

ATTACHMENT B: 2007-2014 Photo Log Comparison

In the summer of 2007, photographs of the Turners Falls Impoundment (TFI) riverbanks were captured by Field Geology Services as part of the report titled *“Fluvial Geomorphology Study of the Turners Falls Pool on the Connecticut River between Turners Falls, MA and Vernon, VT.”* In 2013, FirstLight conducted the most recent TFI Full River Reconnaissance Survey (FRR) in accordance with the methodology detailed in the Revised Study Plan (RSP, Study No. 3.1.1). As part of the 2013 FRR, FirstLight replicated, as closely as possible, the 2007 photo log during the summer of 2014. This attachment presents the findings of the comparisons made between the 2007 and 2014 photos in accordance with the RSP.

Task 4 of the RSP calls for a comparison of the 2007 and 2014 photo logs, where applicable. Upon review of the photo logs, it became very clear that the presence of summer foliage along the riverbanks greatly limits the usability of the photos to draw definitive conclusions of changes in riverbank conditions from 2007 to 2014. The ability to see subtle changes in the riverbank or to detect specific features or characteristics is greatly reduced due to the leaf-on conditions. The 2013 FRR survey was specifically conducted during leaf-off conditions (November and December) to better observe riverbank features and characteristics.

A comparison of photographs captured in 2007 and 2014 at 22 sites throughout the longitudinal extent of the TFI are presented in this addendum. These sites were chosen for comparison due to the fact that they 1) spanned the longitudinal extent of the TFI; and 2) included sites of noted interest. Observable changes in the bank structure, vegetation, or sensitive receptor sites are described within the photo pages enclosed. Included in these comparisons are sites which were noted as containing specific bank or erosional features on farms or known areas of interest (photo sets 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 19); past bank restoration sites (photo sets 13, 14, 15, and 18); and potential future restoration sites which were identified in the 2013 FRR report (photo sets 2, 16, 17, 20, 21, and 22).

FirstLight attempted to recreate the 2007 photo log as closely as possible, however, due to a variety of factors, exact replication proved to be difficult. The 2007 photo set lacked embedded GPS coordinates and aspect (direction) which did not permit an exact photo station comparison. The 2014 photographs had both the GPS coordinates and the aspect embedded into each photograph. Furthermore, due to the distance from the bank, the 2007 photos lacked detail of important bank areas. As observed in the enclosed comparisons, water levels during 2007 and 2014 were similar and typical of summer conditions. Water levels often changed during the course of a given day, but in general, both photo sets were taken during periods of similar summertime low water flows. Additional replication or comparison challenges included:

- Some photographs are zoomed in, while the comparison photograph may be zoomed out. Additionally, the distance from shore may be different between the two years.
- The angle and direction of the two comparison photographs may be different.
- It is very difficult to compare riverbank features and characteristics due to the presence of heavy vegetation/leaf cover.

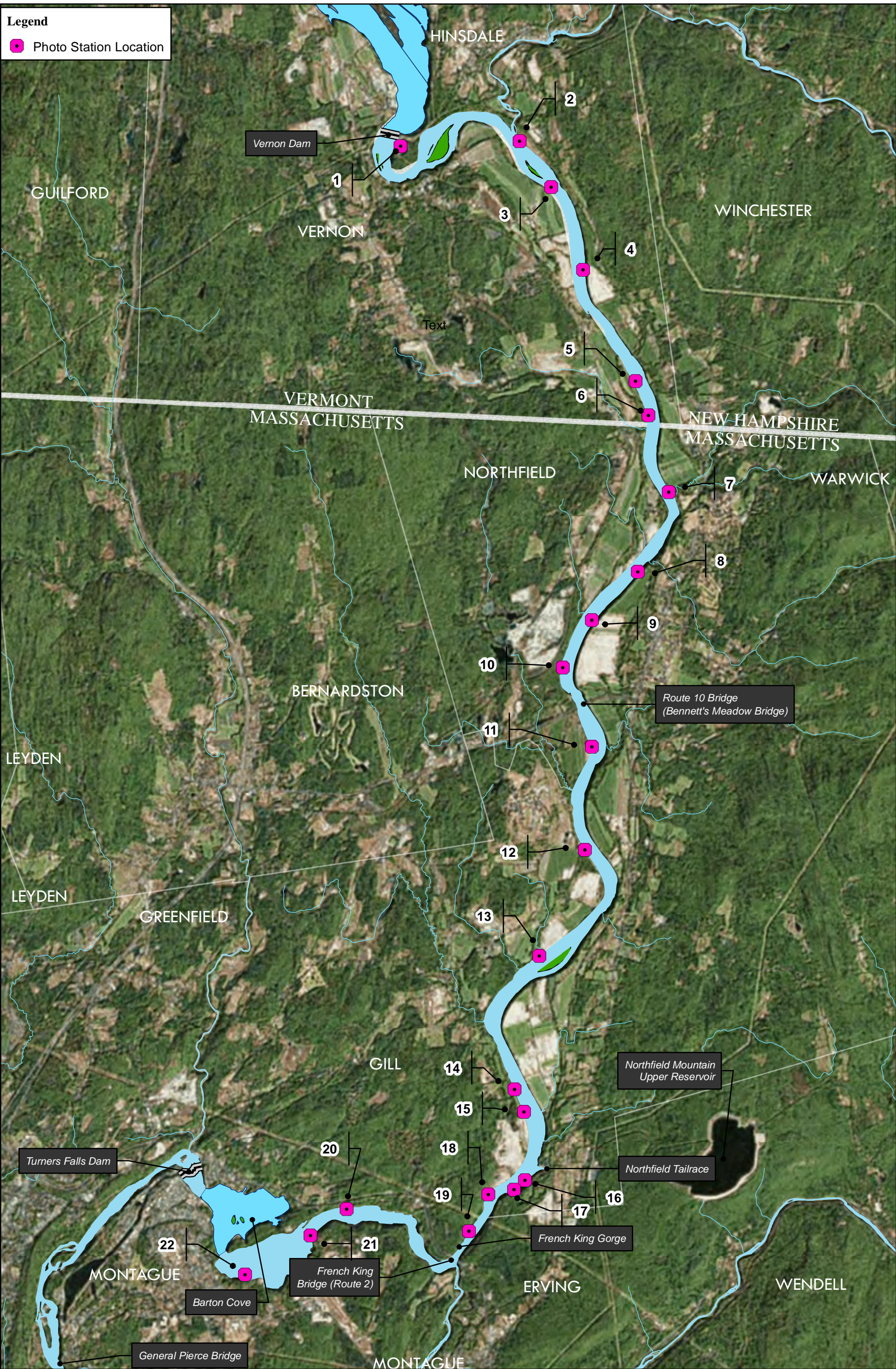
The 2007 Field Geology Services photographs were collected over a period of four days (June 15, 19, 20, and 21, 2007) by boat. The 2007 photo set included several thousand photographs. The spatial datum for these photos is WGS 84; the camera used was a Canon EOS digital Rebel XT. The GPS coordinates and azimuth are not embedded into the photographs, but were provided in an excel worksheet.

On the days when photographs were taken in 2007, the flows released from Vernon ranged from approximately 2,000 to 7,600 cfs. Water levels at the Northfield tailrace ranged from approximately 181 to 184 ft. On the days when photographs were taken in 2014, the releases from Vernon ranged from approximately 4,000 to 13,000 cfs while the water levels at the Northfield tailrace ranged from approximately 181 to 184 (data was only available for July 28th). Flows through the TFI were relatively low for both time periods; however, 2014 flows were a few thousand cfs higher.

The 2014 photographs were collected over three days (July 27, 28, and August 3, 2014) also by boat. The spatial datum for the 2014 photos is WGS 84; the camera used was a Canon EOS-1DX. The GPS coordinates and the photo aspect data were embedded into each photograph. Over four thousand photographs were collected to document the riverbank conditions in 2014.

Legend

● Photo Station Location



FIRSTLIGHT POWER RESOURCES
RELICENSING STUDY 3.1.1
2013 FULL RIVER RECONNAISSANCE
TURNERS FALLS IMPOUNDMENT



Addendum Figure 1:
Photo Station Locations for Comparison of
2007 Photographs (Field) and
2014 Photographs (NEE)

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

PHOTO SET #1

2007 Photo: Vernon Dam: Located immediately downstream of the Vernon Dam on the left bank.



2014 Photo: Vernon Dam



Observations: The young trees present in the photo from 2007 have grown, additional coarse woody debris has accumulated on the bench since the 2007 photo, and some of the trees fell since the 2007 photograph. The overhang at the top of the bank appears to have receded back indicated by the toppled trees at the top of bank but the lower bank appears to have remained in place allowing increased growth of vegetation.

PHOTO SET #2

2007 Photo: Bonnette Farm: Located in New Hampshire on the left bank.



2014 Photo: Bonnette Farm



Observations: Dense and well established vegetation are observed in both photographs, indicative of relative stability. Since the 2007 photograph, the bank has become more vegetated, particularly with oriental bittersweet vines. There were sensitive receptor sites (kingfisher next cavity) present in 2007 and in 2014.

PHOTO SET #3

2007 Photo: Vermont Farm: Located in Vermont on the right bank. Note the bank is steep, and there are exposed roots at the toe.



2014 Photo: Vermont Farm



Observations: Banks in both photos support a significant density of trees. An increase in lower level vegetative growth, including a patch of emergent vegetation on the bench which was not observed in the 2007 photo, can be observed in the 2014 photo.

PHOTO SET #4

2007 Photo: Across from Urgiel Upstream: Located in New Hampshire on the left bank. The bench is gravelly at this site, with some areas of exposed bedrock, and some patches of emergent vegetation.



2014 Photo: Across from Urgiel Upstream



Observations: No significant changes in the bank at this location are observed.

PHOTO SET #5

2007 Photo: Downstream from Kendall, Site 1: Located in Vermont on the right bank, and immediately downstream from the Kendall restoration site.



2014 Photo: Downstream from Kendall, Site 1



Observations: Banks in both photos are well-vegetated, however, since the 2007 photograph oriental bittersweet has overgrown many of the trees.

PHOTO SET #6

2007 Photo: Downstream from Kendall, Site 2: Located further downstream from the Kendall restoration site than Photo set 5, this site is located in Vermont on the right bank.



2014 Photo: Downstream from Kendall, Site 2



Observations: The banks appear to be similar in both time periods with heavy vegetation. Part of a large oak tree has fallen since 2007 (white arrow), and the oriental bittersweet has become denser.

PHOTO SET #7

2007 Photo: Pauchaug: Located upstream of the Pauchaug boat launch site on the left bank of the River, in Northfield, Massachusetts.



2014 Photo: Pauchaug



Observations: Both photographs indicate dense vegetation on the upper bank as well as dense vegetation on the lower bank/beach area. Since the 2007 photograph, the bench has accumulated sediment and the emergent vegetation has become very well established. The extent of the *Phragmites* colonization has grown since 2007.

PHOTO SET #8

2007 Photo: Downstream from the old Railroad Bridge: Located on the left bank of the River.



2014 Photo: Downstream from the old Railroad Bridge



Observations: Bank conditions appear similar in both sets of photographs but oriental bittersweet has become more established since 2007 at this location. There is a kingfisher nest cavity in the 2014 photograph (white arrow).

PHOTO SET #9

2007 Photo: Northfield Farm: Located in Northfield, Massachusetts, on the left bank



2014 Photo: Northfield Farm



Observations: Bank conditions do not appear to have changed significantly from 2007 to 2014. The vegetated riparian buffer along this farm field is narrow, and has not changed since 2007.

PHOTO SET #10

2007 Photo: Upstream from the Rt. 10 Bridge: Located upstream of the Route 10 Bridge on the right bank in Northfield, this section of Riverbank is very steep, and is heavily forested.



2014 Photo: Upstream from the Rt. 10 Bridge



Observations: No observable changes can be seen at this site since 2007.

PHOTO SET #11

2007 Photo: Downstream from the Rt. 10 Bridge: Located in Northfield, Massachusetts, on the right bank.



2014 Photo: Downstream from the Rt. 10 Bridge



Observations: There are no observable changes at this photo station since 2007.

PHOTO SET #12

2007 Photo: Upstream from Urgiel: Located in Gill, Massachusetts, on the right bank.



2014 Photo: Upstream from Urgiel



Observations: Bank conditions appear to be similar in both photographs. This photograph shows the approximate location of a linear erosion feature with a vertical exposed face ranging from 1 to 2 feet high that extends longitudinally through part of the repaired segment (Urgiel) as well as farther upstream even crossing through a small drainage feature.

PHOTO SET #13

2007 Photo: Flagg Farm: This site is located at the downstream end of the Flagg restoration site, on the right bank, in Gill, Massachusetts.



2014 Photo: Flagg Farm



Observations: Since the 2007 photograph the bank face has become more vegetated and recovering from past grazing activity by cattle since this site was restored in 1999. Sediment has deposited on the lower bank and emergent vegetation is becoming established and growing. Close observation of this site during field data collection for the erosion causation study showed that a number of cottonwood seedlings have become established on this lower bank. There were several bank swallow nest cavities observed at this site in 2007, but there were none observed in 2014.

PHOTO SET #14

2007 Photo: Wallace Watson: This photo shows a portion of the Wallace/Watson restoration site prior to restoration efforts. It is located in Gill, Massachusetts, on the right bank.



2014 Photo: Wallace Watson



Observations: This site was restored using bioengineering techniques in 2013. Techniques utilized included, building up the lower bank/beach with gravel and imbedded large woody debris and planting of vegetation. Since the 2007 photo was taken, new vegetation has become established on the bench. There are bank swallow and kingfisher cavities along this section of the riverbank.

PHOTO SET #15

2007 Photo: Bathory Gallagher Oak Tree: This photo station is at the downstream end of the Bathory/Gallagher restoration site, prior to restoration efforts, in Gill, Massachusetts, on the right bank.



2014 Photo: Bathory Gallagher Oak Tree



Observations: This site was restored using bioengineering techniques in 2013. Techniques utilized included, building up the lower bank/beach with gravel and imbedded large woody debris and planting of vegetation. Since the 2007 photo was taken, new vegetation has become established on the bench. There are bank swallow and kingfisher cavities along this section of the riverbank.

PHOTO SET #16

2007 Photo: Located downstream from the tailrace in Northfield, Massachusetts, on the left bank.



2014 Photo: Downstream from the tailrace



Observations: Erosion is occurring at this site and has been recommended for preventative maintenance and/or bank stabilization work in the 2013 FRR report.

PHOTO SET #17

2007 Photo: Pine Meadow: This site is located at the mouth of Pine Meadow Brook in Northfield, MA, on the left bank.



2014 Photo: Pine Meadow - This photo is a close-up of the area shown in photo 17a (white arrow), which is at the mouth of Pine Meadow Brook.



Observations: This site has been eroded for some time and was recommended for preventative maintenance and/or bank stabilization work in the 2013 FRR report.

PHOTO SET #18

2007 Photo: Lower Split River Farm: Located at Lower Split River Farm restoration site prior to restoration efforts, in Gill, MA, on the right bank.



2014 Photo: Lower Split River Farm



Observations: This site was restored using bioengineering techniques in 2009. Techniques utilized included, placement of gravel on the lower bank/beach area along with large woody debris and planting of vegetation. Since the 2007 photo was taken, new vegetation has become established on the bench.

PHOTO SET #19

2007 Photo: Upstream from French King Bridge: This photo station is located upstream from the French King Bridge in Gill, MA, on the right bank.



2014 Photo: Upstream from French King Bridge



Observations: This is a stable section of riverbank; no observable changes are noted between these photos.

PHOTO SET #20

2007 Photo: Camp 2W: This station is located at Camp Site 2W, on the right bank, in Gill, MA.



2014 Photo: Camp 2W



Observations: This site (see white arrow location in the 2007 photo) has been recommended for preventative maintenance and/or bank stabilization work in the 2013 FRR report.

PHOTO SET #21

2007 Photo: Camp 4E: This camp is located in Montague, MA, on the left bank.



2014 Photo: Camp 4W



Observations: This camp site has been recommended for preventative maintenance and/or bank stabilization work in the 2013 FRR report.

PHOTO SET #22

2007 Photo: Montague: Located downstream from the Montague Rod & Gun Club, in Montague, MA, on the left bank.



2014 Photo: Montague



Observations: Erosion has been ongoing at this site for quite some time and has been recommended for preventative maintenance and/or bank stabilization work in the 2013 FRR report.