September 10, 2018

VIA MAIL
Mr. Kevin Cafferty
Department of Public Works Director
Town of Scituate Public Works
600 Chief Justice Cushing Way
Scituate, MA 02066

Re: Examination of As-Built Conditions for
Mordecai Lincoln Road Pond Dam Removal (a.k.a. Hunters Pond Dam)
Town of Scituate, Massachusetts

Dear Mr. Cafferty:

As you are aware, the US Army Corps of Engineers New England District determined that the work associated with the Mordecai Lincoln Road Pond Dam Removal (a.k.a. Hunters Pond Dam Removal) "will have only minimal individual or cumulative environmental impacts on waters of the United States, including wetlands." They conveyed their determination to you in their April 18, 2017 authorization (File Number: NAE-2016-02616). However, this authorization stipulated under Special Condition #4 that:

"If at any time there is a project design change that may:

A. *Result in any increase to the crossed waterway's National Flood Insurance Program (NFIP) Base Flood Elevation (BFE) profile;*
B. *Result in a greater than 0.5 foot decrease to the crossed waterway's NFIP BFE profile; or*
C. *Require alteration to the waterway's existing NFIP Regulatory Floodway delineation.*

the permittee shall coordinate with the Federal Emergency Management Agency (FEMA) Region 1 Risk Analysis Branch personnel to determine if initiation of an NFIP flood insurance study change review process is warranted."

Henceforth, we will refer to these as Conditions A, B, and C. Based on our analysis, it is Princeton Hydro's opinion that the removal of the spillway of Mordecai Lincoln Road Pond Dam has not caused an increase in the BFE profile (Condition A), has resulted in a maximum decrease of the BFE profile of 0.2 foot (Condition B), and does not require an alternation to the waterway's existing NFIP Regulated Floodway delineation (Condition C). Therefore, no additional coordination beyond this memorandum should be required with the Corps or FEMA to meet the requirements of Special Condition #4 of Corps authorization NAE-2016-02616. Furthermore, Princeton Hydro believes that NIFP flood insurance study change is not necessary, nor required, for this dam removal project.

A summary of those findings is presented in the following technical memorandum and additional supporting information can be downloaded here: https://goo.gl/pM6sBD. The supporting information includes:

- 1/8/18 MA DER Letter Describing the Project Purpose and Funding
- 3/15/17 Engineering Plans
- As-Built HEC-RAS Modeling Files
- 2018 As-Built Plans
- FIRM Map
- 7/22/16 Hydraulic Analysis Memo
- 3/27/15 Preliminary Design Memo
- Location Map
- 4/18/17 Army Corps of Engineers Authorization Letter

Should you have any questions regarding this letter or the attached technical memorandum, please do not hesitate to reach out to me directly at DKetzer@princetonhydro.com or via phone at 513-708-8099.

Sincerely,

Daniel T. Ketzer, P.E.
Water Resources Engineer

/Enclosures

cc: Kerry Bodgan, Chief, FEMA Region 1

Barbara Newman, Chief, USACE

Kristopher Houle, MA DER (via email)

Eric Derleth, USFWS (via email)

Eric Hutchins, NOAA (via email)

Technical Memorandum: Mordecai Lincoln Road Pond Dam Removal - Examination of As-Built Conditions

Technical Approach

The following approach was used to determine the level of FEMA coordination required as a result of the removal of the spillway of Mordecai Lincoln Road Pond Dam (a.k.a. Hunters Pond Dam).

As-Built Site Survey

An as-built topographic survey was conducted of the area impacted by the dam removal in order to document post-dam removal conditions. The project was completed per the intentions of the 2017 final design plans. As shown in Figure A, the current flow path of Bound Brook has taken one of the three paths anticipated during the design phase. The design relied upon passive restoration (i.e passive sediment transport and natural revegetation that allowed the natural channel processes to determine the final dimensions of the channel management) and as such, the only channel grading required by the design was through the footprint of the former dam/spillway just upstream of the Mordecai Lincoln Road Bridge. Rounded river stone was used to stabilize the brook in this section of channel. The Mordecai Lincoln Mill culvert was repaired, slip-lined, and partially blocked with an operable and maintainable plastic gate structure. All work was performed per the intentions of the design plans.

The as-built survey was conducted in May 2018 to both confirm that the work was completed per the plans and to document the progression of the passive restoration. Based on the as-built survey, the construction did indeed occur per the intentions of the plans. The section through the former dam/spillway, just upstream of the Mordecai Lincoln Road Bridge, shown as Detail 3 on sheet 4 of the Engineering Plan sheets, was depicted in the plans as an approximately 20-feet wide channel, with a depth of 1.5 to 2.0 feet and a channel invert of approximately 6.1-feet. The constructed channel, per the survey, was 22-feet wide, 1.6-feet deep, and has an invert elevation of 6.4-feet (NAVD88).

The as-built survey also documented changes throughout the passive recovery of Bound Brook. Bound Brook through the former impoundment has experienced both deposition and incision with a change of thalweg depth ranging from +1.0-feet (aggradation) to -1.5-feet (degradation). It is important to note that the existing conditions survey was conducted in April 2013 and November 2014. Some changes in the bathymetry of the former impoundment documented by the as-built survey may have occurred due to other forces before the dam was removed.

This as-built survey design included cross-sections that generally coincided with the FEMA FIS cross-section locations (shown in Figure B), allowing for an update of the pre-construction modeling.

Figure A - Anticipated flow paths (blue) compared with post-removal conditions (aerial taken 4/22/2018). The primary flow-path is the eastern-most alignment.

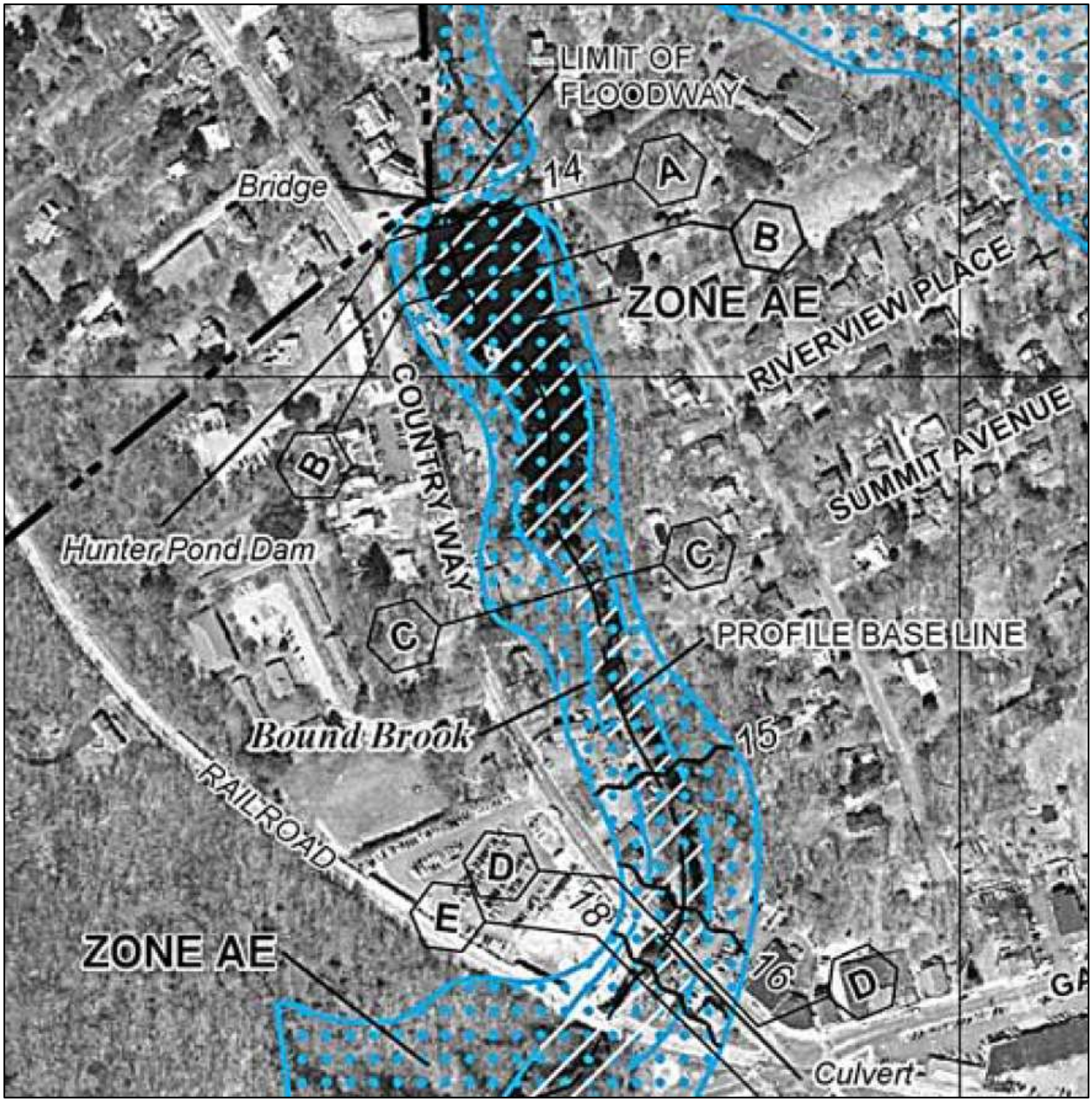

Figure B - Flood Insurance Rate Map (FIRM) for Bound Brook (25023C0106K) - Map Revised November 4, 2016

As-Built Hydrologic & Hydraulic Modeling

Princeton Hydro has previously prepared a HEC-RAS water surface profile model for the Hunters Pond Dam removal utilizing the revised effective FEMA model obtained from STV, Inc. in February 2013 in digital format. That model was part of the CLOMR application to FEMA for the upstream bridge replacements at Country Way and the railroad station. A datum difference existed requiring a conversion from NGVD29 to NAVD88 (-0.8 ft) for use in the design and as-built models. The 2013 FEMA modeling was then revised in March 2015 to add more detail at the dam and up-to-date survey in the reach where Bound Brook enters the Gulf River estuary, near the former confluence of the dam's primary and secondary flow paths, extending throughout the former impoundment to Country Way; and again, in June 2018 to reflect the as-built conditions surveyed as part of this study. Differences between the FIRM model results and the modeling results associated with this project are due to the inclusion of the more detailed survey discussed above and not as a result of a project design or construction change.

In order to address Special Conditions A, B and C of the Town's Corps authorization (NAE-2016-02616), Princeton Hydro modified the existing model geometry utilizing the May 2018 as-built survey and ran the model with the effective FEMA 100-year flood flows and the fixed downstream tidal elevation of 12 (NAVD 88) utilized in the effective Flood Insurance Rate Map (FIRM). The FIRM data is from Flood Insurance Study Number 25023CV001C through 25023CV004C (2016).

The modeling results are shown below in

Table 1 and modeled profiles shown in Figure C. Although the channel bed varies from +1.0 to -1.5 feet, as shown in Figure C, the BFE is lower by a maximum of 0.28-feet and has no increases. Minimal change is observed upstream of Country Way Bridge (0.07-feet decrease) and negligible change downstream of Mordecai Lincoln Road (0.02-feet decrease). Decreases in water surface elevation within the former impoundment range between 0.10-feet and 0.28-feet with an average of 0.16-feet of decrease. These changes in water surface elevation are summarized in

Table 1. All decreases in depth are below the thresholds described in Special Conditions 4A, 4B, and 4C of the Town's Corps authorization.

Based on our analysis, the spillway of Mordecai Lincoln Road Pond Dam has not caused an increase in the BFE profile, has resulted in a maximum decrease of the BFE profile of less than 0.5 foot (actual decrease in BFE is only 0.2 foot), and does not require an alternation to the waterway's existing NFIP Regulated Floodway delineation. Our results therefore confirm that a NIFP flood insurance study change is not necessary, nor required, for this dam removal project and that no further coordination with FEMA should be needed for this completed river restoration project.

Table 1 - Summary of FIRM, Pre-Construction, and As-Built Modeling Results (NAVD88)

Modeled River Station	Profile	FIRM Mapping Results		Project Mapping Results		
		Cross-Section	W.S. Elev (ft)	Pre-Construction W.S. Elev (ft)	As-Built W.S. Elev (ft)	Change in W.S. Elev (ft)
0.332	FEMA 100-yr	E	18.3	17.38	17.36	-0.02
0.318	FEMA 100-yr	-	-	17.35	17.35	0.00
0.304	FEMA 100-yr	-	-	17.13	17.06	-0.07
0.301	Country Way Bridge					
0.298	FEMA 100-yr	D	16.7	15.88	15.78	-0.10
0.293	FEMA 100-yr	-	-	15.82	15.70	-0.12
0.286	FEMA 100-yr	-	-	15.08	14.97	-0.11
0.27	FEMA 100-yr	-	-	14.49	14.37	-0.12
0.24	FEMA 100-yr	-	-	14.43	14.29	-0.14
0.21	FEMA 100-yr	-	-	14.35	14.20	-0.15
0.19	FEMA 100-yr	-	-	14.21	14.03	-0.18
0.169	FEMA 100-yr	C	14.4	14.00	13.72	-0.28
0.151	FEMA 100-yr	-	-	13.92	13.76	-0.16
0.121	FEMA 100-yr	-	-	13.90	13.73	-0.17
0.096	FEMA 100-yr	B	14.3	13.89	13.72	-0.17
0.066	FEMA 100-yr	-	-	13.88	13.72	-0.16
0.05	FEMA 100-yr	A	14.2	13.88	13.71	-0.17
0.044	FEMA 100-yr	-	-	13.87	13.71	-0.16
0.0435	FEMA 100-yr	-	-	13.87	13.71	-0.16
0.043	Mordecai Lincoln Road Dam					
0.042	FEMA 100-yr	-	-	13.47	13.31	-0.16
0.04	Mordecai Lincoln Road					
0.038	FEMA 100-yr	-	-	11.72	11.70	-0.02
0.036	FEMA 100-yr	-	-	11.91	11.89	-0.02
0.029	FEMA 100-yr	-	-	12.01	12.01	0.00
0.026	FEMA 100-yr	-	-	12.01	12.01	0.00
0.022	FEMA 100-yr	-	-	12.01	12.01	0.00
0.015	FEMA 100-yr	-	-	12.01	12.01	0.00
0.006	FEMA 100-yr	-	-	12.00	12.00	0.00
0	FEMA 100-yr	-	-	12.00	12.00	0.00

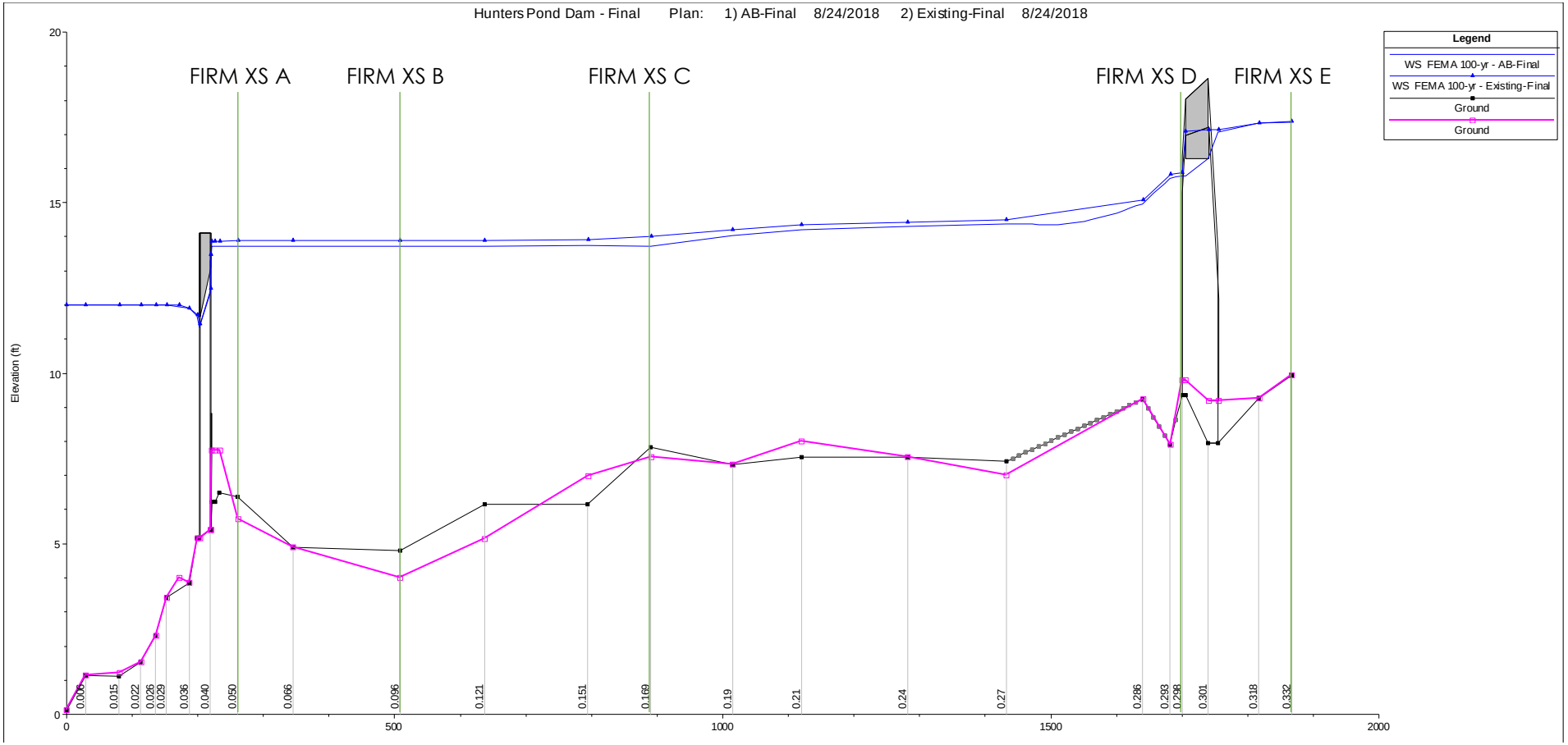

Figure C - Modeled profiles comparing pre-construction conditions and as-built conditions. Datum NAVD88