Lot

3.6.1-Recreation Use/User Contact Survey Methodology

Public Recreation Sites and Access Areas Where Recreation Use Counts and User Surveys Were Conducted

Site ID[1]	Site Name/Access Areas	Spot Counts	Calibration Counts	Traffic Counter	User Surveys
1	Governor Hunt Boat Launch/Picnic Area	✓	✓		✓
4	Pauchaug Wildlife Management Area	✓	✓		✓
5	Pauchaug Boat Launch	✓	✓	✓	✓
8	Bennett Meadow Wildlife Management Area	✓	✓	✓	✓
9	Munn's Ferry Boat Camping Recreation Area (campsites only)	✓	✓		✓
11	Boat Tour and Riverview Picnic Area	✓	✓	✓	✓
12	Northfield Mountain Tour and Trail Center	✓	✓	✓	✓
14	Cabot Camp Access Area	✓	✓	✓	✓
15	Barton Cove Nature Area (parking)	✓	✓	✓	✓
15	Barton Cove Campground (campground)	✓	✓	✓	✓
16	Barton Cove Canoe and Kayak Rental Area	✓	✓	✓	✓
17	State Boat Launch	✓	✓	✓	✓
18	Canalside Trail Bike Path	✓	✓		✓
19	Unity Park	✓	✓		✓
20	Gatehouse Fishway Viewing Area	✓	✓		✓
21	Turners Falls Branch Canal Area	✓	✓		✓
22	Turners Falls Station No. 1 Fishing Access	✓	✓		✓
23	Cabot Woods Fishing Access	✓	✓	✓	✓
25	Poplar Street Access Site	✓	✓	✓	✓
27	Rose Ledge Climbing Area (Parking)	✓	✓		✓
28	Farley Ledge Climbing Area (Wells St. parking)	✓	✓		✓
28	Farley Ledge Climbing Area (Route 2 parking)	✓	✓		✓

[1] *Site numbers were assigned as part of Study 3.6.2 Recreation Facilities Inventory and Assessment*

3.6.1-Recreation Use/User Contact Survey Findings

Overall Recreation Use

Estimated Total Annual Use and Seasonal Breakdown of Use, by Recreation Site, for 2014

Recreation Site	Estimated Annual Use (2014)	Estimated Winter Use	Estimated Spring Use	Estimated Summer Use	Estimated Fall Use
Governor Hunt Boat Launch/Picnic Area	1,812	13%	11%	67%	9%
Pauchaug Wildlife Management Area	1,005	15%	0%	23%	62%
Pauchaug Boat Launch	9,630	1%	7%	68%	23%
Bennett Meadow Wildlife Management Area	3,729	2%	14%	40%	44%
Munn's Ferry Boat Camping Recreation Area	1,716	0%	0%	84%	16%
Boat Tour and Riverview Picnic Area	13,651	17%	23%	39%	21%
Northfield Mountain Tour and Trail Center	20,024	24%	12%	33%	31%
Cabot Camp Access Area	5,326	4%	10%	62%	24%
Barton Cove Nature Area	7,842	15%	19%	45%	21%
Barton Cove Campground	2,963	0%	5%	92%	3%
Barton Cove Canoe and Kayak Rental Area	4,455	2%	0%	98%	0%
State Boat Launch	15,126	1%	2%	74%	23%
Canalside Trail Bike Path	6,362	1%	13%	54%	31%
Gatehouse Fishway Viewing Area	27,345	7%	28%	46%	20%
Turners Falls Branch Canal Area/Turners Falls Station No. 1 Fishing Access	1,264	27%	29%	20%	24%
Cabot Woods Fishing Access	18,230	17%	19%	38%	27%
Poplar Street Access Site	1,877	14%	5%	56%	25%
Rose Ledge Climbing Area Parking	1,790	2%	27%	54%	17%
Farley Ledge Climbing Area—Wells Street Parking	2,390	7%	51%	29%	13%
Farley Ledge Climbing Area—Route 2 Parking	6,232	4%	22%	48%	25%
Total	**152,769**	**10%**	**16%**	**50%**	**23%**

- 152,769 total recreation days in 2014
- 50% of the recreation use occurred during summer
  - Summer: May 23, 2014 – Sept 1, 2014 (Memorial Day weekend – Labor Day weekend)

3.6.1-Recreation Use/User Contact Survey Findings

Recreation Use by Activity

- Walking/hiking/jogging were most popular (30%), followed by motorized boating, fishing, bike riding, picnicking, rock climbing, and non-motorized boating.

Recreation Use by Activity Type based on Spot Counts and Calibration Counts in 2014

Recreation Activity	Estimated Use (Recreation Days)	Percent (%) of Recreation Use
Walking/Hiking/Jogging	45,691	30%
Motor boating	18,470	12%
Fishing	9,966	7%
Bike Riding	8,744	6%
Picnicking	8,362	5%
Rock Climbing	6,703	4%
Non-motor boating	6,656	4%
Fishway Viewing	5,061	3%
Cross-country Skiing	3,960	3%
Camping	3,478	2%
Riverboat touring	2,733	2%
Sightseeing	1,802	1%
Hunting	1,569	1%
Birding	847	1%
Ice Fishing	761	1%
Horseback Riding	746	<1%
Snowshoeing	188	<1%
Whitewater boating	171	<1%
Ice skating/ Ice boat	112	<1%
Unidentified Activity	26,750	18%
Total	**152,769**	**100%**

3.6.1-Recreation Use/User Contact Survey Findings

Recreation Use and Utilization, by Recreation Site

Recreation Site Capacity Utilization by Site

Recreation Site	Recreation Days	Percent Capacity Utilized
Governor Hunt Boat Launch/Picnic Area	1,812	50%
Pauchaug WMA	1,005	1%
Pauchaug Boat Launch	9,630	20%
Bennett Meadow WMA	3,729	10%
Munn's Ferry Boat Camping Recreation Area	1,716	40%
Boat Tour and Riverview Picnic Area	13,651	10%
Northfield Mountain Tour and Trail Center	20,024	10%
Cabot Camp Access Area	5,326	15%
Barton Cove Nature Area	7,842	20%
Barton Cove Campground	2,963	40%
Barton Cove Canoe and Kayak Rental Area	4,455	25%
State Boat Launch	15,126	65%
Canalside Trail Bike Path	6,362	N/A
Gatehouse Fishway Viewing Area	27,345	25%
Turners Falls Branch Canal/Station No. 1 Fishing Access	1,264	1%
Cabot Woods Fishing Access	18,230	25%
Poplar Street Access Site	1,877	10%
Rose Ledge Climbing Area Parking	1,790	60%
Farley Ledge Climbing Area—Wells Street Parking	2,390	30%
Farley Ledge Climbing Area—Route 2 Parking	6,232	60%
Annual Total	**152,769**	

- The Gatehouse Fishway Viewing Area (including adjacent picnic area and a portion of the bike trail) received the most use, followed by the NMTTC, the Cabot Woods Fishing Area, the State Boat Launch, and the Boat Tour and Riverview Picnic Area.
- Estimated capacity utilization per site was identified.
  - All sites were found to have utilization below the design capacity.

3.6.1-Recreation Use/User Contact Survey Findings

Recreational User Survey

User surveys included ratings and users' recreational experiences at the Projects.

- Total number of surveys collected: **945**
- Average age of users: 48.8 years old
- Majority are male (63%)
- Most use is local, with an average distance traveled to the Projects of 23 miles
- Average length of stay is 1.7 hours
- 91% had visited the Project area before
- 96% estimated they spent "less than $100" during their visit
- User surveys indicated most popular recreation activities were walking and dog walking. This is consistent with the findings from the use counts.

3.6.1-Recreation Use/User Contact Survey Findings

Recreational User Survey

Recreational User Ratings of Recreation Sites, Facilities and Amenities, Reported as Percent of Respondents

Site/Facility/Amenity	Number of Responses	5 Excellent	4	3 Fair	2	1 Poor
Parking	917	46%	35%	14%	4%	2%
Facility Condition	918	42%	40%	14%	4%	<1%
Variety of Amenities	905	28%	35%	25%	9%	3%
Toilets/Restrooms	139	17%	20%	13%	9%	41%
River Access	198	43%	36%	14%	4%	4%
Overall Quality	914	41%	44%	12%	2%	<1%

- Overall quality of the recreation sites/facilities and amenities rated well:
  - 85% rated facilities Excellent or better than Fair
- Parking, facility condition, river access, and variety of amenities also rated well.
- Only restrooms/toilets received notably lower ratings, with 50% rating them from Fair to Excellent and 50% rating them less than Fair.

3.6.1-Recreation Use/User Contact Survey Findings

Recreational User Survey

Recreational User Ratings of Number of the Facilities, Level of Use, and Water Levels, Reported as Percent of Respondents

Topic	Number of Responses	Respondents' Ratings				
		5 Extremely Crowded	4	3 Somewhat Crowded	2	1 Not Crowded
Level of Use	908	6%	16%	21%	19%	39%
		5 Extremely Satisfied	4 Moderately Satisfied	3 Satisfied	2 Slightly Satisfied	1 Not Satisfied at all
Number of Facilities	193	36%	31%	29%	4%	<1%
		5 Extremely Satisfied	4 Moderately Satisfied	3 Satisfied	2 Slightly Satisfied	1 Not Satisfied at all
Water Levels[1]	427	13%	43%	37%	5%	2%

[1] The question regarding water levels was included on surveys administered throughout the year. Less than half of the 945 recreationists answered this question.

3.6.1-Recreation Use/User Contact Survey Findings

Recreational User Survey

Summary of Open-ended Responses to: "What did you like **least** about your recreational experience today?"

Response	Number of Comments
Weather	42
Trash/litter	41
Parking lot and road maintenance/plowing	28
Crowded/noisy	27
No restrooms/restrooms closed	23
Goose droppings/goose feedings	23
Dogs	23
Behavior of other recreationists	19
Insects	13
Poor fishing	12
Muddy	7
Access to water	7
Restrictions	6
Low water level	6
Boat access/ramp	6
Poison Ivy/Japanese Knotweed	6
Location	6
Motor boats/boaters	5
Poor/lack of amenities	4
Picnic tables	4
Dangerous drivers	4
Facilities/gate closed	3
Safety	3
Not in guidebook/on map	3
View of power lines	2
Flooding	2
Construction projects	2
Fishway	2
Lack of trees/trees cut	2
Handicapped accessibility	2
Other	12
Total	**345**

- A host of different factors were indicated across the many surveys collected.
- Factors identified by respondents that they liked the "least" or which "detracted" from their experience included: trash and litter, and parking lot and road maintenance.
- Other factors consistently cited but generally beyond the control of FirstLight included: weather, goose droppings, dogs, and the behavior of other recreationists.

3.6.1-Recreation Use/User Contact Survey Findings

Recreational User Survey

Summary of Open-ended Responses to: "What did you like **most** about your recreational experience today?"

Response	Number of Comments
Peaceful/quiet	178
Beauty/scenery	137
Location/close to home	69
Weather	67
Nature/wildlife	67
Not crowded	61
Fishing	61
Walking	46
Water/River	44
Water access	42
Good for dogs	26
Eagles, geese, ducks, waterfowl	25
Cleanliness	24
Birding	23
Community feel/friendliness	19
Time with family and friends	17
Safety	15
Parking/plowed access	13
Climbing	12
Public access/free	12
Boating/being on water	11
Biking/bike path	9
Recreation/relaxation	8
Historic/geologic interest	6
Picnicking	6
Fishway	5
Hunting	4
Variety	3
Camping	2
Other	18
Total	**1,030**

- Factors identified by respondents that they liked the "best" or which "enhanced" their experience included: scenery/beauty, nature/wildlife, and peaceful/quiet.
- Weather and location/close to home were also mentioned routinely as contributing factors.
- Interestingly, one of the more commonly mentioned positive features was "cleanliness"; suggesting that there were mixed views among users regarding the trash/litter situation, or that trash/litter might be more of an occurrence at some sites than others.

3.6.1-Recreation Use/User Contact Survey Findings

Residential Abutters Survey

Summary of Responses to Residential Abutter Survey Questions

- Mail survey of the 211 residential landowners abutting or within the Project boundaries.
- 95 surveys (45%) completed and returned.
- Among respondents:
  - 86% were year-round residents.
  - 65% indicated that their property was adjacent to the Connecticut River.
  - 47% use public recreation sites associated with the Projects.
- Results suggest that there is probably some use of Project waters that occurs via access across private property, either by the residents themselves, or by others who have permission to cross the private lands.
- In all four seasons, most popular recreation activities reported by the residents: walking, dog walking, birding, hiking, photography, and nature observation.
- Kayaking, power boating, canoeing, fishing, and picnicking were popular in the spring, summer, and fall.
- In the summer, many residents also reported enjoying swimming, water skiing, and tubing.

3.6.1-Recreation Use/User Contact Survey Findings

Project Area Population Trends and Projected Recreation Demand

Projected 2060 Average Summer Weekend Use by Site

Site	Available Spaces	2060 Projected Spaces in Use, summer weekend	Percent Capacity (rounded)
Governor Hunt Boat Launch/Picnic Area	4	2	50%
Pauchaug WMA	20	0.1	>5%
Pauchaug Boat Launch	32	7	25%
Bennett Meadow WMA	7	1	15%
Boat Tour and Riverview Picnic Area	27	3	15%
Northfield Mountain Tour and Trail Center	57	6	10%
Cabot Camp Access Area	20	3	15%
Barton Cove Nature Area	26	9	35%
Barton Cove Canoe and Kayak Rental Area	28	7	30%
State Boat Launch	46	31	70%
Canalside Trail Bike Path	N/A	N/A	N/A
Gatehouse Fishway Viewing Area	29	7	25%
Turners Falls Branch Canal Area/Turners Falls Station No. 1 Fishing Access	26	0.2	>5%
Cabot Woods Fishing Access	20	6	30%
Poplar Street Access Site	16	2	15%
Rose Ledge Climbing Area Parking	10	6	65%
Farley Ledge Climbing Area—Wells Street Parking	16	10	65%
Farley Ledge Climbing Area—Route 2 Parking	8	2	30%
Total	**392**	**103**	**30%**
Site	**Available Sites**	**2060 Projected Sites in Use, summer weekend**	**Percent Capacity (rounded)**
Munn's Ferry Boat Camping Recreation Area	5	2	45%
Barton Cove Campground	29	11	40%
Total	**34**	**13**	**40%**

- Projected that on the average summer weekend in 2060:
  - All of the recreation sites at the Projects will be under-capacity
  - Only 4 sites predicted to be at 50% capacity or over: Governor Hunt Boat Launch/Picnic Area; State Boat Launch; Rose Ledge Climbing Area Parking; and Farley Ledge – Wells Street Parking
  - Majority to be less than half-filled

3.6.1-Recreation Use/User Contact Survey Findings

Other Information on Recreation Use

Private Clubs and Recreational Facility Survey Results

- Three entities (two clubs and a school) were surveyed
  - Franklin County Boat Club
    - No response
  - Turners Falls Rod and Gun Club
    - Private, non-profit functions open to public for fee
    - 24 boats docked at facility
    - Satisfied with river water levels over the course of the summer
  - Northfield Mount Hermon School
    - Utilize Connecticut river for recreation during spring, summer, fall
    - Concerned about water level changes

Limited results of this survey found that members of these groups do utilize the Projects for recreation (primarily the Turners Falls Impoundment), but that their use does not appreciably add to the level of use of the recreation sites assessed in this study.

Local Recreation Departments and Police

- State and local policing entities were contacted via email and phone.
- No consistent problems observed. Some occurrence of minor incidents, including illegal camping and boating infractions.

3.6.1-Recreation Use/User Contact Survey Conclusions

- The study resulted in the collection of much data regarding recreation use and user perceptions at the Projects.
- Recreation use was greatest at the Gatehouse Fishway Viewing Area, Northfield Mountain Tour and Trail Center, Cabot Woods Fishing Access and Boat Tour and Riverview Picnic Area sites.
- Recreation use greatest in summer (50%), followed by fall (23%), spring (16%), and winter (10%) .
- Most popular recreation activities Project-wide were walking/hiking/jogging, motor boating, fishing, bike riding, and picnicking.
- Based on utilization estimates, all recreation sites were found to be meeting current demand and projected future demand (2060).
- User ratings were very high for Overall Quality of recreation sites, Parking, Facility Conditions, River Access and Variety of Amenities.
- User ratings were more variable for Toilets/Restrooms.

3.6.5-Land Use Inventory

Purpose of the Study:

Develop appropriate land use designations for future land use management decisions for lands within the Project boundary.

Study Objectives

- Identify the current land uses within the Projects' boundaries and on lands abutting the Projects' boundaries up to 200 feet;
- Identify current land use controls on lands within the Projects' boundaries and on lands abutting the Projects' boundaries up to 200 feet;
- Identify FirstLight owned lands adjacent to the Projects' boundaries; and
- Determine the appropriate land use designations for lands within the Projects' boundaries.

Methodology:

- Three specific tasks:
  - Literature and aerial photography review;
  - Development and application of proposed land use designations;
  - Development of maps and summary of results.

3.6.5-Land Use Inventory Findings

Existing Land Uses

- 35 existing land use categories identified within the study area were consolidated into 9 land use categories listed below.

Existing Land Use within the Projects' Boundaries and within 200 Feet of the Projects' Boundaries

Consolidated Existing Land Use Categories	No. of Acres within the Projects' Boundaries	% of Land within the Projects' Boundaries	No. of Acres within 200 ft. of the Projects' Boundaries	% of Land within 200 ft. of the Projects' Boundaries
Agricultural – Crops	1,010[1]	13.9	330	17.0
Agricultural – Pasture/Grass	37	0.5	31	1.6
Natural/Undeveloped	35	0.5	8	0.4
Developed	333	4.6	422	21.7
Forested	951	13.1	1,067	55.0
Open Water	2647	36.5	25	1.3
Wetland	396	5.5	23	1.2
Shrub/Scrub	1	0.0	4	0.2
Recreation	1,835[2]	25.3	32	1.6
Total	**7,246**	**100**	**1,942**	**100**

[1] The majority of the agricultural cropland within the Projects' boundaries is on lands, which the Licensee does not own in fee.

[2] Approximately 1,673 of these acres are the Northfield Mountain Tour and Trail Center.

3.6.5-Land Use Inventory Findings

Conservation Easements within the Projects' Boundaries and within 200 ft of the Projects' Boundaries

- 10 grantors of conserved land within boundaries or 200 ft. These lands total approximately 715 acres.

Conservation Protections within the Projects' Boundaries and within 200 Feet of the Projects' Boundaries

Site Name	Type of Protection	Acres Conserved within the Projects' Boundaries	Acres Conserved within 200 feet of the Projects' Boundaries
Bennett Meadows Wildlife Management Area	Lease Holding[1]	181.71	18.16
Connecticut River Greenway State Park[2]	Conservation Restriction (CR), Right-of-Way (ROW), Easement	32.07	137.55
French-Samuels CR	CR	0.24	5.92
Vern-Mont Farm	Agricultural Preservation Restriction (APR)	0.66	5.79
Four Star Farms APR	APR	38.77	21.73
Split River Farm	APR	118.20	39.13
Roberts Farm APR	APR	0.00	2.29
Storrows Cold Spring Farm APR	APR	0.44	14.56
Urgiel Farm APR	APR	15.42	20.41
Nourse Farms APR	APR	26.18	35.80

[1] Identified as Lease Holding in MassGIS.

[2] The Connecticut River Greenway State Park connects open spaces, parks, scenic vistas, and archaeological and historic sites along the length of the Connecticut River as it passes through Massachusetts. The Connecticut River Greenway State Park permanently protects over 12 miles of shoreline and is comprised of many parcels owned by private landowners over which MADCR holds an an easement, right-of-way, or conservation restriction. (http://www.mass.gov/eea/agencies/dcr/massparks/region-west/connecticut-river-greenway-state-park.html).

Purpose of Conservation Protections within the Projects' Boundaries and within 200 Feet of the Projects' Boundaries

Purpose of Protection	Acres Conserved within the Projects' Boundaries	% Land Conserved within the Projects' Boundaries	Acres Conserved within 200 feet of the Projects Boundaries	% Land Conserved within 200 feet of the Projects Boundaries
Wildlife Management	181.71	2.5%	18.16	0.9%
Recreation	32.07	0.4%	137.55	7.1%
Agriculture	199.67	2.8%	139.71	7.2%
Natural, Undeveloped, and Scenic	0.24	0.0%	5.92	0.3%
Total	**413.69**	**5.7%**	**301.34**	**15.5%**

3.6.5-Land Use Inventory Findings

Licensee Management of Non-Project Uses of Project Lands

- FirstLight has an established FERC-approved Permit Program through which it administers non-project uses of Project lands.
- Requirements provide a comprehensive regulatory structure that assures that the granting of permission for non-project use does not adversely affect the Projects' scenic, recreational and environmental values.

- Non-project uses generally include:
  - Camps (24)
  - Docks (46)
  - Landscape uses for abutters (8)
  - Water withdrawals (8)
  - Short term organized events such as running races, cross-country meets, horseback riding, and triathlons

Non-Project Uses of Project Lands

Licensed Use	Licensee	Town
Miscellaneous Use (Fire Pond)	Town of Erving	Erving
Utility Use (Communications Equipment)	Verizon Wireless	Erving
Public Marina (Boat Club with 4 boat docks)	Franklin County Boat Club, Inc.	Gill
3 Non-commercial Dock & Landscape	2 Individuals, 1 Trust	Gill
3 Landscape	2 Individuals, 1 Sportsmans Club	Gill
10 Non-commercial Docks	Licensed to separate individuals	Gill
6 Camps with Non-commercial Docks	Licensed to separate individuals	Gill
4 Camps without Docks	Licensed to separate individuals	Gill
Water Withdrawal	Split River Farm	Gill
Water Withdrawal with Dock	Northfield Mount Hermon School	Gill
11 Camps with Non-commercial Docks	Licensed to separate individuals	Montague
2 Camps without Docks	Licensed to separate individuals	Montague
1 Camp (sporting club with 2 docks)	Turners Falls Rod & Gun Club	Montague
2 Landscape	2 Individuals	Montague
4 Non-commercial Dock	4 Individuals	Northfield
Agricultural (crops)	Vern-Mont Farm	Northfield
Residential	Fuller Farm Property (historical home)	Northfield
Water Withdrawal	Smiarowski Brothers, LLC	Northfield
2 Water Withdrawals	Nourse Farms, Inc.	Northfield
Water Withdrawal	Four Star Farm	Northfield
Water Withdrawal and non-commercial dock	Sudbury Nurseries West	Northfield
Truck turn-around	paperlogic™	Turners Falls
Parking area	Franklin County Regional Housing and Redevelopment Authority	Turners Falls
Effluent Line	Australis Aquaculture LLC	Turners Falls
Water Withdrawal	Silvio O. Conte Anadromous Fish Research Laboratory	Turners Falls

3.6.5-Land Use Inventory Findings

Licensee ownership within 200 feet of the Project boundary

- Licensee owns approximately 48 acres on 12 parcels within 200 feet of the Project boundary.
- The parcels range in size from approximately 1/10th acre to 15 acres with most parcels 3 to 4 acres in size.
- Land uses on these lands are primarily forested. Five parcels are developed or have limited development on them, such as a road, laydown area, or are used for parking.

3.6.5-Land Use Inventory Findings: Proposed Land Use Designations

Proposed Land Use Designation Acreages and Percentage of Land within the Projects' Boundaries

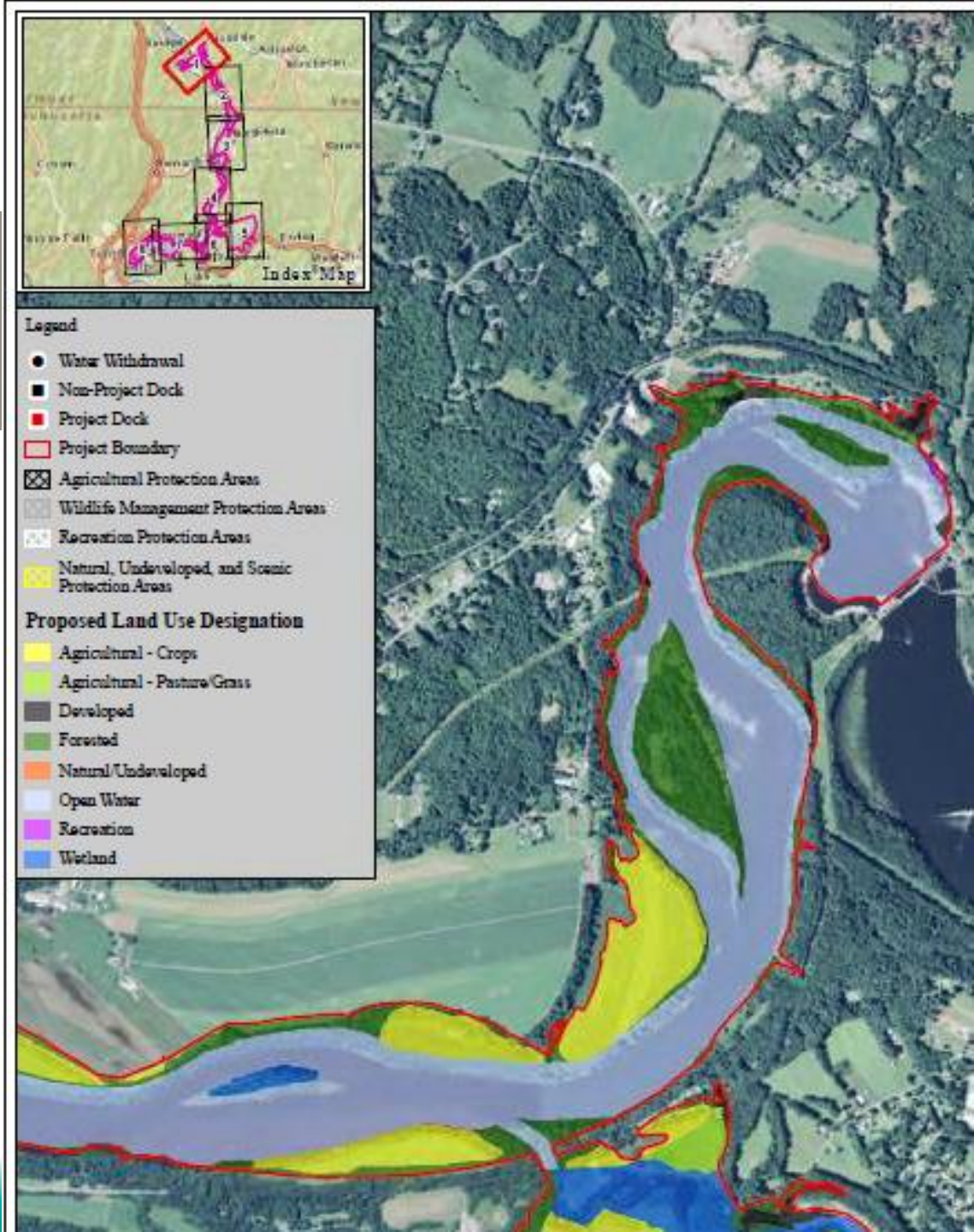
Proposed Land Use Designation	No. of Acres within the Projects' Boundaries	% of Land within the Projects' Boundaries
Open Water	2,647	36.5
Recreation	1,835	25.3
Agricultural – Crops	1,010	13.9
Forested	951	13.1
Wetland	396	5.5
Developed	333	4.6
Natural/Undeveloped	37	0.5
Agricultural – Pasture/Grass	37	0.5
Total	**7,246**	**100%**

Proposed Land Use Designation Acreages and Percentage of Land (excluding Open Water) within the Projects' Boundaries

Proposed Land Use Designation	No. of Acres within the Projects' Boundaries	% of Land within the Projects' Boundaries
Recreation	1,835	39.9
Agricultural – Crops	1,010	22.0
Forested	951	20.7
Wetland	396	8.6
Developed	333	7.2
Natural/Undeveloped	37	0.8
Agricultural – Pasture/Grass	37	0.8
Total	**4,599**	**100%**

3.6.5-Land Use Inventory Findings

- Proposed Land Use Designations, Conservation Protections, and Existing Docks and Water Withdrawals permitted by the Licensee within the Projects' Boundaries



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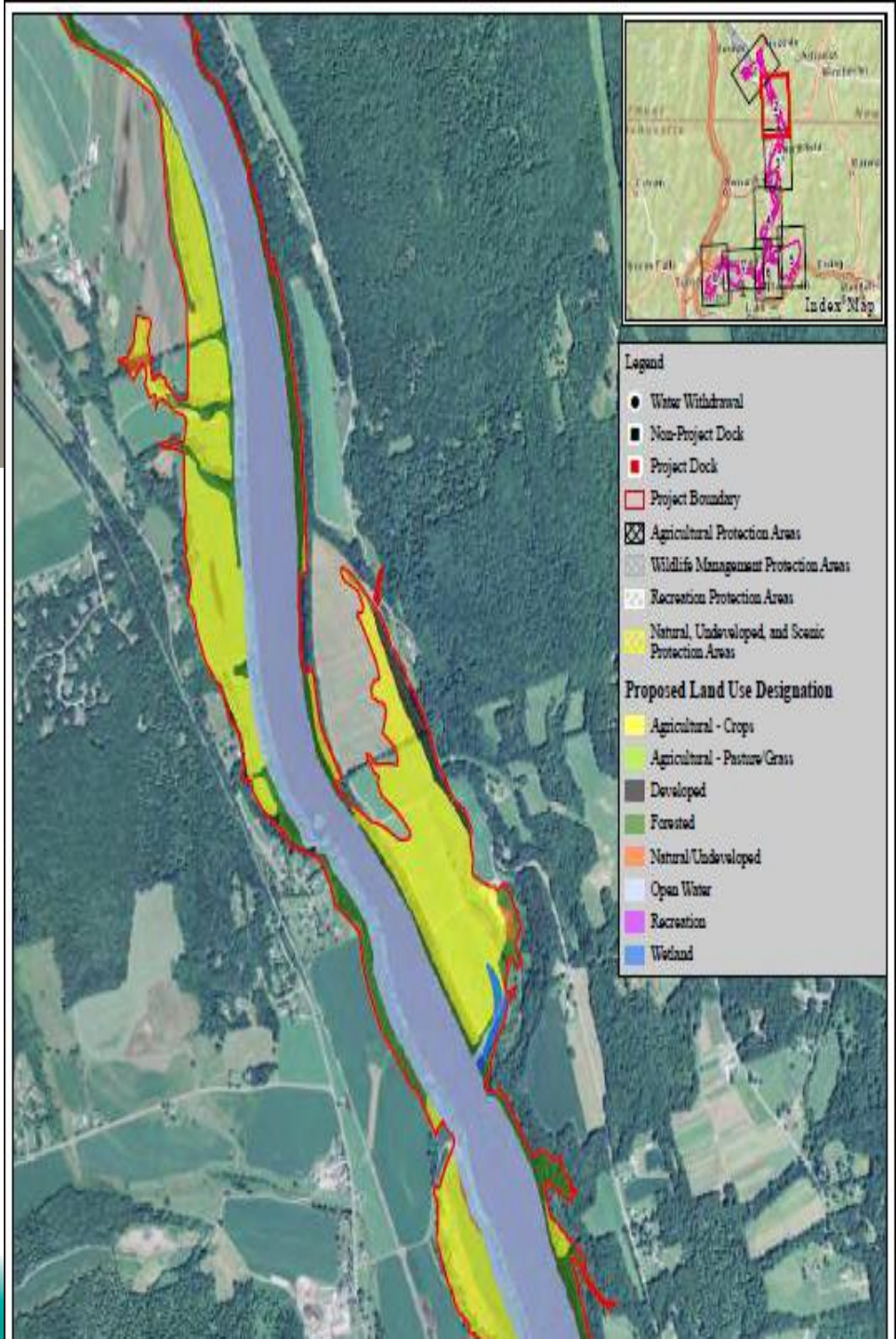

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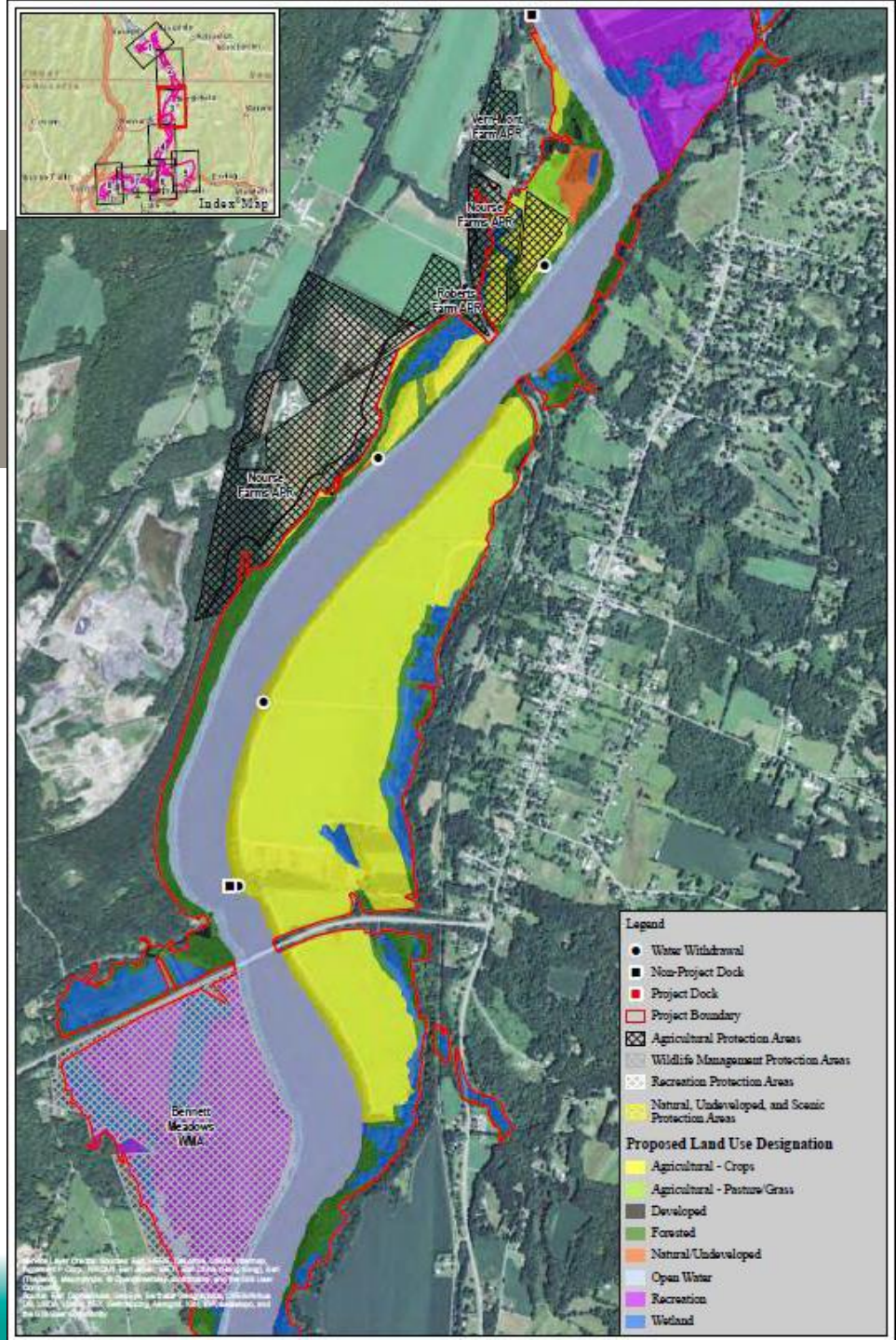

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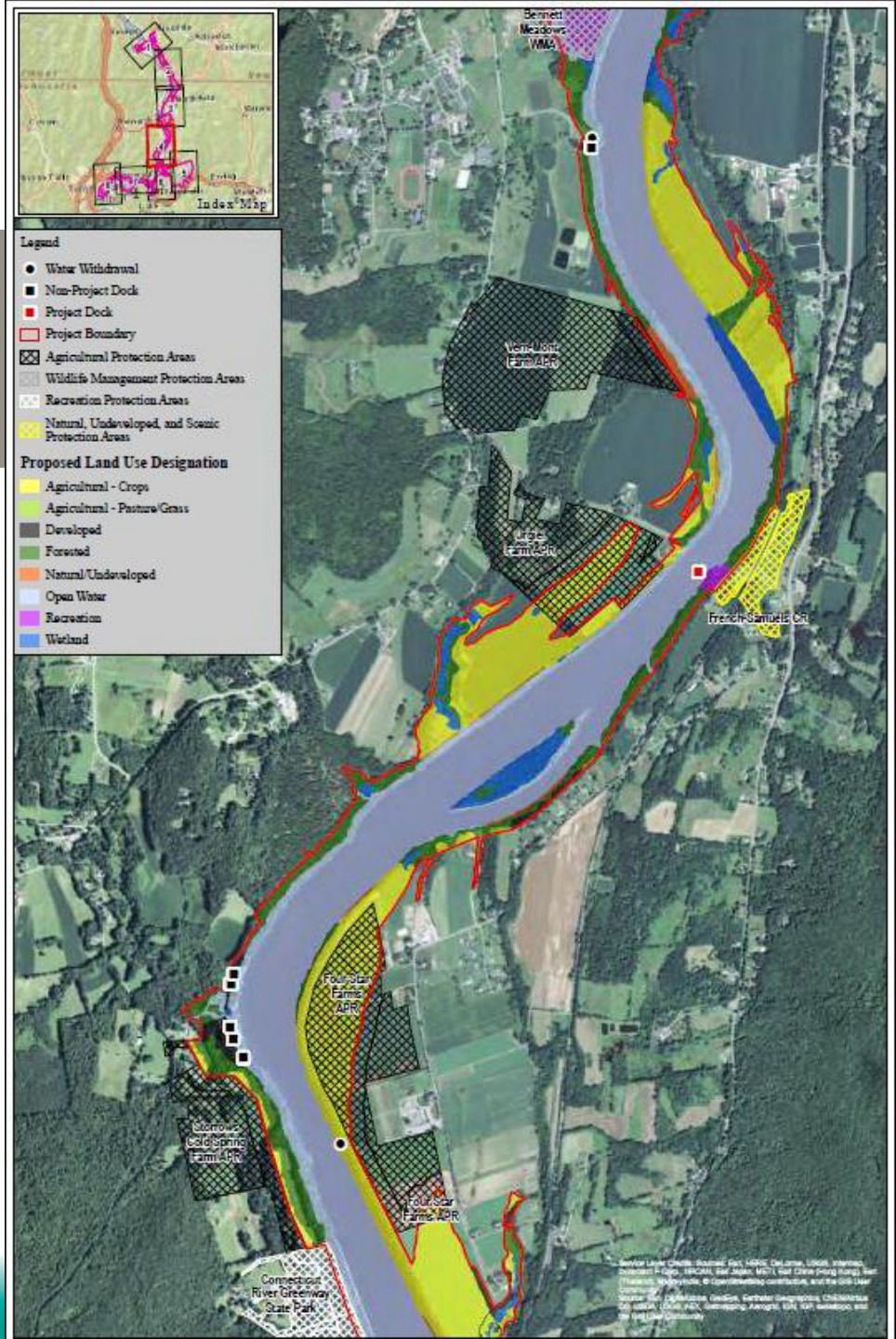

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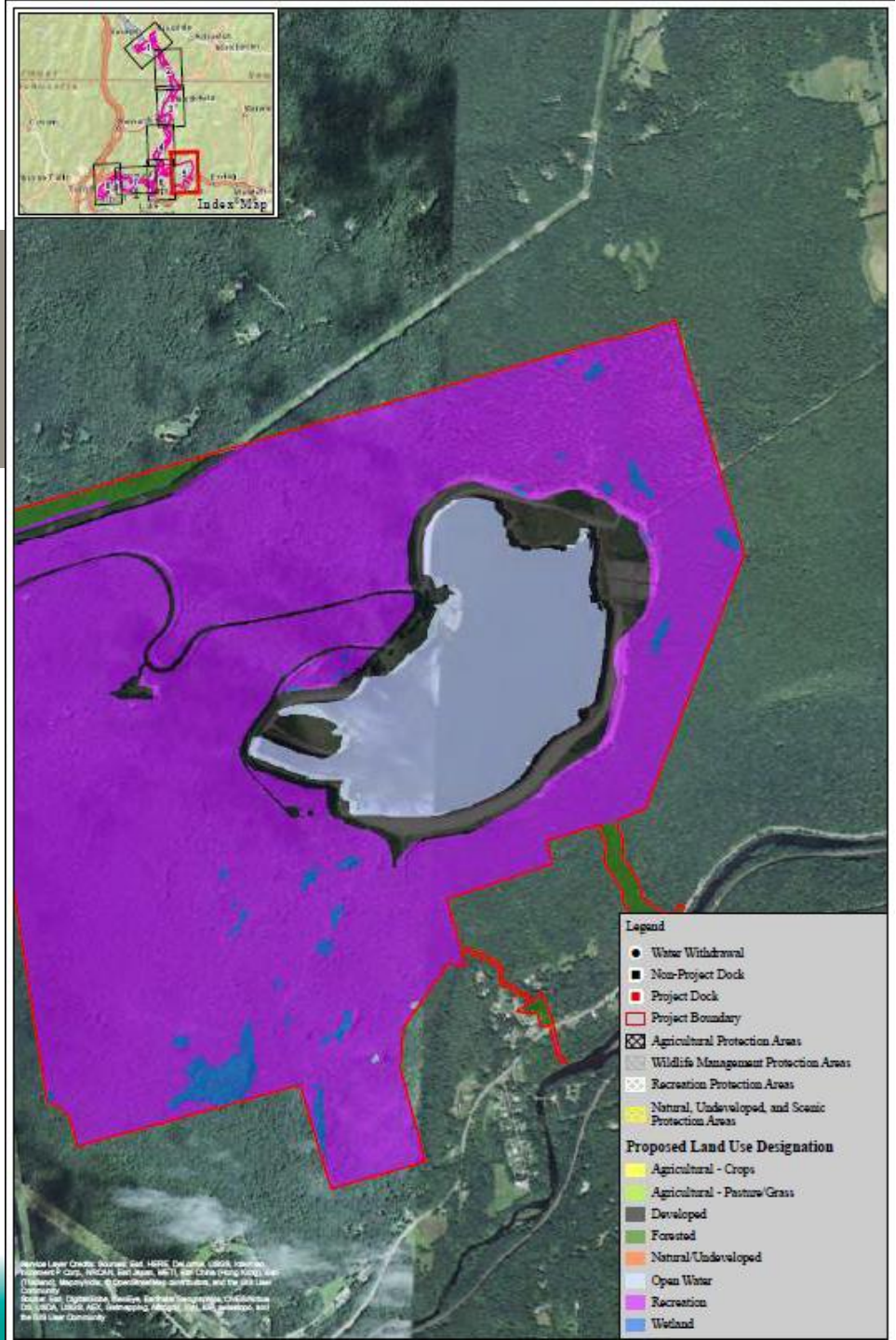

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3.6.5-Land Use Inventory Findings

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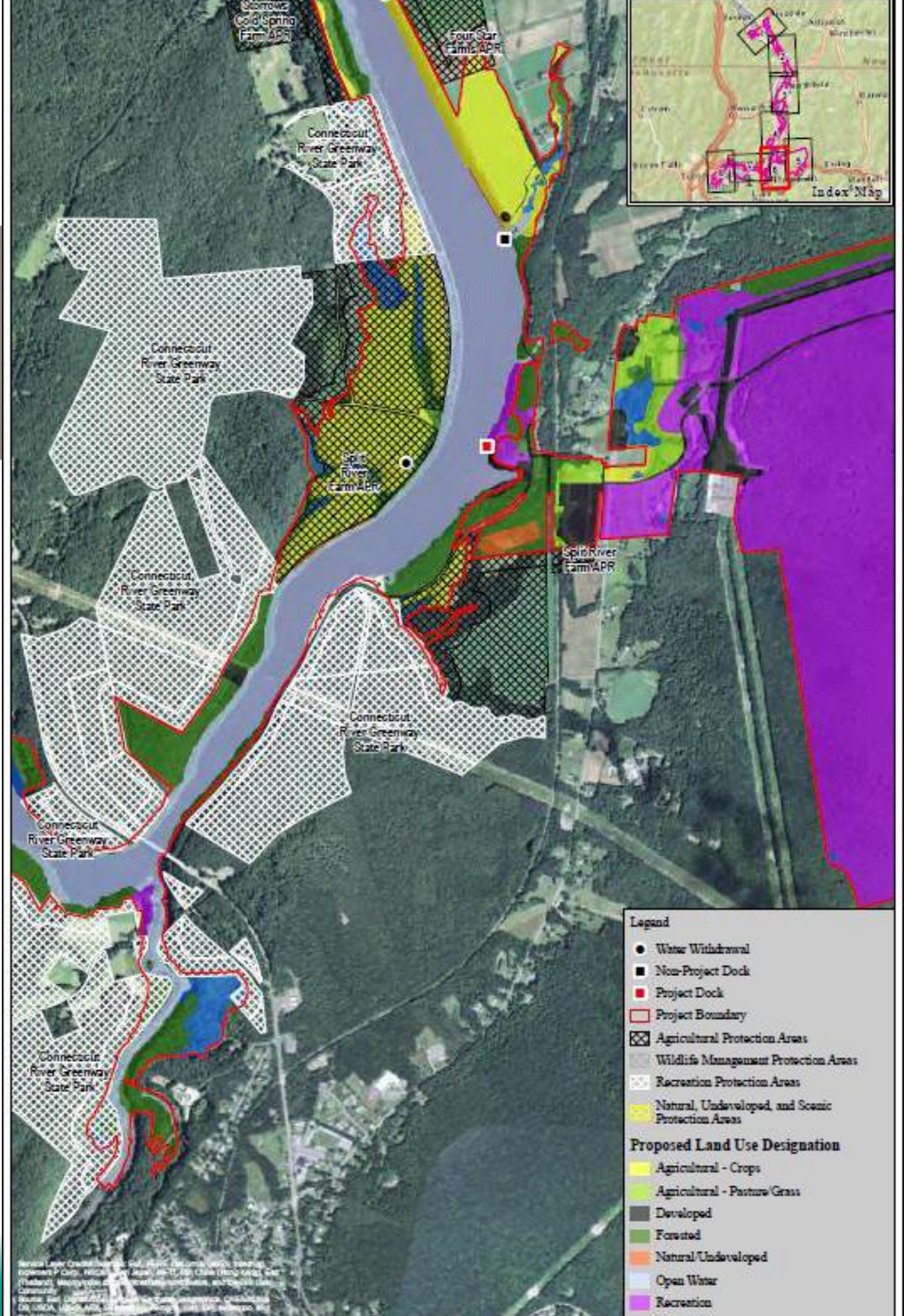

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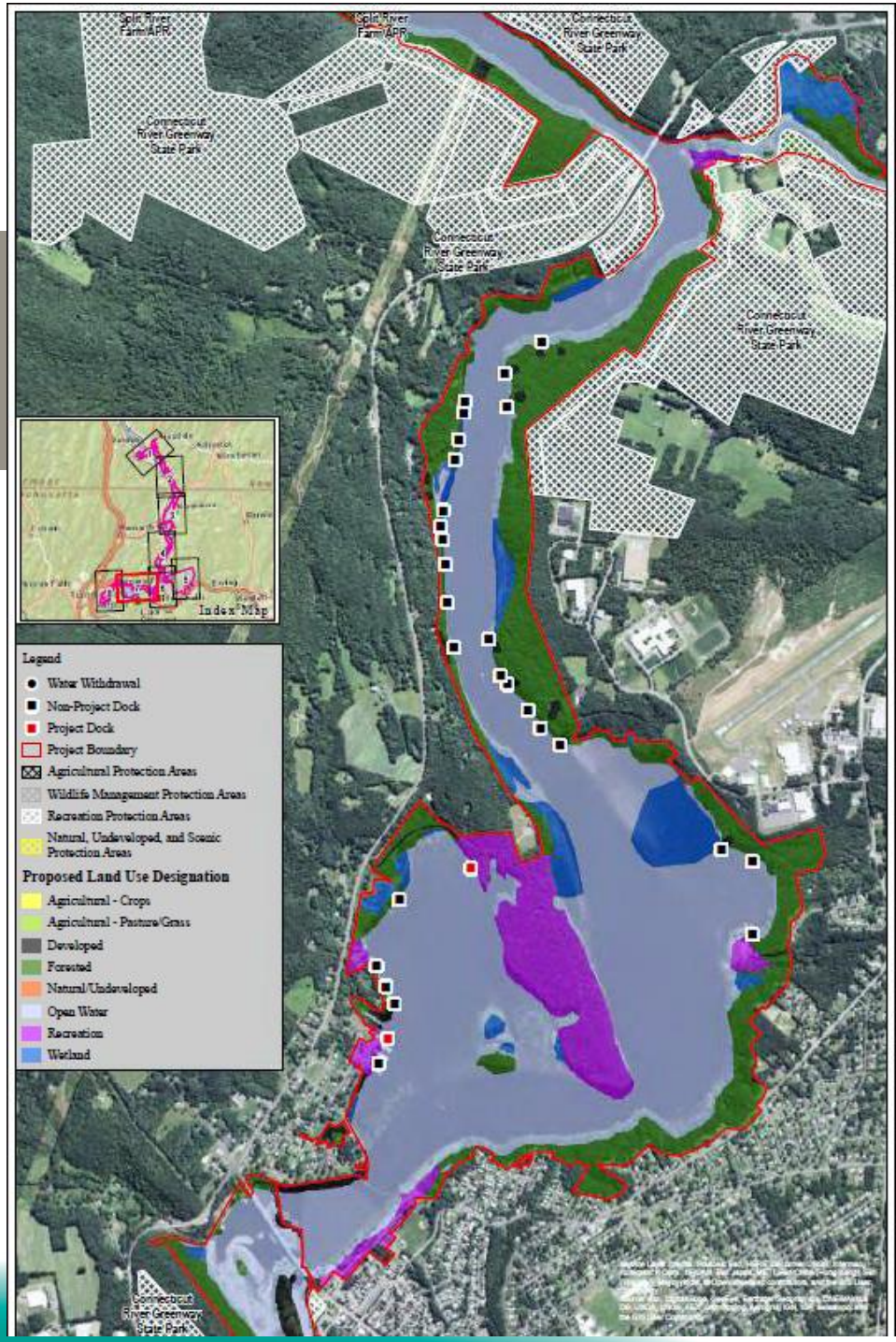

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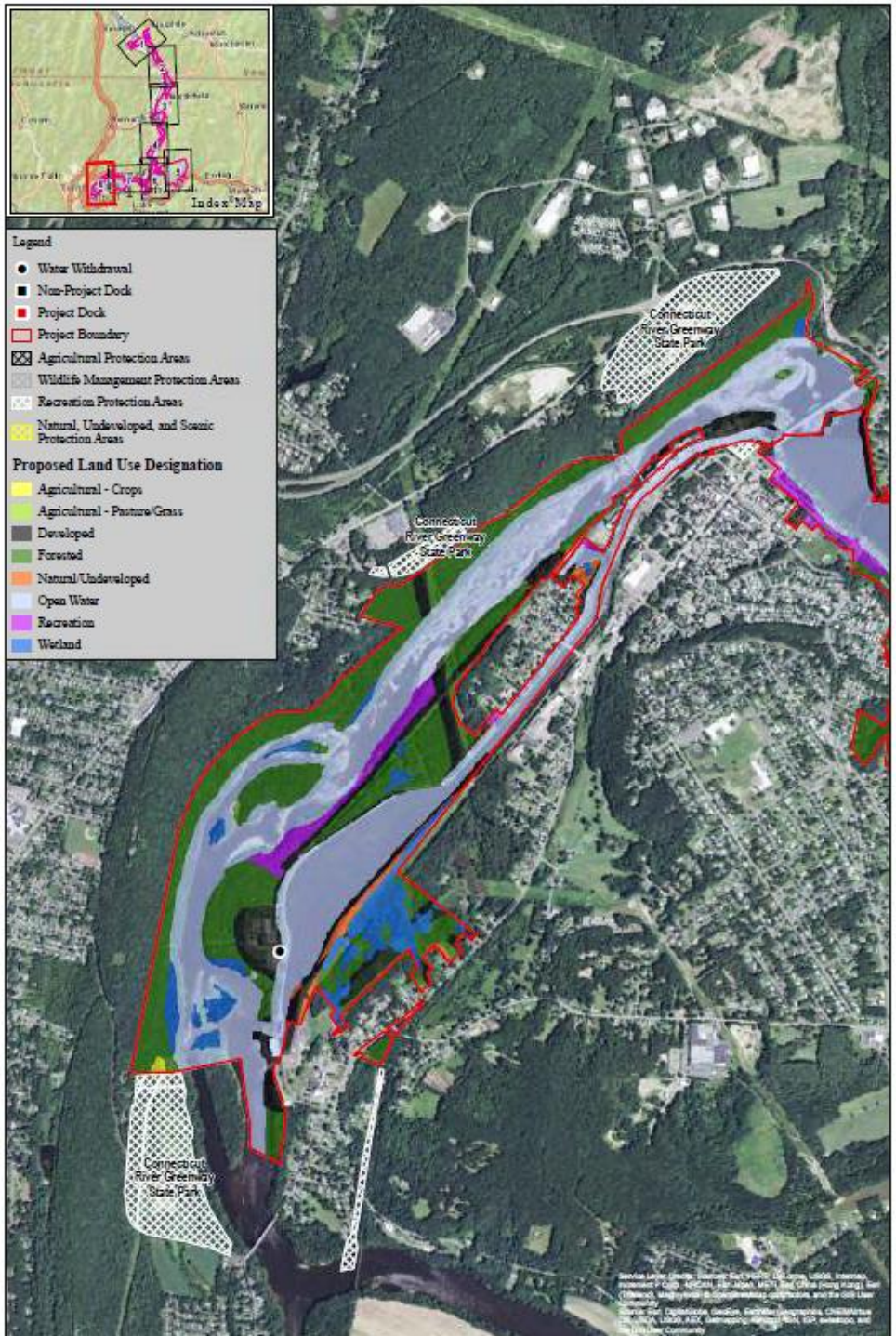

3.6.5-Land Use Inventory Summary

- Proposed land use designations in almost all cases are the same as existing land use categories.
- Majority of existing land uses within the Project boundary are forested, recreation, or agriculture – crop lands.
- Majority of existing land uses within 200’ of Project boundary are forested, developed, or agriculture – crop lands.
- There are approximately 414 acres of land within the Project boundary and an additional 301 acres within 200’ of the Project boundary that are subject to conservation protections (wildlife management; recreation; natural; undeveloped and scenic; and agricultural).
- Non-project uses include camps, docks, landscape, and water withdrawals. A good portion of the non-project uses are in the Barton Cove area.
- The Licensee owns approximately 48 acres of lands within 200’ of the Project boundary. Land uses are primarily forested, although there is some limited development such as a road or lay down area**.**
- Land use designations and sensitive resources overlay will be used by the Licensee when reviewing any proposed non-project use of Project lands and in managing Project lands.