Relicensing Study 3.3.1

INSTREAM FLOW HABITAT ASSESSMENTS IN THE BYPASS REACH AND BELOW CABOT STATION

Updated Study Report Summary

Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)

Prepared for:

FirstLight GDF SUEZ

Prepared by:

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SEPTEMBER 2015

1.1 Study Summary

The purpose of the study is to assess the potential effects of the range of discharges from Turners Falls Dam, Station No. 1, and Cabot Station on wetted area and aquatic habitat suitability in the Connecticut River between Turners Falls Dam and Cabot Station (the bypass reach) and below Cabot Station downstream to the Route 116 Bridge in Sunderland, MA. The assessment will also focus on any state or federally listed mussels in the reach between the Route 116 Bridge and Dinosaur Footprints Reservation.

Specific resource management goals are to:

- Determine an appropriate flow regime that will protect and enhance aquatic resources in the bypassed reach between Turners Falls Dam and the Cabot Station discharge.
- Determine an appropriate flow regime that protects and enhances aquatic resources from the Cabot tailrace downstream to the Route 116 Bridge in Sunderland, MA.
- Determine an appropriate flow regime that will protect state or federally listed mussel resources between the Route 116 Bridge in Sunderland and Dinosaur Footprints Reservation.

Aquatic habitat suitability was evaluated using standard field procedures and Physical Habitat Simulation (PHABSIM) modeling techniques of the Instream Flow Incremental Methodology (IFIM), developed by the National Ecology Research Center of the National Biological Survey (Bovee, 1982; Bovee, *et al*., 1998; Milhous *et al.*, 1989). The IFIM quantifies habitat values of alternative stream flows using habitat suitability index (HSI) criteria for selected evaluation species based on stream hydraulics models of study reaches. HSI criteria are based on flow-related depth, velocity, substrate, and cover preferences of targeted lifestages of the evaluation species.

1.2 Study Progress Summary

<u>Task 1: Consult with Agencies and Interested Stakeholders to Determine Study Area, Study Reaches, and Habitat Suitability Index Curves.</u>

FirstLight began consultation with stakeholders in early 2013 to define the study area, reach boundaries, range of flows, modeling techniques and species and life stages for habitat assessment. A total of five reaches were defined as follows:

Reach 1- Turners Falls Dam downstream to the tailrace of Station Number 1

Reach 2: Tailrace of Station Number 1 downstream to Rock Dam (a natural rock feature located in the bypass reach)

Reach 3: Rock Dam downstream to the confluence with the Deerfield River (including Cabot tailrace) near the Montague United States Geological Survey (USGS) gage.

Reach 4: USGS Montague Gage downstream to Route 116 Bridge in Sunderland, MA

Reach 5: Route 116 Bridge in Sunderland downstream to Dinosaur Footprint Park

In September 2013, FirstLight and the stakeholders conducted a detailed site visit to study reaches 1 and 2 to collectively establish cell boundaries and transect locations necessary to support a PHABSIM analysis. The study area was walked and waded at a flow of approximately 200 cfs. A total of 11 transects were selected to simulate hydraulics and habitat in each mesohabitat type (pool, run, glide, riffle).

Throughout early 2014, FirstLight and the stakeholders reviewed literature and consulted to finalize HSI criteria for use in the study. Criteria were established for multiple life stages of American shad, shortnose sturgeon, white sucker, fallfish, longnose dace, tessellated darter, benthic macroinvertebrates, and the following habitat use guilds: shallow-slow, shallow-fast, deep-slow, and deep-fast. Consultation up to September 2014 was provided in the Initial Study Report.

On August 20, 2015, FirstLight and the stakeholders conducted a detailed site visit to study reach 4 to collectively establish transect locations necessary to support a PHABSIM analysis. A total of 12 transects was selected to simulate hydraulics and habitat in pool, run, and glide mesohabitats. Information from the American shad spawning study (Study 3.3.6) and past freshwater mussel surveys was used to inform the locations of some transects specific to those habitat uses. The consultation related to the transect section process for Reach 4 is included in Appendix A.

Task 2: Method for Assessing State and Federally Listed Mussels

Task 2a: Screening Level Mussel Assessment

Category I mussel habitat suitability criteria for state-listed freshwater mussels will be developed through a combination of literature review and by convening a panel of credentialed mussel biology experts who will provide input to developing specific HSI criteria. The specific method for developing state and federally listed mussel HSI criteria is explained in Study No. 3.3.16, Task 3 and is expected to be complete by March 2016.

Using the binary HSI criteria developed in Study No. 3.3.16 for any state-listed species discovered in study reach 4 or 5, FirstLight will determine if any binary HSI thresholds are not met under a range of modeled operating conditions, as described in the RSP. In general the approach includes using the HEC-RAS hydraulic model to simulate the range of operating conditions at Holyoke Dam (WSEL at the dam) and the Turners Falls Project (up to its hydraulic capacity) to determine how operations impact depth, velocity, shear stress and Froude number at model transects near documented state or federally listed mussel beds. If threshold levels are not exceeded in any transects, then no further assessment of documented state and federally listed mussel beds is proposed. If threshold levels are exceeded, then a more detailed assessment is proposed as described in Task 2b.

Task 2b: Detailed One-Dimensional HEC-RAS Modeling

This task is contingent on the results of Task 2a, which is not complete at this time.

Task 3: Field Data Collection

For the 1-D model, general procedures involve collecting hydraulic data (*e.g*. bed profile, depth, velocity, and water surface elevation at a series of known calibration flows) and habitat data (*i.e*. substrate and relevant cover characteristics) at a series of loci (“verticals”) along representative cross-sectional transects. Paired verticals along each transect define the lateral boundaries of a series of "cells". The area within each cell is assumed to be homogeneous with respect to depth, velocity, substrate, and cover. The length of stream represented by each transect is determined by field mapping. Hydraulic modeling predicts changes in depth and velocity in each cell as discharge varies. The area of each cell is then weighted relative to HSI criteria for each evaluation species life stage to compute a habitat suitability index referred to as Weighted Usable Area (WUA). One unit of WUA is equal to one square foot of theoretical “optimum” habitat as defined by the habitat suitability criteria.

Due to complex flow patterns near the islands above the Cabot Station tailrace, a 2-D model was developed for the reach from the upstream end of the Rawson Island downstream to just below the Deerfield River confluence. This includes the downstream-most segment of Reach 2 and all of Reach 3. A two dimensional (2-D) approach best represents hydraulics in this area due to the complex channel characteristics and hydraulics. Data were collected at two calibration flows under approximately steady flow conditions to evaluate the flow directionality and magnitude under different flow inputs both from the bypass reach as well as from station discharge. The 2-D model relies on a fine scale mesh model developed using a combination of terrain (LIDAR and/or 10m DEM, depending on availability) and bathymetric data and includes a WSEL survey, and flow gaging at the inlet and/or outlet of the study site boundaries.

Reaches 1 and 2 (1D Model)

Field methods followed standardized procedures (Bovee *et al*., 1998). Transect data were collected to facilitate hydraulic modeling with the Water Surface Profile (WSP) model using two velocity calibration data sets and a third water surface elevation set. Transect bed profile elevations, substrate data, water surface elevations (WSEL's) were surveyed at three calibration flows, and mean-column-velocity calibration data at two calibration flows. Each transect location was geo-referenced using GPS. Longitudinal cell distance was determined by upstream and downstream cell boundaries established by the study team. Transect location and substrate mapping work was done at low stream discharge to ease examination of stream channel characteristics (Photo 1).

Lateral boundaries of each study transect were defined by head- and tailpins placed above the crest of each bank. Headpins were oriented along the right bank (looking downstream). Pin locations were field-blazed and semi-permanently fixed with either rebar or by using a large tree or other fixed object and then benchmarked by survey. Fiberglass survey tape or high-strength Kevlar® lines were secured between headpin and tailpin. Streambed elevation, mean column velocity, substrate and edge of water were recorded at intervals (verticals). Verticals were established wherever a major change in any of the above four parameters occurred. At each vertical, substrate type was recorded, and bed elevations surveyed to the nearest 0.01-ft elevation using a level and standard surveying techniques (Photo 1). Pre-established benchmark datum was used to standardize elevations among transects. Additional hydraulic control transects were also established at the direction of the hydraulic modeler.

Photo 1. Bed profile and substrate data collection at low flow

Field work was coordinated with pre-arranged releases from the Turners Falls Dam (discharge through the study area is regulated by the Turners Falls Dam, Cabot Station and Station No. 1). Discharge from Turners Falls Dam was provided by managing a stable flow over the bascule gate according to the impoundment elevation. Flow from Station No.1 was maintained as leakage. Inflow contributions from Fall River and Station No. 1 were manually gaged.

Substrate types were classified according to particle diameter corresponding to pre-defined standardized substrate suitability criteria In addition, the substrate classification scheme was tailored to account for specific types of complex folded bedrock that provides habitat suitability different from conventional barren bedrock, in accordance with criteria established during consultation (Photo 2).

Photo 2. Examples of complex bedrock classifications

2a. complex bedrock dominated by cobble

2b. complex bedrock with no overlayment

Hydraulic data were collected at three calibration discharges according to study objectives, to facilitate modeling in a range from approximately 120 cfs up to 10,000 cfs as follows:

Table 1. Calibration Flows for Reach 1

Calibration flow set	Discharge	Simulation range[1]
Low flow	210 cfs	120-400 cfs
Medium flow	626 cfs	400-1,400 cfs
High flow	3,904 cfs	1,600-10,000 cfs

Table 2. Calibration Flows for Reach 2

Calibration flow set	Discharge	Simulation range[1]
Low flow	293 cfs	120-400 cfs
Medium flow	720 cfs	400-1,400 cfs
High flow	4,000 cfs	1,600-10,000 cfs

[1]As a rule of thumb, calibrated hydraulic models may be extrapolated to as low as 40% to 250% of the target flow. The flow range shown in the tables are what will actually be simulated in the hydraulic model.

Three calibration flows were targeted to define the shape of the stage-discharge curve for the flow range of interest because the stage-discharge relationship is rarely linear. PHABSIM hydraulic models, as a rule of thumb, may extrapolate to as low as 40% of the lowest flow and up to 250% of the highest flow under ideal conditions. Therefore a low calibration flow of approximately 200 cfs was targeted to provide data to model down to approximately 100 cfs and a high calibration flow of 4,000 cfs was targeted to enable model extrapolation up to 10,000 cfs. The choice of middle calibration flow was made to be at least twice as high as the low flow in order to capture a set of hydraulic conditions significantly different than the low flow, and also approximately an order of magnitude lower than the high calibration flow. Each transect was photographed at each calibration flow to assist hydraulic modeling.

Two HOBO U20-001-01 water level loggers were deployed to aid in the 1-D hydraulic modeling. The two loggers were installed July 18, 2014 and placed about 100 ft downstream of transect one (T-1) and at transect ten (T-10). The loggers were surveyed in on July 22, 2014. The sensor depth was added to logger elevation to establish a five minute time series of the WSEL's at these loggers.

Bed profile, substrate and cover data were collected at the low calibration flow. Water surface elevation (stage) was surveyed at each transect at all three flows. Most transects contained complex hydraulics, thus velocity data sets were collected at both the low flow and mid flow to enhance hydraulic modeling. Table 3 summarizes hydraulic data gathered at each transect. A temporary staff gage installed in the vicinity of each group of transects was monitored to verify that discharge remained adequately stable during measurements. Stage was checked at the beginning and end of velocity and water surface elevation measurements at each transect. Staff gages were also deployed and monitored in Fall River and the Station No. 1 discharge channel.

Table 3. Summary of Hydraulic Data Gathered at Transects

Transect	Low Flow	Mid Flow	High Flow
T-1	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL*	WSEL
T-2	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL*	WSEL
H-1	Bed Profile, Mean Column Velocity, WSEL	-	WSEL
T-3	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL*	WSEL
T-4	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL	WSEL
T-5	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL	WSEL
T-6	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL	WSEL
T-7	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL	WSEL
T-8	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL	WSEL
T-9	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL	WSEL
T-10	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL*	WSEL
T-11	Bed Profile, Substrate, Mean Column Velocity, WSEL	Velocity and WSEL*	WSEL

*Transects 1, 2, 3, 10 and 11 were gaged with a Sontek M9 Acoustic Doppler Current Profiler (ADCP)

Velocity was measured to the nearest 0.1-ft/s using calibrated Marsh-McBirney Model 2000 Flowmate electronic current meters tethered to a top-setting wading rod (Photo 3). In water less than 2.5-ft deep, mean-column-velocity was measured at 0.6 of the depth. In water greater than 2.5-ft deep, mean-column-velocity was taken as the average of the velocities measured at 0.2 and 0.8 of the depth. In unwadable areas, velocity was measured from a raft tethered to the transect line with a USGS stationing rig. The rig features a boom that permits the meter sensor to be manually lowered to the desired depth (Photo 4)[1].

Photo 3. Velocity and water elevation survey in wadable area

Photo 4. Boat-mounted USGS stationing rig used in unwadable areas.

[1] In some cases a Sontek M9 Acoustic Doppler Current Profiler (ADCP) was also used (Photo 5). The ADCP unit was mounted to a custom designed float, and had Bluetooth wireless data transmission to a shore side laptop computer that allowed for real-time data collection review and recording. The ADCP unit was aimed vertically from the tethered platform and was drawn across the river on the alignment of the transect to continuously record data during its transit.

Photo 5. ADCP velocity data recording

Each point velocity was derived from the mean of at least three 15-second time-averaged readings. Stream discharge at each study reach was determined by a review of real time data from both the Project gate settings combined with discharge calculated from readings taken at Fall River and Station No. 1. Where possible, this was also opportunistically checked against concurrent results obtained through the ADCP unit.

Reaches 2 and 3 (2D Model)

In Reach 3, detailed depth and velocity data were collected under targeted flow conditions of about 300 and 1,000 CFS through the Bypass Reach and about 8,200 CFS from Cabot Station. Data were collected using an ADCP linked to an RTK GPS, though depth and velocity at a small number of shallow transects were measured with a digital flow meter at one or two-foot intervals, depending on the width of the channel. Additionally, a very extensive survey of bathymetry and topography was performed throughout the reach. Boatable and unwadable areas were surveyed with an ADCP linked to an RTK GPS, wadable and dewatered areas were surveyed with an RTK GPS, and areas where reception was not sufficient for RTK GPS point collection was surveyed using a total station. All surveys incorporated the use of multiple benchmarks to ensure accuracy and consistency among different surveys and equipment.

Reach 1 Plunge Pool Bathymetry

In Reach 1, detailed cross-sectional depth and velocity data were collected at eleven transects below Turners Falls Dam downstream of and in the vicinity of the spillway fishway. Data were collected with a Sontek M9 ADCP linked to an RTK GPS at a flow of approximately 120 cfs from the fishway and no spill at the dam; data collection close to the dam was not possible when bascule gate No. 1 was spilling ~ 300 cfs during an initial survey due to swift current and turbulence.

Additional general bathymetry data were collected in the wetted areas of Reach 1 below Turners Falls Dam using an ADCP linked to an RTK GPS. Topography was also collected in areas where bathymetry was not possible using an RTK GPS in most areas, and a total station was utilized where GPS reception was not sufficient for RTK GPS point collection (i.e. under the bridge or close to the dam). All bathymetric and topographic data collection incorporated the use of multiple benchmarks, such that data were accurate and consistent among surveys and equipment.

Task 4: Hydraulic Modeling (Reaches 1-4)

Reaches 1 and 2 (1-D Modeling)

The 1-D stage-discharge relationships were modeled within Reaches 1 and 2 using WSP, the standard step-backwater computation model embedded in the library of Physical Habitat Simulation (PHABSIM) programs. A total of six hydraulic models were created to account for inflow from Station No. 1 and the three calibration flows. The WSP hydraulic models were successfully calibrated to +/- 0.12 ft. The WSP models generally provide accurate WSEL simulation from 40 to 250 percent of each calibration flow. Figure 1 and Figure 2 display the observed and simulated water surface profiles for the WSP models.

Figure 1. Observed Water Surface Elevations

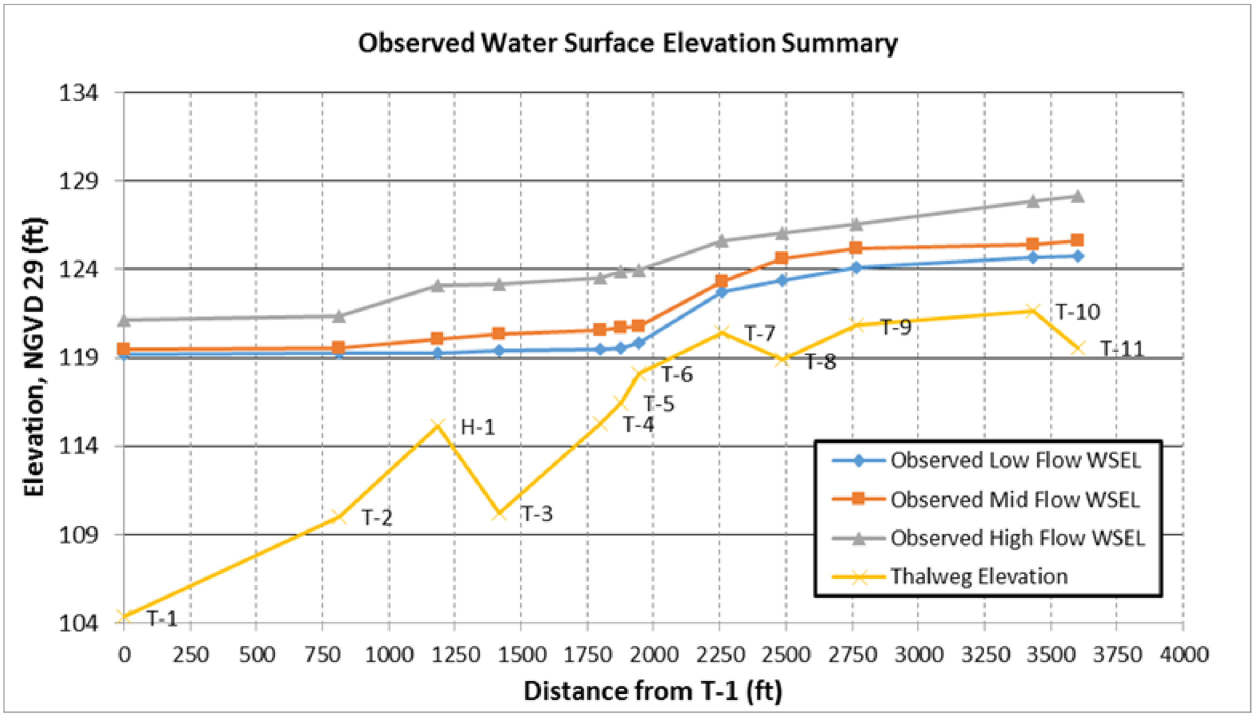
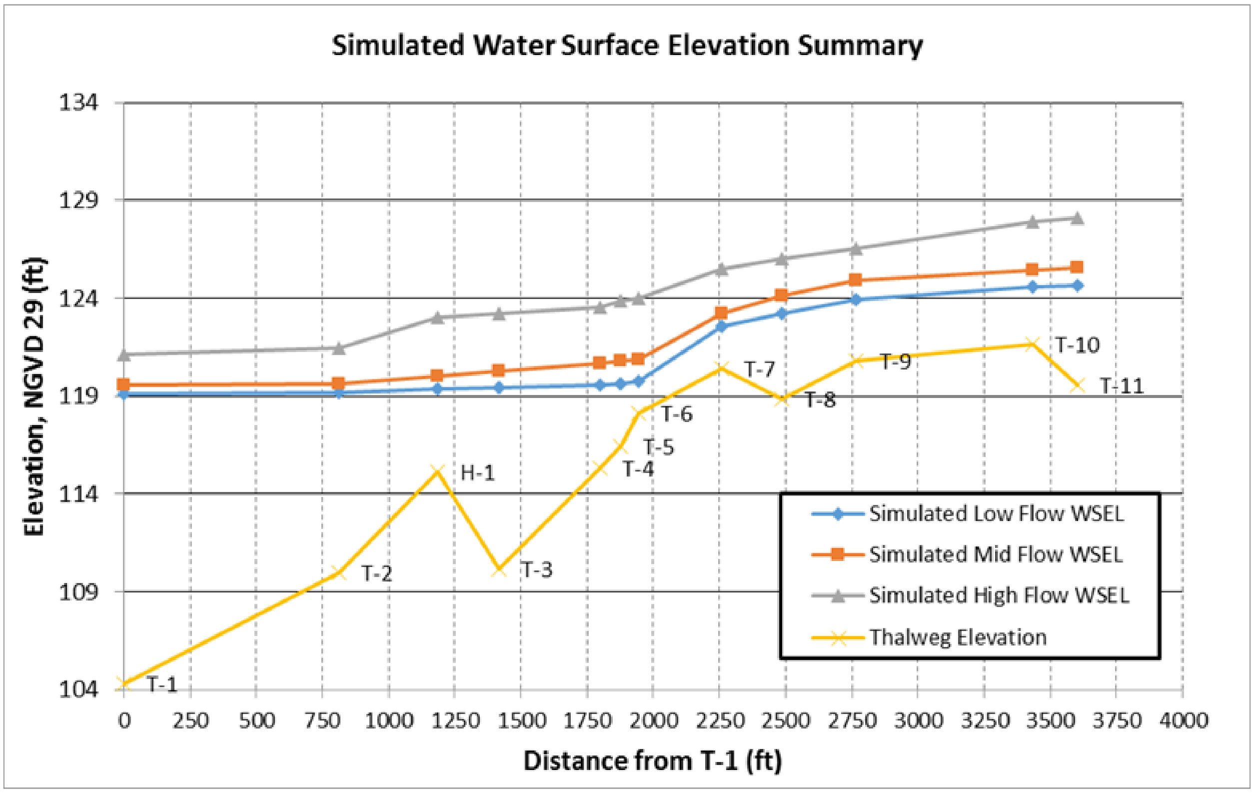


Figure 2. Simulated Water Surface Elevations

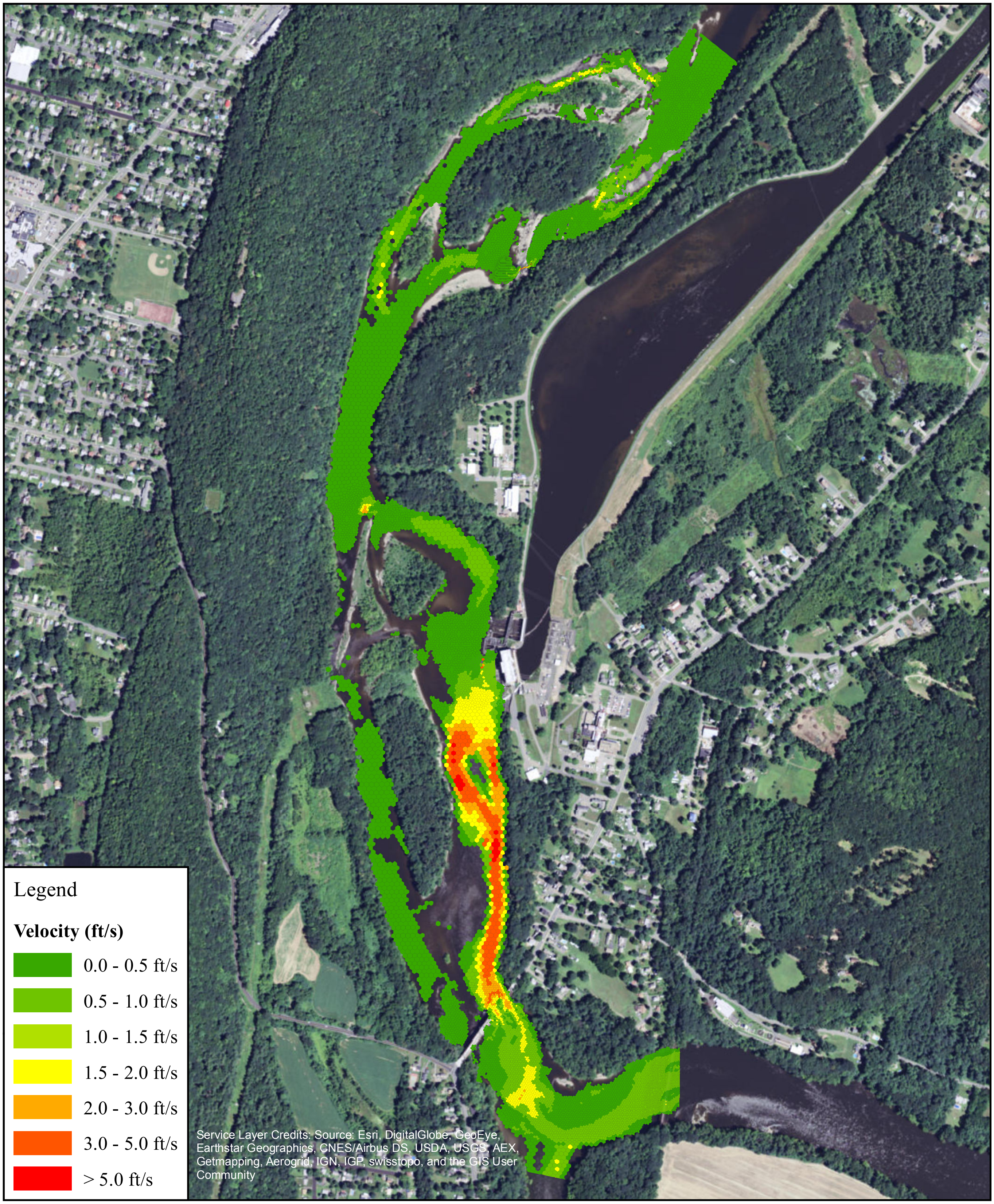


The 1-D model velocities were modeled using VELSIM, which is the velocity distribution model embedded in PHABSIM. In VELSIM calibration attempts were made to match simulated velocities, at each transect, with velocities from the calibration discharges. Overall the velocity calibration fit is excellent and the 1D hydraulic modeling of Reaches 1 and 2 is complete.

Reaches 2 and 3 (2-D Modeling)

For the IFIM study area that includes the lowest portion of Reach 2 and all of Reach 3, the hydraulic model River 2D (a 2-dimensional, finite element model) is being used to develop the relationships between flow and habitat in the Connecticut River. This area includes a series of islands and split channel complexes that are affected by inflow from Turners Falls Dam, Station No.1, Cabot Station, and the Deerfield River and is not suited for a 1-D model. The River 2D model area starts about 600 feet upstream of Rawson Island and continues downstream about 2 miles, past the confluence with the Deerfield River to the railroad bridge where the Montague USGS gage is located. The bathymetric, hydraulic, and habitat classification surveys were conducted during the summer of 2014 and consisted of data obtained by LiDAR, real time kinematic GPS units, total stations survey units, and acoustic Doppler current profilers which also obtained water velocities. Twenty water level loggers obtained water level data in the River 2D model area from May until early October 2014. Input data to the River2D model include a digital bathymetric (bed topography) map, a stage-discharge relationship at the downstream end of the study site, and bed roughness throughout the study reach. Observed water surface elevation from the water level loggers and velocity data were used for calibration purposes of the River2D model. The River 2D model is currently being used to stimulate the hydraulic conditions associated with a large combination of: 1) inflows to the upper part of the model area; 2) Cabot operations; and 3) inflows from the Deerfield River. These modeling runs are being used for the weighted usable area (WUA) analysis, and the habitat persistence and time series analyses. The WUA analysis is producing a habitat versus flow relationship for each species and life stage.

In addition to the graphs and tables associated with the WUA, habitat persistence, and time series analyses, a large number of maps showing the: Velocity; Depth; Habitat Suitability; Combined Suitability; and Habitat Persistence will be prepared. As an example, Figure 3 is a velocity map of the River2D area with an upstream inflow of 1,000 cfs, Cabot at one unit generation (2,288 cfs) and low flow (200 cfs) from the Deerfield River.



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UPDATED STUDY REPORT SUMMARY
RELICENSING STUDY 3.3.1

N

0 500 1,000 2,000 Feet

Figure 3:
Example Velocity Map

Path: W:\gis\studies\3_3_1\maps\velocity_figures.mxd

Task 5: Hydraulic Modeling (Reach 5)

This task is contingent on the results of Task 2.

Task 6a: Habitat Modeling (Reaches 1-4)

Habitat modeling of reaches 1-3 is presently underway. Habitat modeling for reach 4 will be completed after the hydraulic modeling is complete.

Task 6b: Persistent Potential Habitat Modeling (Reach 4 (if necessary) and 5, mussels only)

Habitat modeling for reach 4 and 5 if necessary will be completed following the 2015 field season.

Task 7: Habitat Time Series (Reaches 3 and 4)

This analysis will be completed following the 2015 field season.

Task 8: Persistent Habitat Analysis and Mapping (Reach 3) and Dual Flow Analysis (Reach 4)

This analysis will be completed following the 2015 field season.

Task 9: Study Report

A final report will be completed by September 1, 2016. Additional time will be required to accommodate the following activities:

- Reach 1 demonstration flow study has not been conducted; scheduled for fall 2015.
- Reach 4 hydraulic data collected in fall 2015 will require processing and modeling to be completed in first quarter 2016.
- Agency review and comment on Reach 4 model output is needed prior to reaching consensus about persistent habitat modeling, likely would occur during early 2nd quarter 2016.
- Analysis of mussel habitat will be conducted once the HSI curves for state-listed mussel species are complete, anticipated by March 2016.
- The resulting persistent habitat modeling and reporting will be completed by September 2016.

1.3 Variances from Study Plan and Schedule

To date, there are no variances from the study plan. The SPDL called for a report to be submitted by March 1, 2016. FirstLight is proposing a report due date of September 1, 2016 for the reasons discussed above.

1.4 Remaining Activities

- Reaches 1 through 3:
  - Complete hydraulic and habitat modeling
  - Review model output with stakeholders
  - Conduct BOBSAR assessment of complex channels within Reach 1 using agreed-to flow targets
  - Perform Habitat Time Series
  - Perform Persistent Habitat Analysis and Mapping

- Reach 4:
  - Finalize Habitat Suitability Index criteria for freshwater mussels

  - Collect hydraulic and habitat data
  - Conduct hydraulic modeling
  - Conduct habitat modeling
  - Habitat Time Series
  - Persistent Habitat Analysis and Mapping (if necessary)
  - Dual Flow Analysis
  - Review model output with stakeholders

- Reach 5:
  - Finalize Habitat Suitability Index criteria for freshwater mussels
  - Conduct screening level assessment (Task 2a)
  - Conduct Task 2b, if necessary

- Prepare Study Report

1.5 Literature Cited

Bovee, K.D. (1982). A guide to stream habitat analysis using the instream flow incremental methodology. (Office of Biol. Service FWS/OBS-82-26). Washington, DC.: USFWS, U.S. Dept. of Interior.

Bovee, K.D., Lamb, B.L., Bartholow, J.M., Stalnaker, C.B., Taylor, J. & Henriksen, J. (1998). Stream habitat analysis using the instream flow incremental methodology. (Biological Resources Division Information and Technology Report USGS/BRD-1998-0004/ viii). U.S. Geological Survey.

Milhouse, R. T., Updike, M. A, & Schneider, D. M.. (1989). *Physical habitat simulation system reference manual: version 2, Instream flow information paper 26* (Biological Report 89(16)). Washington, D.C.: U.S. Fish and Wildlife Service.

Appendix A
Correspondence Log

From:	Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>
Sent:	Monday, July 20, 2015 3:27 PM
To:	'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; 'peter.hazelton@state.ma.us'; 'kkennedy@tnc.org'; 'micah_kieffer@usgs.gov'; 'Jesse Leddick'; 'Bill McDavitt'; Karl Meyer; 'don.pugh@yahoo.com'; 'sims@honors.umass.edu'; 'Caleb Slater'; 'Ken Sprankle'; 'brett_towler@fws.gov'; Warner, John; 'Misty-Anne Marold'; 'Bob Nasdor'; 'Jessica Pruden'
Cc:	Jason George; Howard, John; 'glemay@gomezandsullivan.com'; Stira, Robert; Tom Sullivan; Mark Wamser; Bryan Apell
Subject:	First Light IFIM - Reach 4 scoping coordination
Attachments:	Reach 4 study site selection memorandum_MJW.pdf

Good afternoon IFIM study stake holders,

As you are aware, the next phase of data collection for the Turners Falls instream flow study will occur later this field season. We are currently beginning to plan work for Reach 4 (*from the USGS Montague gage downstream to Sunderland*). As you may recall, this will follow a conventional transect-based PHABSIM model. The purpose of the attached memo is to provide some orientation mapping, jot down some key background information and preliminary thinking about how study sites and transects may be distributed in this Reach, and to invite you to joini us in the field to reach decisions about field details such as transects and study sites. Data collection will begin subsequent to that.

We appreciate that everyone is busy, so we will also shortly launch a Doodle Poll to identify a date in August for which the site visit can be scheduled. We expect that the entire study area can be addressed by boat in the course of a single (long) day. Details about boats, access shuttling etc. are being worked out, but for now we'd like to settle on a firm date as soon as possible.

We look forward to seeing you in the field

Let us know if you have any questions

Regards,

Brandon

Brandon H. Kulik
Senior Fisheries Scientist
Kleinschmidt
Pittsfield, Maine
207-487-3328

MEMORANDUM

TO: Instream Flow Study Team

FROM: Brandon Kulik, Senior Fisheries Biologist

DATE: July 20, 2015

RE: Planning for Turners Falls Reach 4 IFIM study data collection

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As you are aware, the next phase of the Turners Falls IFIM study involves modeling habitat suitability in the Connecticut River. A 1-D PHABSIM model will be used to assess stream flow and habitat suitability in Reach 4.

BACKGROUND INFORMATION

HSC evaluation species and lifestages

Per the Revised Study Plan (RSP), habitat suitability in Reach 4 will be modeled for the following species and lifestages:

Species	Lifestage
American shad	*spawning, juvenile, adult*
sea lamprey	*spawning*
white sucker	*spawning, fry, juvenile, adult*
fallfish	*spawning, fry, juvenile, adult*
walleye	*juvenile, adult*
tessellated darter	*juvenile, adult*
dace	*juvenile, adult*
freshwater mussels	
macroinvertebrates	*larvae*
shortnose sturgeon	*Young of year, juvenile, adult*

Biological Surveys

Habitat use of this reach by American shad for spawning was documented by FirstLight in 2015 (relicensing study 3.3.6), and also by Layzer (1972), Gilmore (1973-1974) and Kuzmeskus (1975). These studies identified specific locations within the study area where spawning occurred (Figures 1 and 2). Potential freshwater mussel habitat was also investigated by FirstLight in 2014[1] (locations depicted in Figures 1 and 2).

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[1] http://www.northfieldrelicensing.com/Lists/Document/Attachments/284/Study%20Report%203_3_16.pdf

Mesohabitat

This reach will be modeled using a 1-D transect-based PHABSIM model. The reach is approximately nine miles long and extends from the USGS Montague gage to the Route 116 Bridge in Sunderland, which is approximately the backwater influence of the Holyoke Project impoundment. Mesohabitat in the reach was mapped in 2013; this section of river is relatively uniform, alluvial and low gradient, with well defined channel and embankments. Based on mesohabitat mapping, run mesohabitat comprises 68% of the study area, followed by pool (27%) and glide (5%). There are no riffles. Substrate varies but is dominated by gravel, cobble, coarse sand and fines.

Mesohabitat	Length (ft)	percentage
Run	32,425	68%
Pool	13,031	27%
Glide	2,436	5%
TOTAL	*47,891*	

Provisional study sites and transects

Figures 1 and 2 show that Reach 4 is heavily dominated by relatively uniform run mesohabitat, combined with a repeating pattern of short glide and pool segments in the downstream segment of the reach. We recommend focusing on the runs and glides; habitat suitability in pools is inherently not sensitive to changes in flow and thus pools are poor indicators of habitat suitability in flow studies. With that in mind our preliminary recommendation is to use the four study sites depicted in the figures as follow:

Study Site 1 (2 transects) is chosen as it is in relatively close proximity to Cabot Station discharge and the confluence with Deerfield River and should be reflective of near-field effects resulting from changes in flow. We recommend two transects to account for both an open channel at a known American shad spawning location, and a divided channel created by an alluvial island.

Study Site 2 (1 transect) is chosen as it is approximately 0.6 mile further downstream so slightly further away from discharge sources, and also in an area of shad spawning. We feel that these two study sites (Study Sites 1 and 2) collectively represent habitat and hydraulics throughout the long reach terminating downstream at the first glide.

Study Site 3 (1 transect) is selected as a representative glide, with documented historic shad spawning. It will be used to represent habitat in the similar next downstream glide.

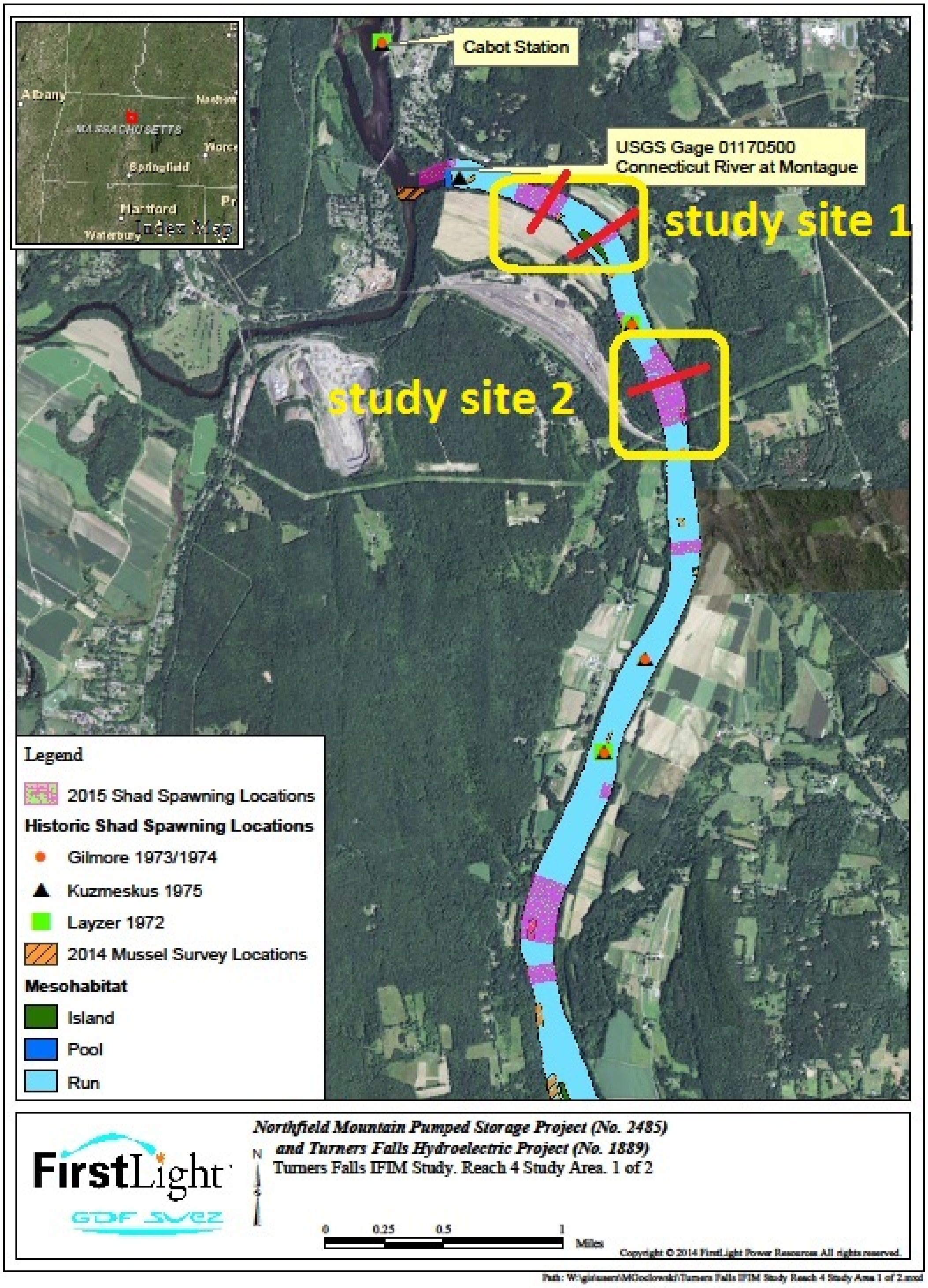
Study Site 4 (2 transects) is selected to account for run habitat in the downstream section of the study reach. Both runs in this lower area feature divided channels but are otherwise similar, however the proposed reach also has a segment of interest relative to freshwater mussels. It will be used to represent habitat in the similar next downstream run.

We have populated each proposed study site with approximate transect locations for purposes of study team discussion. We anticipate refining and adjusting these study sites and transects as necessary with study team participants.

NEXT STEPS

FirstLight proposes to convene interested stakeholders to view the study area and finalize transect locations. FirstLight will attempt to manage flow so river channel features can be adequately viewed to facilitate transect selection. Due to limited shoreline access and the length of the study area, this will of necessity require boat travel, an early start and a long day.

We will be scheduling this site visit in the near future, based on Doodle Poll input, and are investigating options for on-water transportation. Once we have more details we will provide a detailed itinerary.



Cabot Station
USGS Gage 01170500
Connecticut River at Montague
study site 1
study site 2
Albany
MASSACHUSETTS
Springfield
Hartford
Waterbury
Index Map
Legend
2015 Shad Spawning Locations
Historic Shad Spawning Locations
Gilmore 1973/1974
Kuzmeskus 1975
Layzer 1972
2014 Mussel Survey Locations
Mesohabitat
Island
Pool
Run
Northfield Mountain Pumped Storage Project (No. 2485)
and Turners Falls Hydroelectric Project (No. 1889)
Turners Falls IFIM Study. Reach 4 Study Area. 1 of 2
FirstLight
GDF SUEZ
0 0.25 0.5 1
Miles
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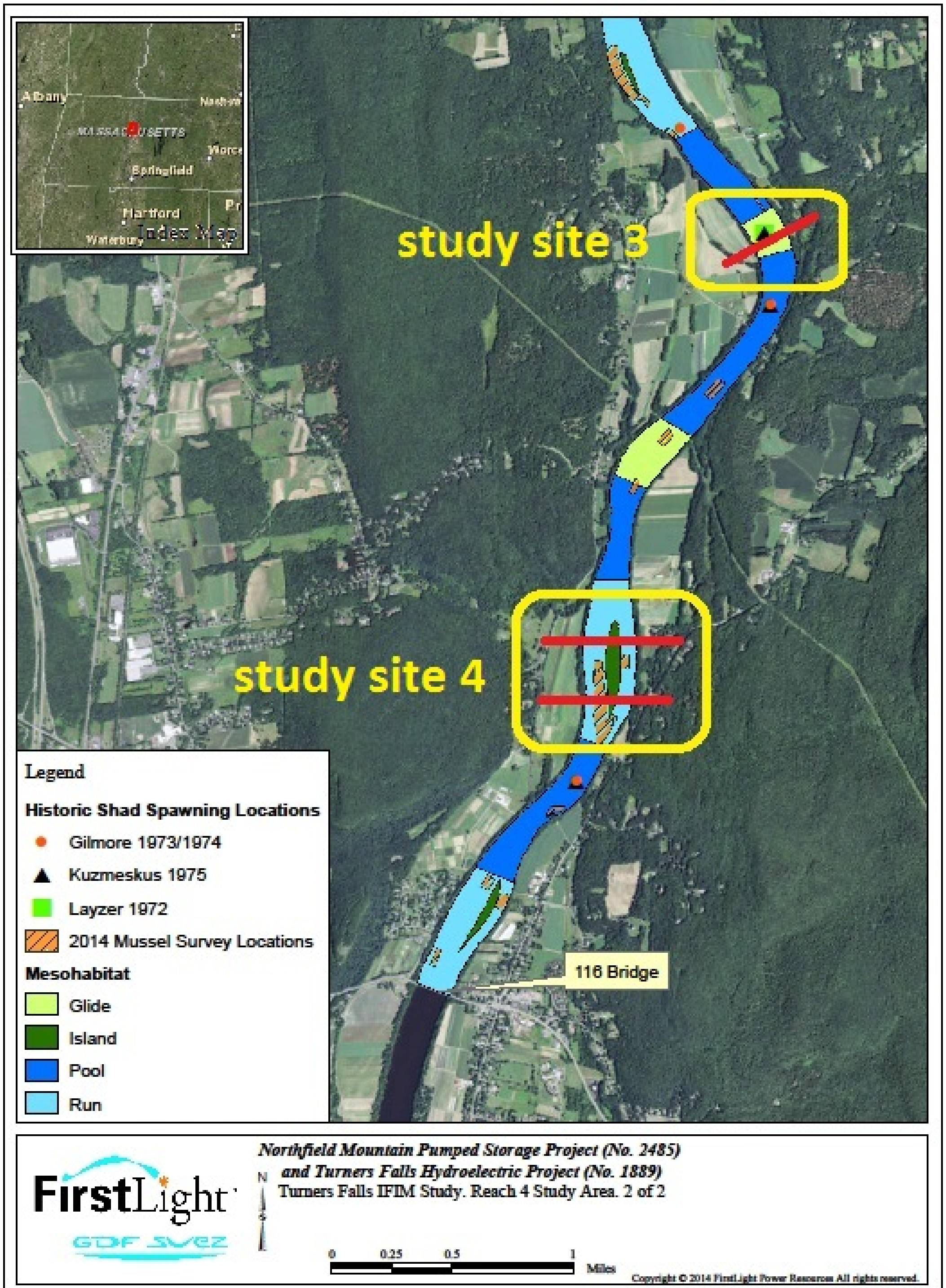

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From: Brandon Kulik <Brandon.Kulik@KleinschmidtGroup.com>
Sent: Friday, August 28, 2015 2:02 PM
To: 'Karl Meyer'; 'Tom Christopher'; 'Andrea Donlon'; 'Melissa Grader'; 'peter.hazelton@state.ma.us'; 'kkennedy@tnc.org'; 'micah_kieffer@usgs.gov'; 'Jesse Leddick'; 'Bill McDavitt'; 'don.pugh@yahoo.com'; 'sims@honors.umass.edu'; 'Caleb Slater'; 'Ken Sprankle'; 'brett_towler@fws.gov'; Warner, John; 'Misty-Anne Marold'; 'Bob Nasdor'; 'karlmeyer1809@verizon.net'; 'julie.crocker@noaa.gov'
Cc: Jason George; Howard, John; 'glemay@gomezandsullivan.com'; Stira, Robert; Tom Sullivan; Mark Wamser; Bryan Apell
Subject: First Light IFIM - Reach 4 site visit summary
Attachments: TURNERS FALLS August 10 2015 agency site visit notes.pdf

Greetings all,

Attached for your reference is a summary of the August 10, 2015 site visit to Reach 4.

Thank you,

Brandon H. Kulik
Senior Fisheries Scientist
Kleinschmidt
Pittsfield, Maine
207-487-3328

TURNERS FALLS/CABOT IFIM STUDY

STUDY TEAM SITE ORIENTATION AND TRANSECT SELECTION FIELD VISIT – REACH 4

MEETING SUMMARY

DATE: August 10, 2015.

ATTENDEES: *See attached attendance list*

Attendees gathered at Sunderland, MA public boat ramp. Brandon Kulik gave an overview of the day's activities and Bryan Apell conducted the safety briefing. Sunderland is the downstream boundary of the reach, and the group would travel via motor boat, from Sunderland upstream nine miles to view the reach and then select study transects on the return trip downstream. The upstream reach boundary is near the confluence of the Deerfield River at the USGS gage.

The group embarked on four boats and boated upriver. The Montague USGS gage was reading 5200-5700 cfs during the course of the day. At this flow, the river was generally navigable, participants could observe most mesohabitat distinctions.

Prior to selecting transects, the group discussed preliminary observations. There was agreement that it was not necessary to subdivide the river into sub reaches or stand-alone study sites (as proposed in the July 20 2015 planning memo), but that all transects selected today would be combined in the model and weighted according to mesohabitat type (*i.e*. "representative" model approach). Brandon noted that it will still be possible to pull out transect-specific Weighted Usable Area (WUA) output for critical habitat reach review such as those selected expressly for mussel habitat suitability ("critical" reach approach). The group agreed to build upon the general layout of transects depicted in the July 20, 2015 memo. It was agreed that due to channel uniformity, some transects could be located by field crews at the time of data location; however certain transects such as those proposed at island complexes and or defining mussel spawning areas were located by the stakeholder team. Headpin locations for these transects were field marked with GPS. This process yielded a total of 12 transects as follows (see attached map):

Upstream Run -

The upstream-most run extends from the Montague gage downstream continuously for approximately 5 miles. A total of seven transects will be located in this section, including one cluster near Fourth Island (one above, one through and one immediately downstream from the island). Transects were located to capture:

- a cross-section of known American shad spawning areas
- potential freshwater mussel habitat
- other areas of varying depth and channel width

Glides and Pools -

There are two very short and similar glide mesohabitat segments, bracketed by riverine pools. A single transect will be located within the upper glide and another in an adjacent pool.

Downstream Runs – two similar runs occur in the vicinity of First and Second islands. Three transects will be located above, and bisecting, Second Island.

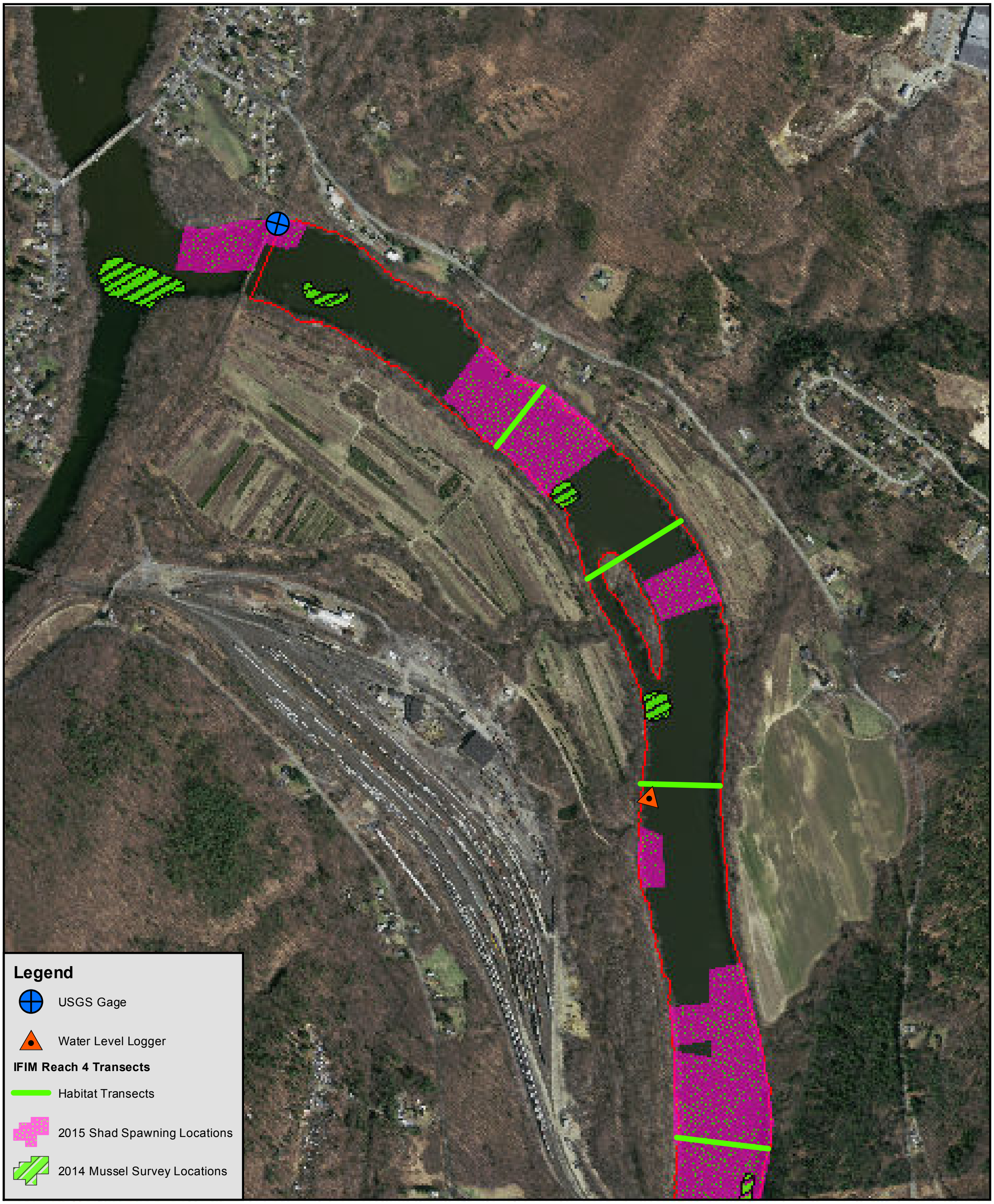
Turner Falls Hydroelectric Project (No. 1889) and Northfield Mountain Pumped Storage Project (No. 2485)
Meeting Sign-In Sheet

IFIM - Reach 4 transect selection site visit

Connecticut River, MA - start at Sunderland boat launch

8/10/2015 9:00:00 AM - 8/10/2015 3:00:00 PM

Name	Organization	Phone	Email	Attendee Signature
Apell, Bryan	Kleinschmidt Associates		Bryan.Apell@KleinschmidtGroup.com	
George , Jason	Gomez and Sullivan Engineers	603-428-4960	jgeorge@gomezandsullivan.com	
Grader, Melissa	US Fish and Wildlife Service	413-548-8002 x 124	Melissa_Grader@fws.gov	
Howard, John	FirstLight Power Resources	413-659-4489	john.howard@gdfsuezna.com	
Kennedy, Kathryn	The Nature Conservancy	(413) 586 2349	kkennedy@tnc.org	
Kulik, Brandon	Kleinschmidt Associates	207-487-3328	Brandon.Kulik@KleinschmidtGroup.com	
Leddick, Jesse	MassWildlife, Natural Heritiage Endangered Species Program	(508) 389-6386	jesse.leddick@state.ma.us	
Meyer, Karl	Town of Greenfield	413-773-0006	karlmeyer1809@verizon.net	
Rosset, Julianne	US Fish and Wildlife Service	413-548-8002 x	Julianne_rosset@fws.gov	
Rubin, Aaron	Gomez and Sullivan Engineers	603-428-4960	arubin@gomezandsullivan.com	
Slater, Caleb	Massachusetts Division of Fisheries and Wildlife	508-389-6331	Caleb.Slater@state.ma.us	
Sullivan, Tom	Gomez and Sullivan Engineers	603-428-4960	tsullivan@gomezandsullivan.com	
Warner, John	US Fish and Wildlife Service	603-223-2541 x 15	John_Warner@fws.gov	



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INSTREAM FLOW STUDY

Reach 4 Study Transects (Page 1 of 6)

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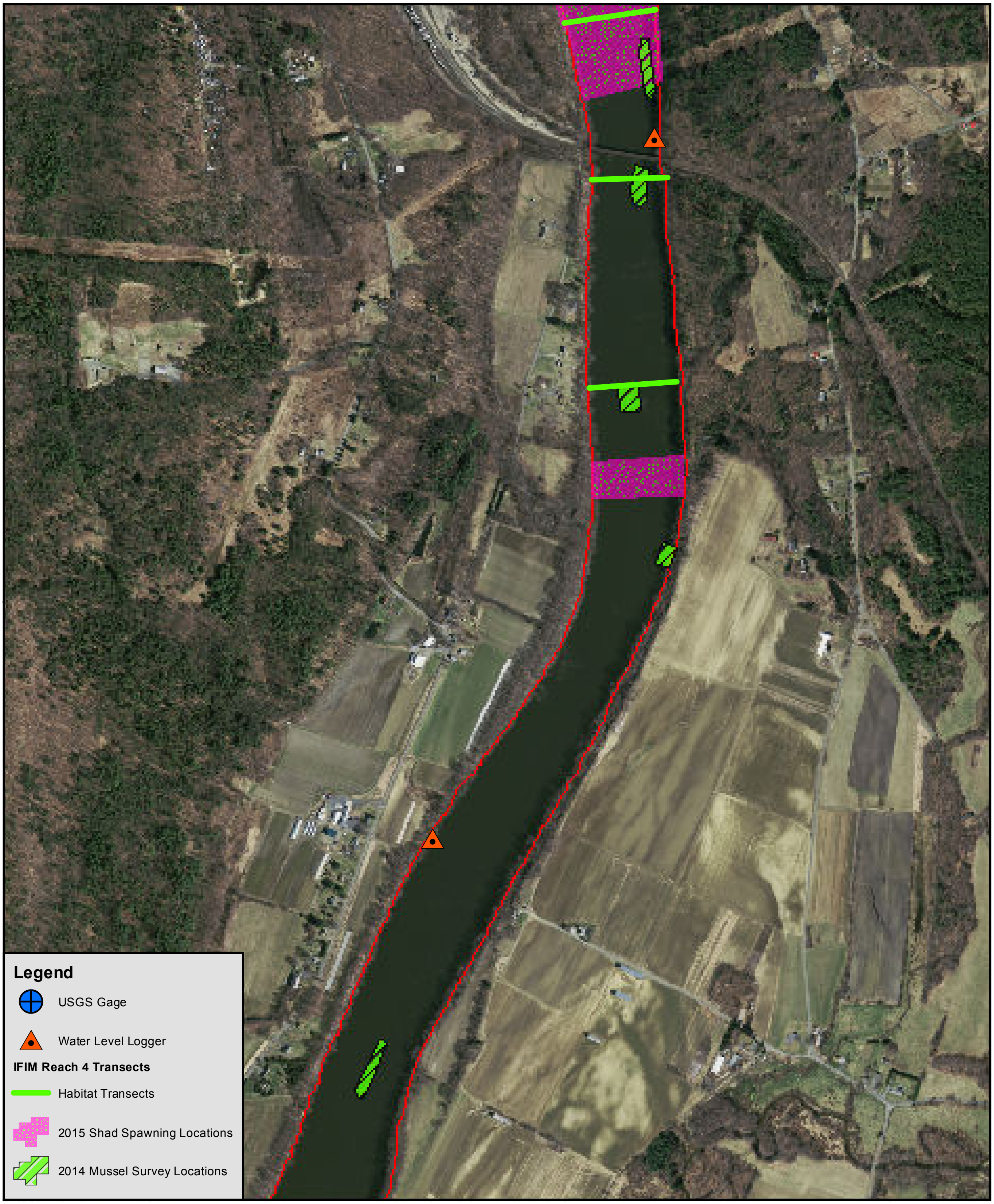

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INSTREAM FLOW STUDY

Reach 4 Study Transects (Page 2 of 6)

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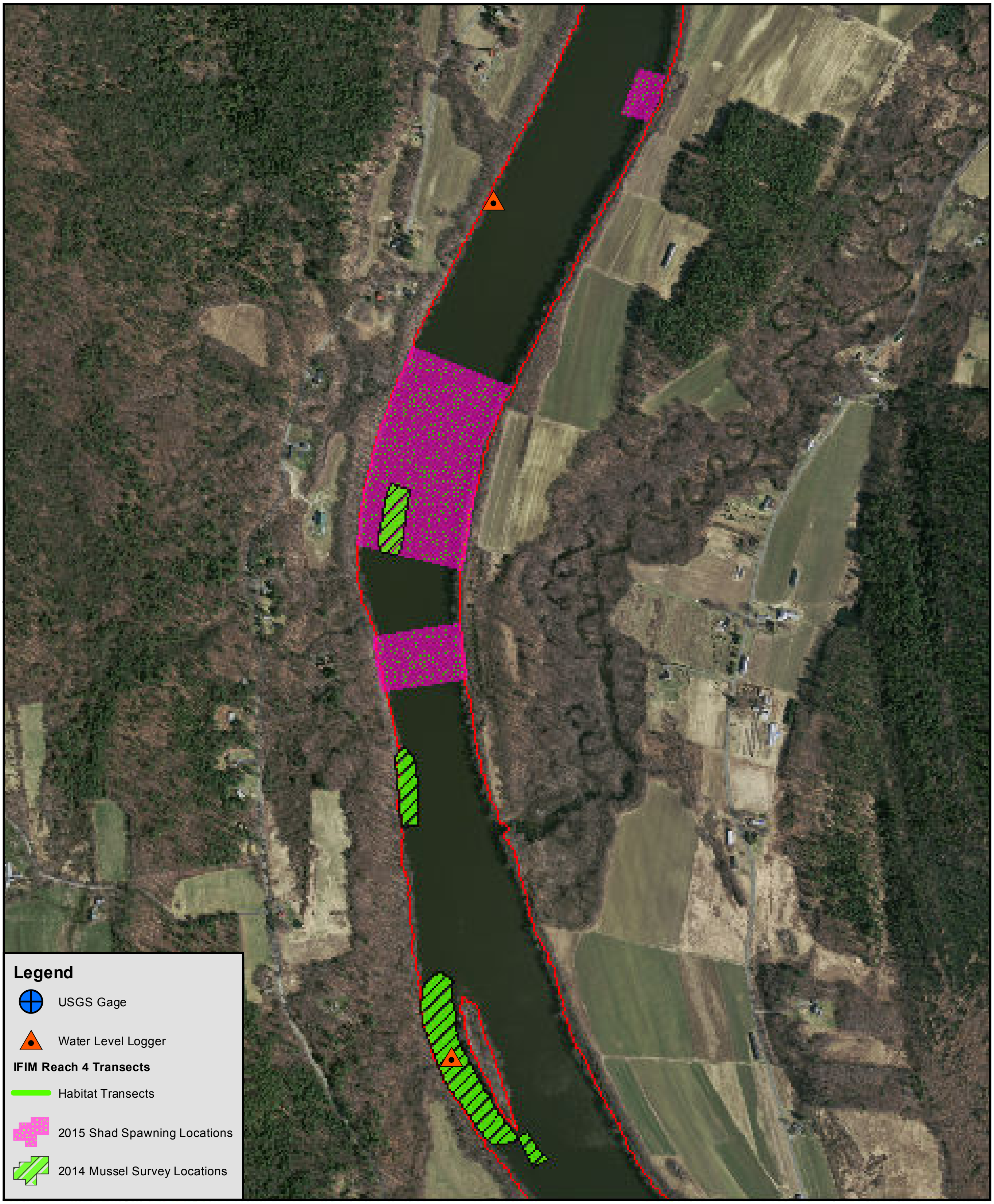

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INSTREAM FLOW STUDY

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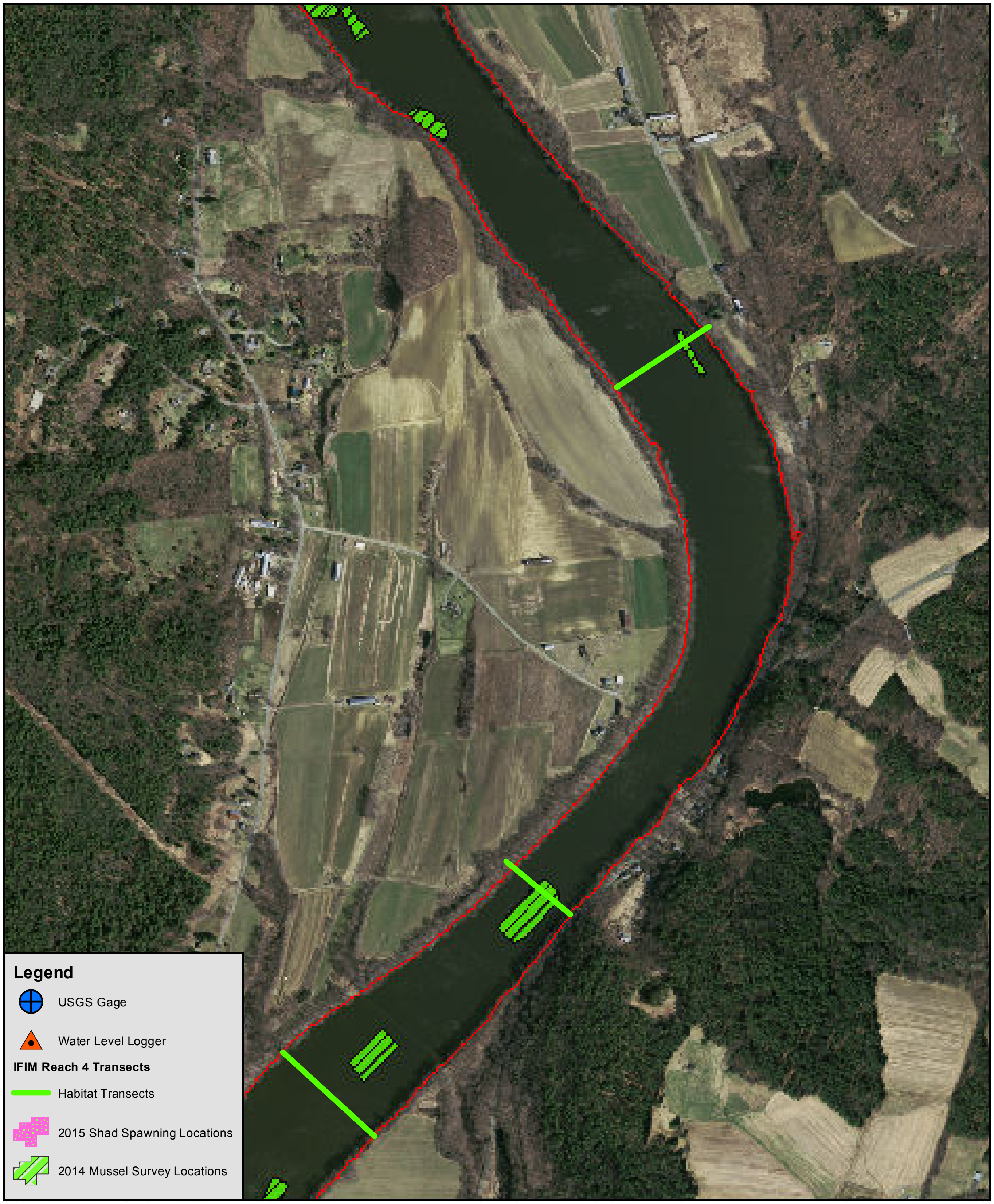

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INSTREAM FLOW STUDY

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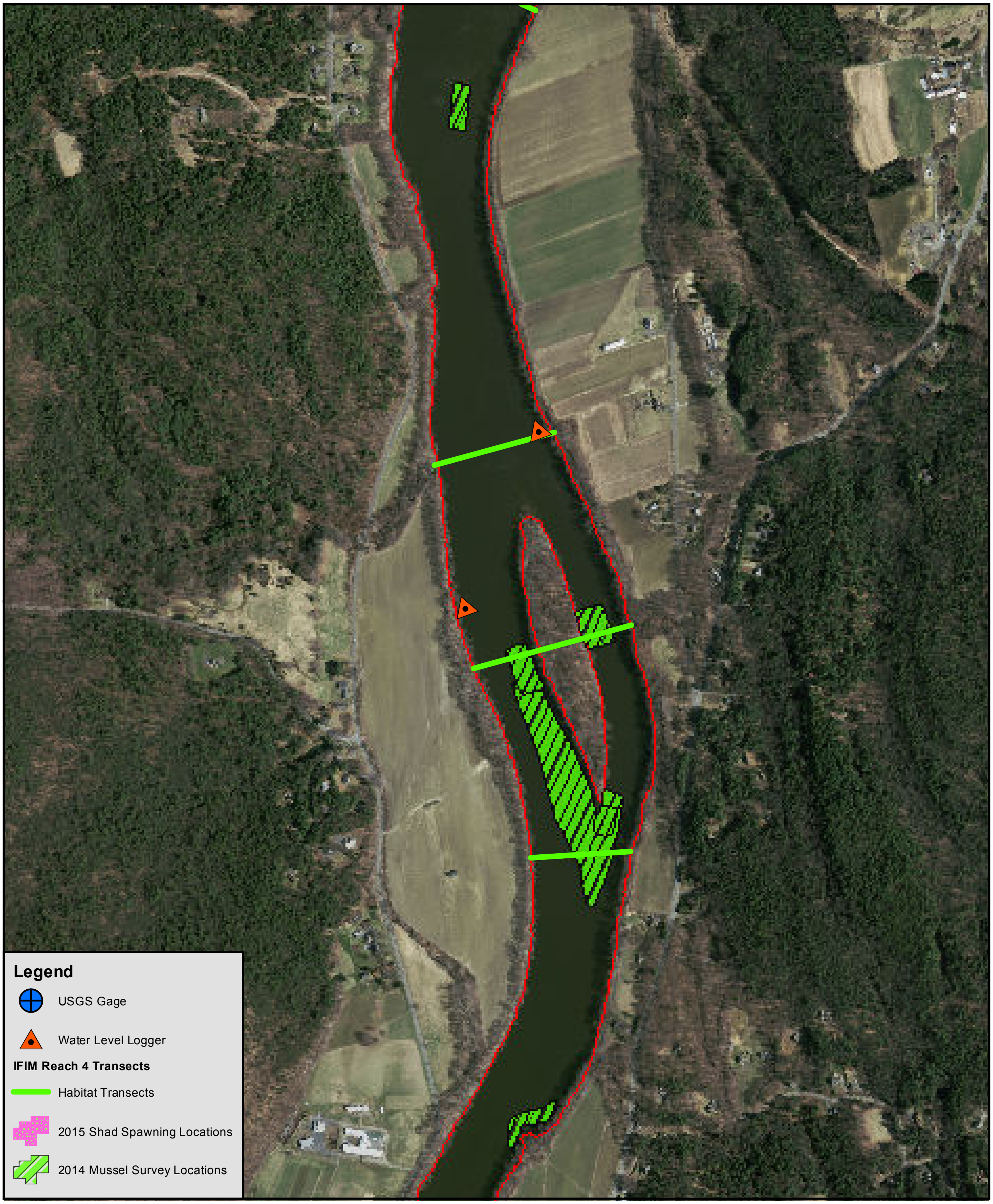

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INSTREAM FLOW STUDY

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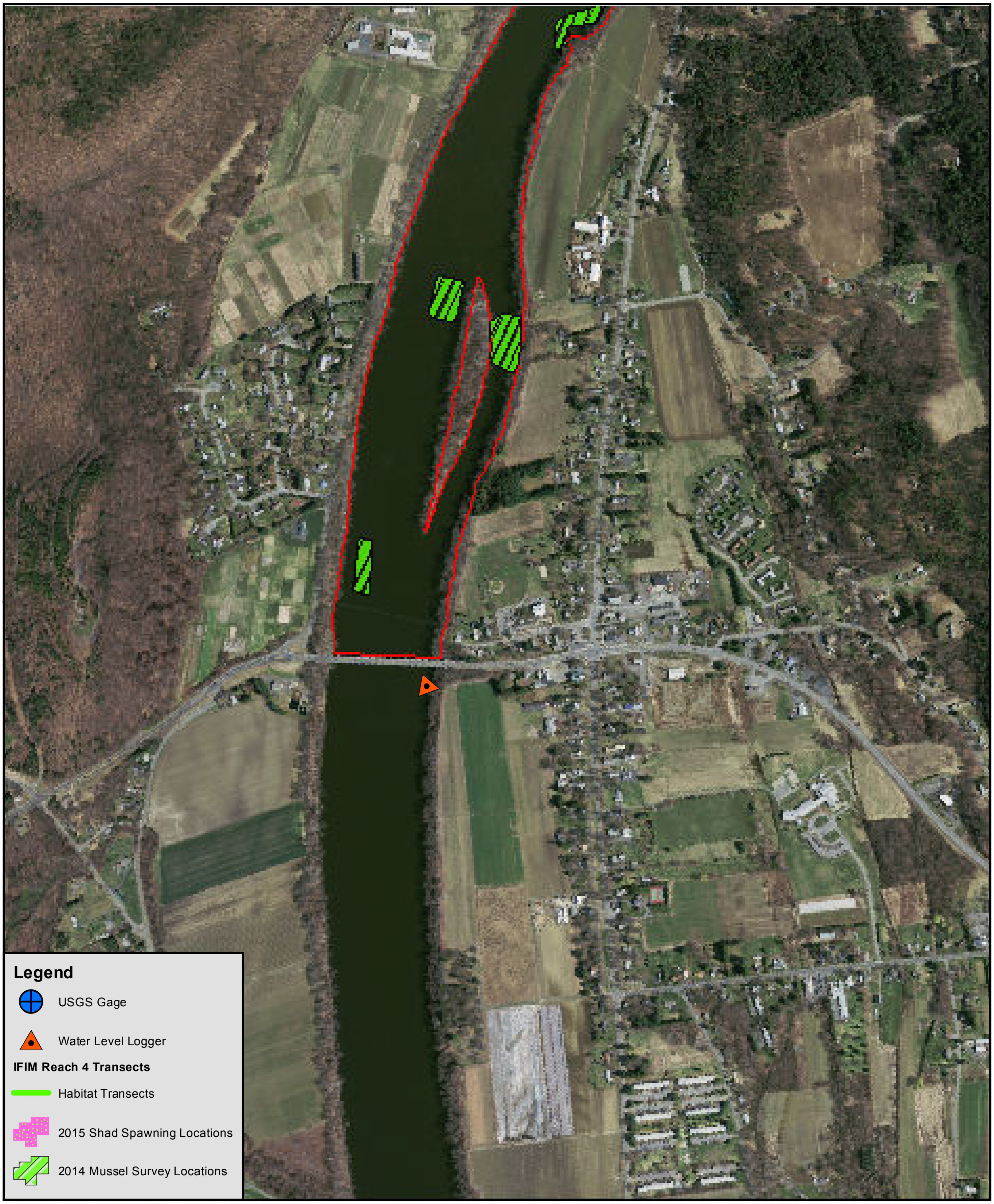

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Reach 4 Study Transects (Page 6 of 6)

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