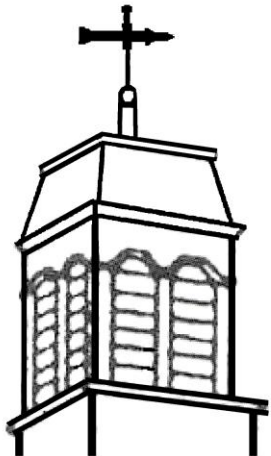


Sawyer's Mill Dams Removal Feasibility Study

Mill Owner:
Sawyer's Mill Associates, Inc.

1 Mill Street, Dover, NH
MARCH 3, 2014



SAWYER MILL
APARTMENTS



WATERFRONT
ENGINEERS LLC



HAIGHT ENGINEERING, PLLC
CIVIL ENGINEERS
P.O. BOX 1166, 181 WATSON ROAD
DOVER, NEW HAMPSHIRE
603.750.4266. FAX 603.749.7348

Truslow
RESOURCE CONSULTING LLC

Funding for this phase of the project is supported in part by the Gulf of Maine Council on the Marine Environment and the National Oceanic and Atmospheric Administration (NOAA) Award #NA10NMF4630084 and from Sawyer's Mill Associates, Inc.

The lead federal agency is the National Oceanic and Atmospheric Administration.

Project input was provided by:

National Oceanic and Atmospheric Administration, Restoration Center

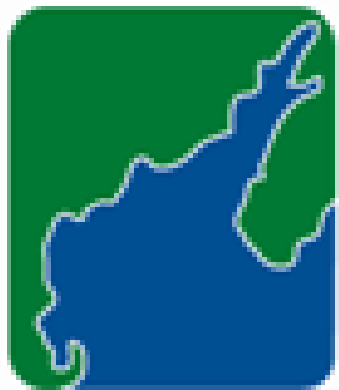
US Fish & Wildlife Service

NH Dept. of Environmental Services, Coastal Program

NH Dept. of Environmental Services, Dam Bureau

NH Fish & Game Department

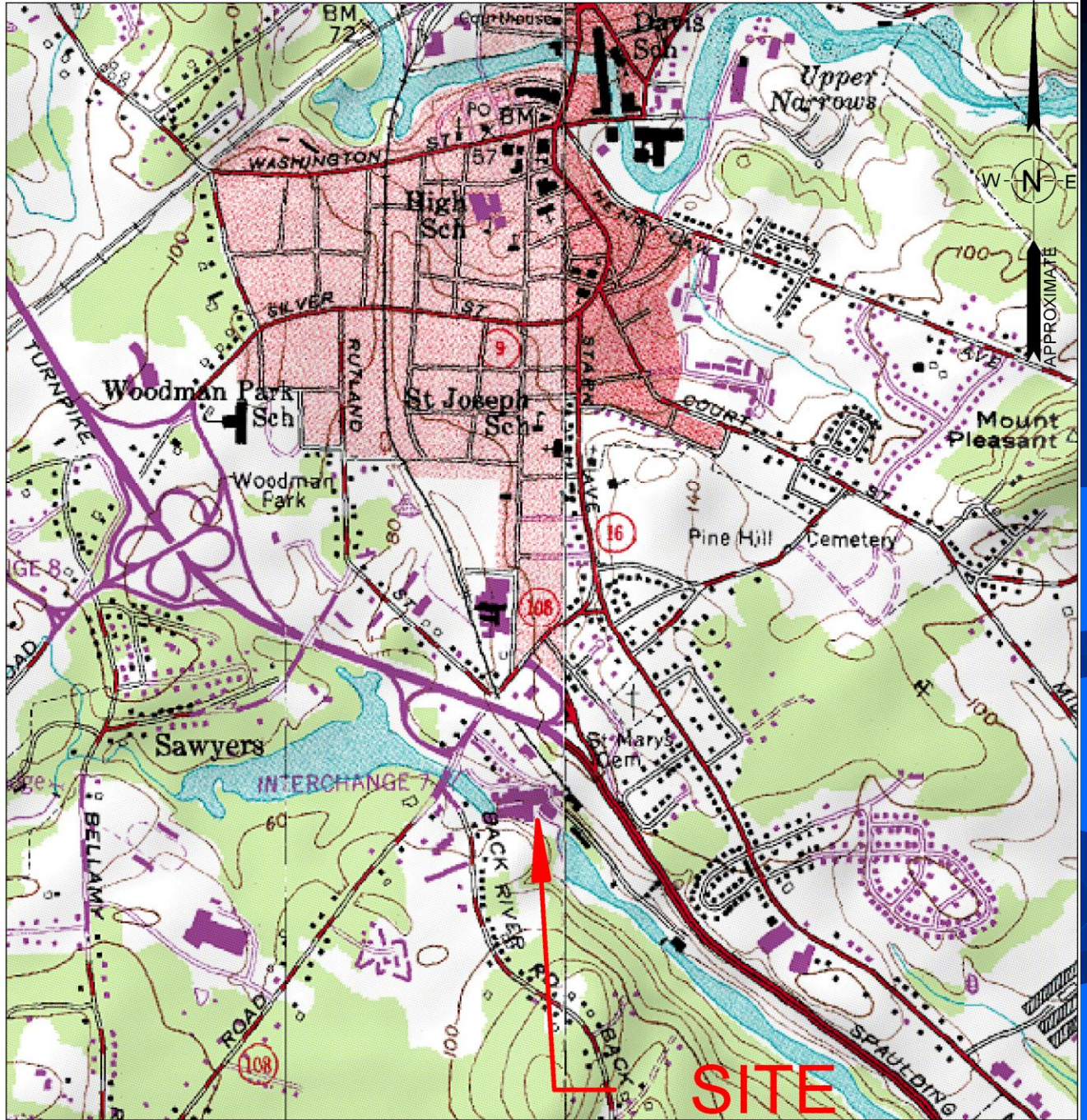
University of New Hampshire, Piscataqua Region Estuaries Partnership



**Gulf of Maine
Council on the
Marine Environment**

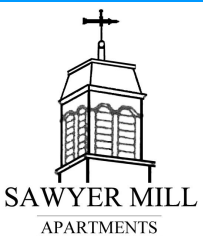


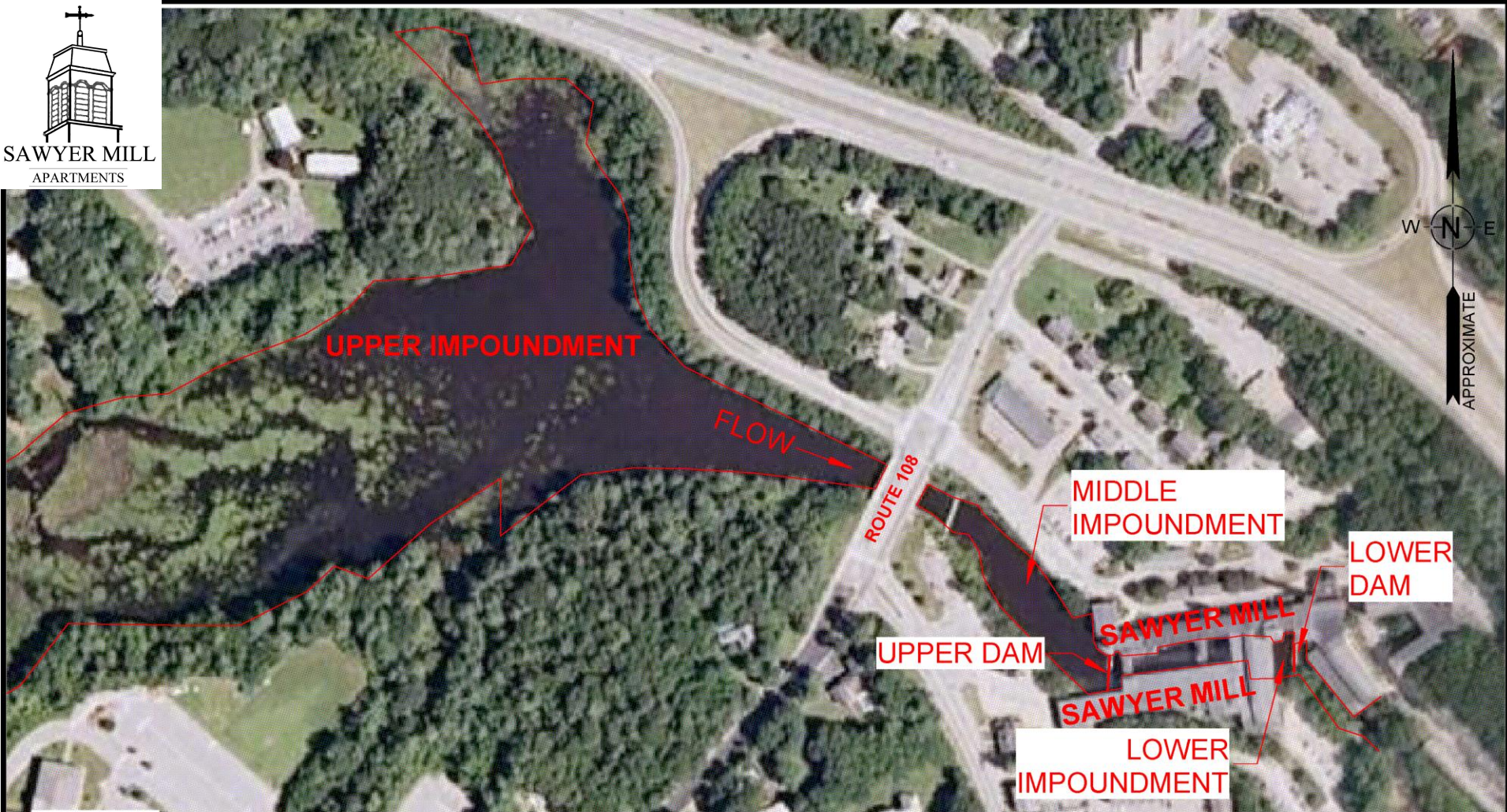
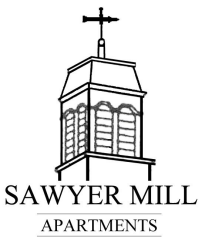
PROJECT LOCATION



NOT TO SCALE

VICINITY MAP





**WATERFRONT ENGINEERS
LLC**

3 LINDA LANE
STRATHAM, NH 03885
(603) 772-3706

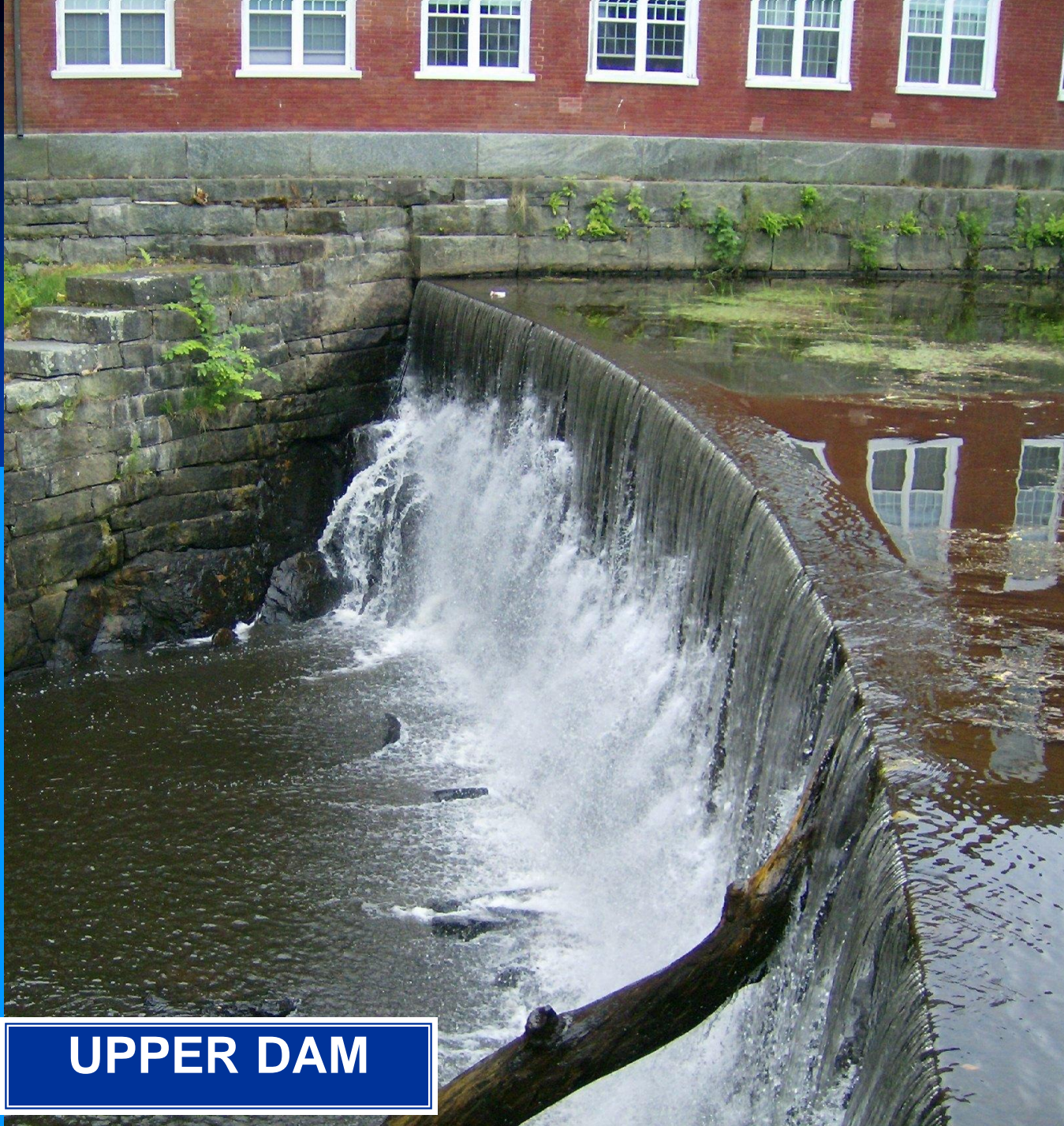
NOT TO SCALE

**SAWYER MILL
DAM REMOVALS**

DOVER
NEW HAMPSHIRE

VICINITY PLAN

STRAFFORD COUNTY
BELLAMY RIVER



UPPER DAM





LOWER DAM

HOW DID THIS PROJECT DEVELOP?

December 2009:

NH DES Dam Bureau Letter of Deficiency requiring both dams to pass 250% of the 100 year flood, dam breach analyses and repair bank erosion at lower dam

June 2010:

Alternative approaches investigated: dam lowering or dam removal

Summer/Fall 2010:

Meetings with agencies on dam removal funding opportunities

Winter 2010:

Lower dam bank erosion repair with riprap

April 2013:

Dams removal feasibility study begins

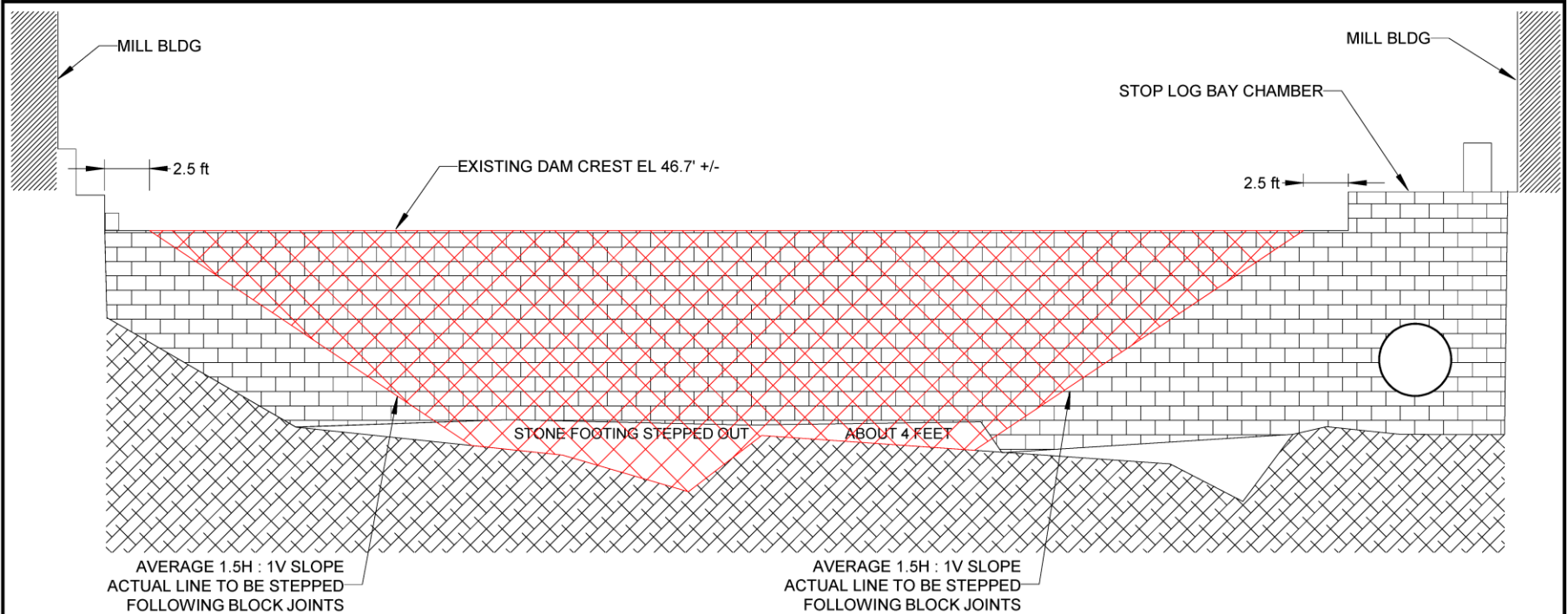


GOALS

- Resolve NH DES dam safety deficiencies by dam removals sufficient to eliminate them from Dam Bureau jurisdiction
- Modify dams to reduce flooding
- Modify/remove dams to eliminate man-made barrier to fish passage
- Remove dams to restore river function, including sediment and nutrient transport, water quality and aquatic organism passage



UPPER DAM REMOVAL CONCEPT




NOTES:

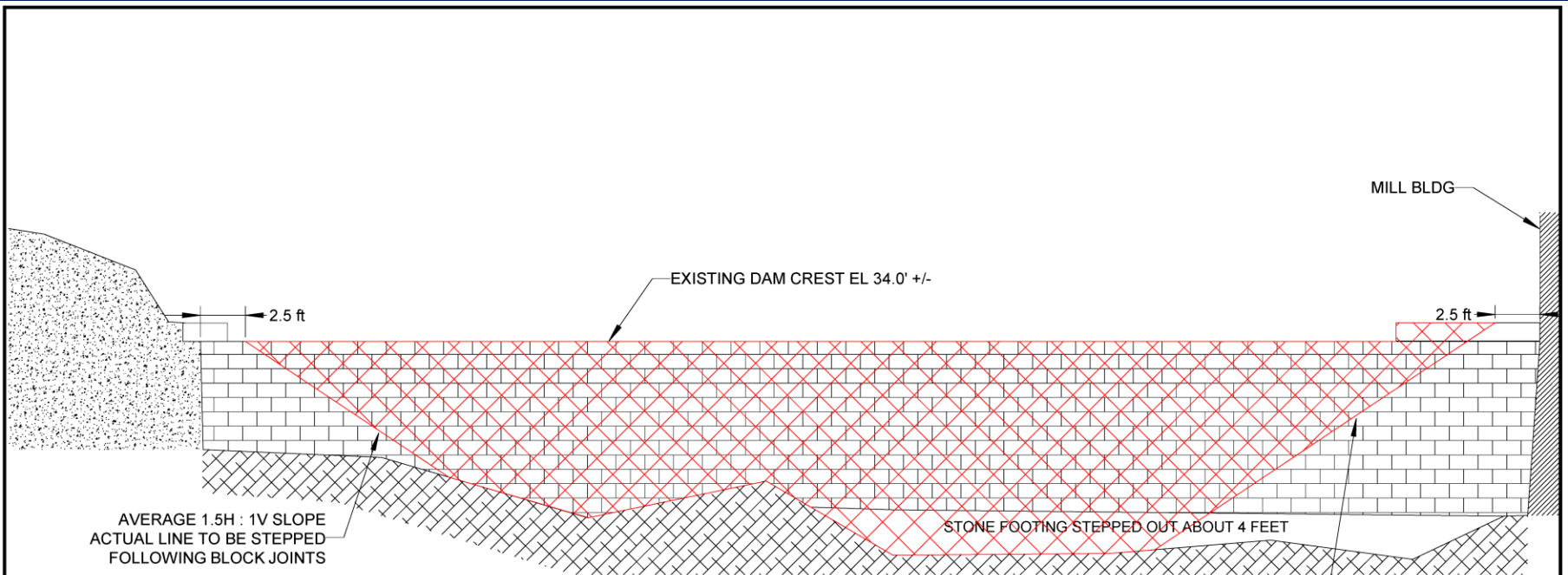
1. DAM ELEVATION DEVELOPED FROM SPOT ELEVATIONS BY DAVID W. VINCENT, LLS LAND SURVEYING SERVICES IN DRAWING "EXISTING CONDITIONS PLAN" DATED DEC. 23, 2014. ELEVATIONS ARE IN FEET RELATIVE TO NAVD88 DATUM.
2. EXISTING DAM HORIZONTAL/VERTICAL HATCH IS NOT MEANT TO REPRESENT ACTUAL STONE BLOCKS, WHICH VARY IN SIZE AND DIMENSIONS.
3. REMOVAL AREA HATCH IS THE DIAGONAL HATCH. SOME STONE BLOCKS MAY NEED TO BE SPLIT TO DEVELOP THE END CUT AVERAGE SLOPES, HOWEVER IT IS EXPECTED THAT BLOCK REMOVALS CAN APPROXIMATE THESE END SLOPE WITH MINIMAL BLOCK SPLITTING. THE FINISH END SLOPES WILL BE STEPPED, NOT DIAGONALLY CUT. REMOVAL AREA SHOWN BELOW DAM CREST IS APPROXIMATELY 565 SF.



UPPER DAM ELEVATION

<p>WATERFRONT ENGINEERS LLC</p>  <p>3 LINDA LANE STRATHAM, NH 03885 (603) 772-3706 www.waterfrontengineers.com</p>	<p>SAWYER MILL DAM REMOVAL FEASIBILITY STUDY</p> <p>DOVER, NH STRAFFORD COUNTY BELLAMY RIVER</p>	<p>OWNER: SAWYER MILL ASSOCIATES, INC</p>
		<p>JAN. 17, 2014 FIGURE VIII - 1</p>

LOWER DAM REMOVAL CONCEPT




NOTES:

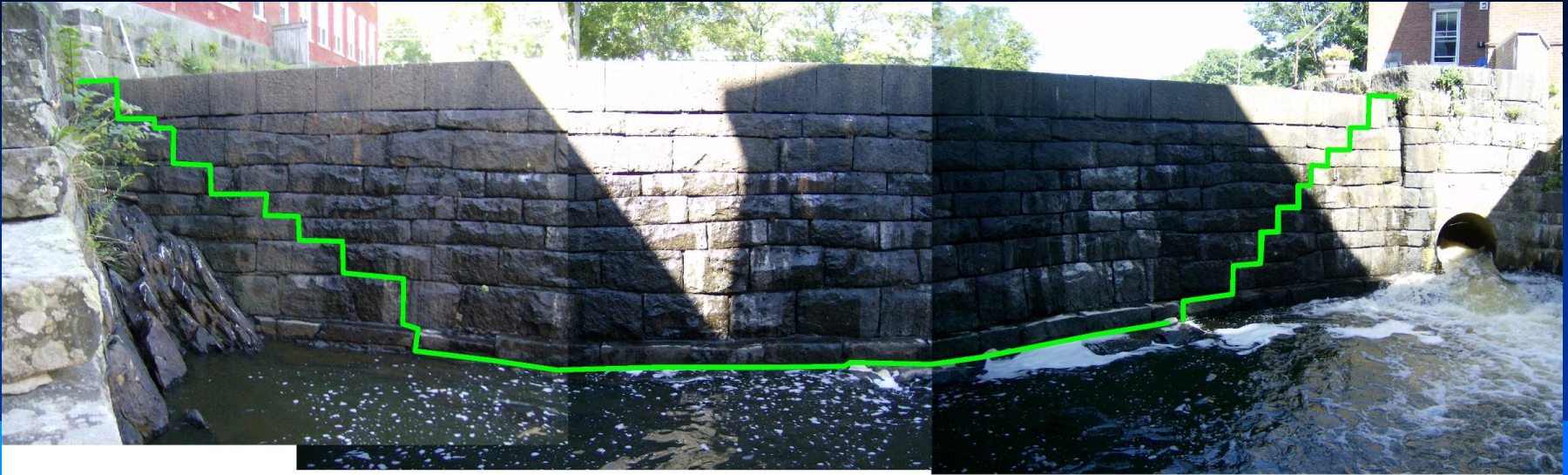
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LOWER DAM ELEVATION

 WATERFRONT ENGINEERS LLC 3 LINDA LANE STRATHAM, NH 03885 (603) 772-3706 www.waterfrontengineers.com	SAWYER MILL DAM REMOVAL FEASIBILITY STUDY DOVER, NH STRAFFORD COUNTY BELLAMY RIVER	OWNER: SAWYER MILL ASSOCIATES, INC
		JAN. 17, 2014 FIGURE VIII - 2

DAM REMOVAL VISUALIZATIONS



NOT TO SCALE

SAWYER MILL UPPER DAM REMOVAL CONCEPT
PORTION OF DAM ABOVE THE LINE PROPOSED FOR REMOVAL

JAN 17, 2014



NOT TO SCALE

SAWYER MILL LOWER DAM REMOVAL CONCEPT
PORTION OF DAM ABOVE THE LINE PROPOSED FOR REMOVAL

JAN 17, 2014

DAM SAFETY & DAM REMOVAL CRITERIA

- Dams currently classified as “High Hazard Potential” due to proximity of the occupied mill buildings
- High Hazard Potential Dams are now required to pass 250% of the 100 year flood with at least 1 foot of freeboard. Sawyer’s Mill dams cannot meet this requirement
- The remains of the dam between the ordinary high water marks on both sides of the river will not create a safety hazard to the public when using the river;
- The natural flow of sediment and nutrients will not be impeded; and the passage of fish and other aquatic species will not be impeded.



HYDROLOGY & HYDRAULICS

Hydrology:

How much water is flowing down the river?

- Flow Recurrence Interval: 2-year, 50-year, 100-year, etc.
- Flow amount: Cubic feet of water per second
- Dependent on rainfall
- Dependent on water removed by users
- Dependent on discharge from upstream dams

Watershed modeled for this study using Hydrocad software

Hydraulics:

What is the depth and velocity of the river at areas of interest?

- Varies depending on cross section, river slope, channel roughness and volume of water

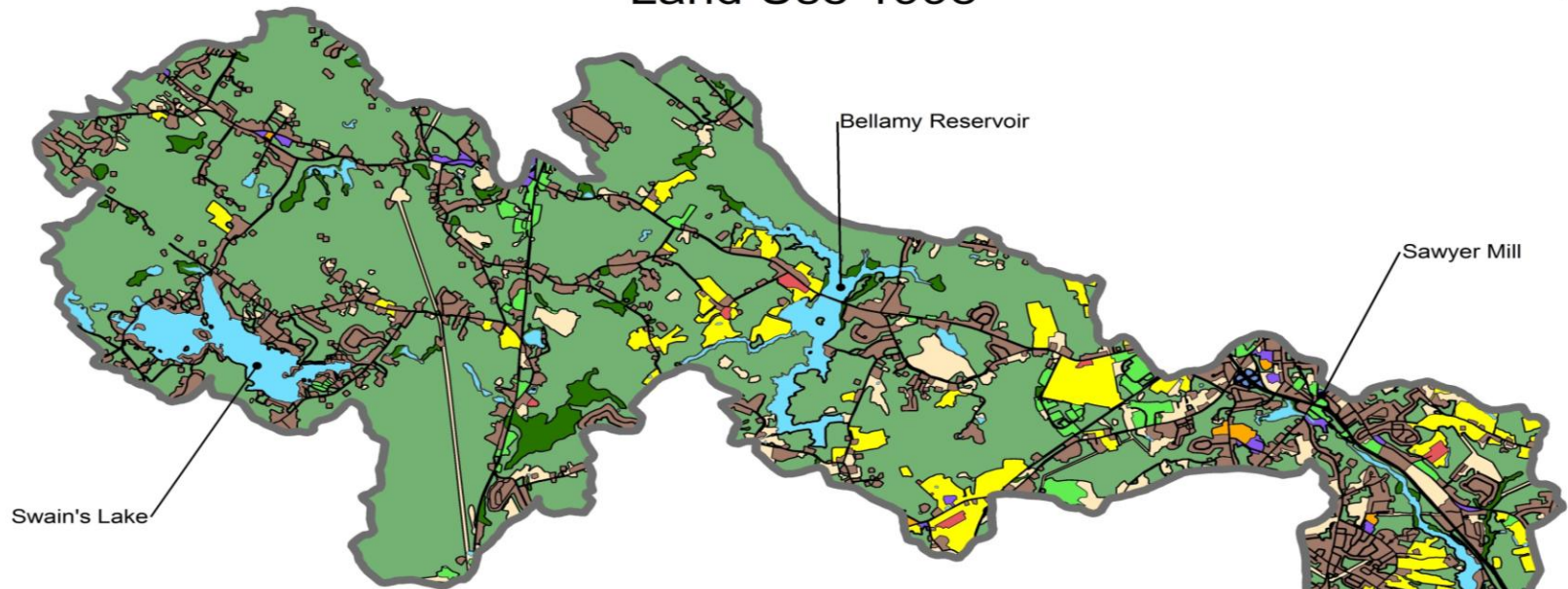
How will the river hydraulics change after the dams are removed?

River stretches modeled for this study using HEC-RAS software



BELLAMY WATERSHED LAND USE

Bellamy River Watershed Land Use 1998

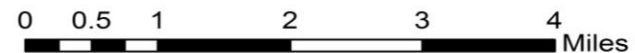


Legend

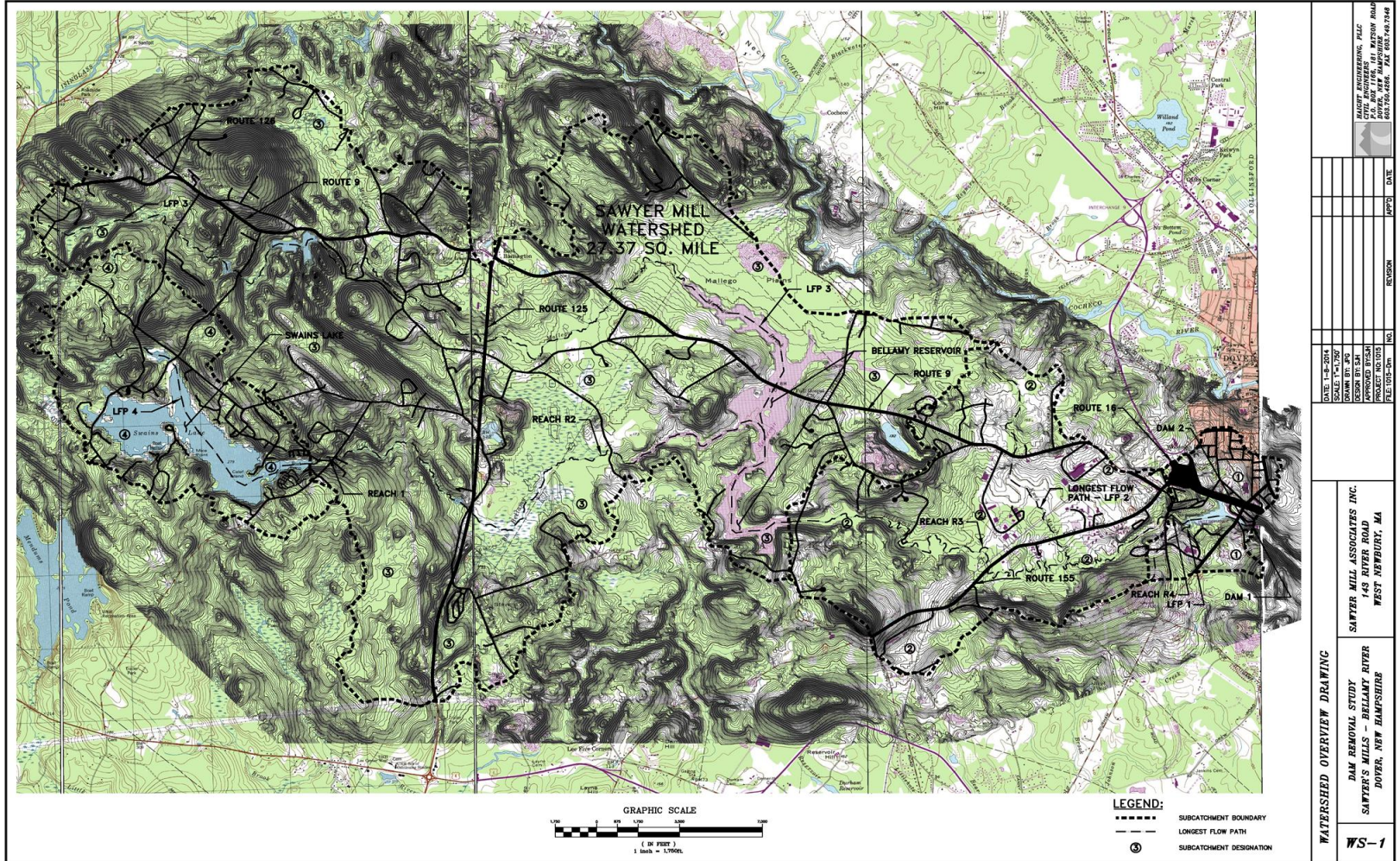
Bellamy River Watershed	Playing Fields/ Recreational
Residential Areas	Agriculture
Industrial/Commercial	Farmstead
Mixed Urban	Forested
Impervious Roads	Open Water
Gravel and Railroad ROW Areas	Open Wetlands
Highway Medians	Cemetary

Sawyer Mill Dam Removal Feasibility Study
Truslow Resource Consulting LLC
January 2014

Data Source:
NH Granit



27.37 SQ. MILE BELLAMY WATERSHED



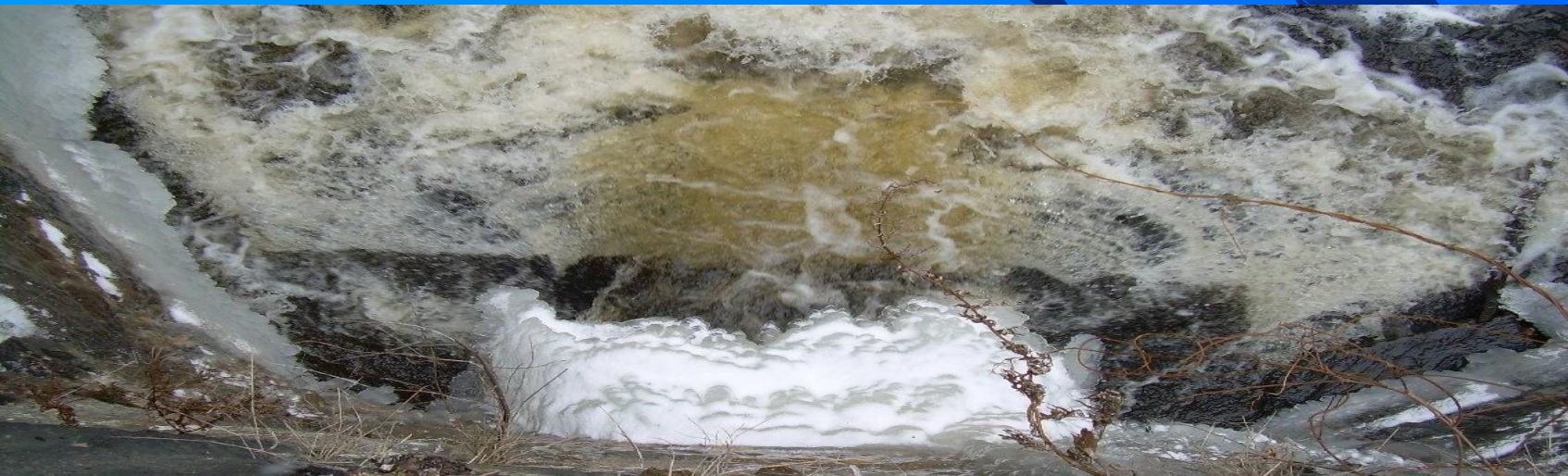
HYDROLOGY

SCS & NRCC Model Comparison

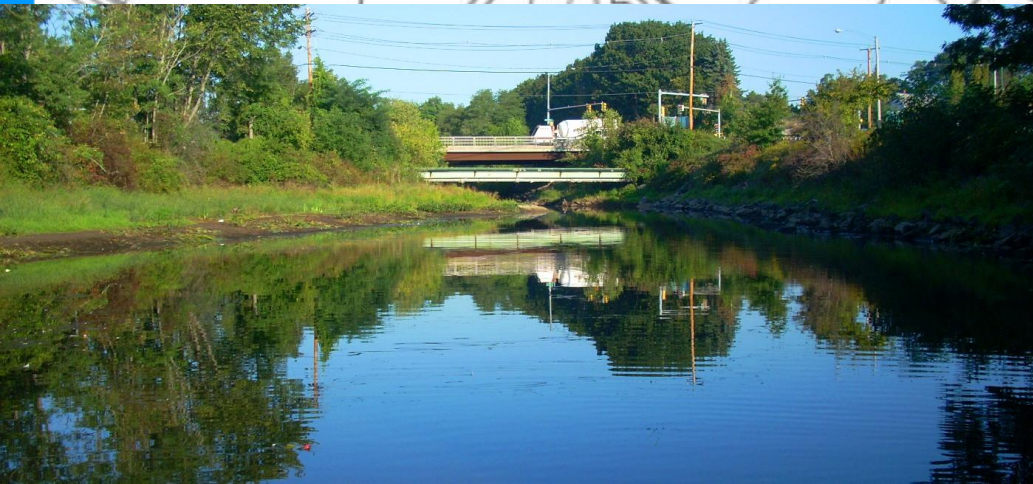
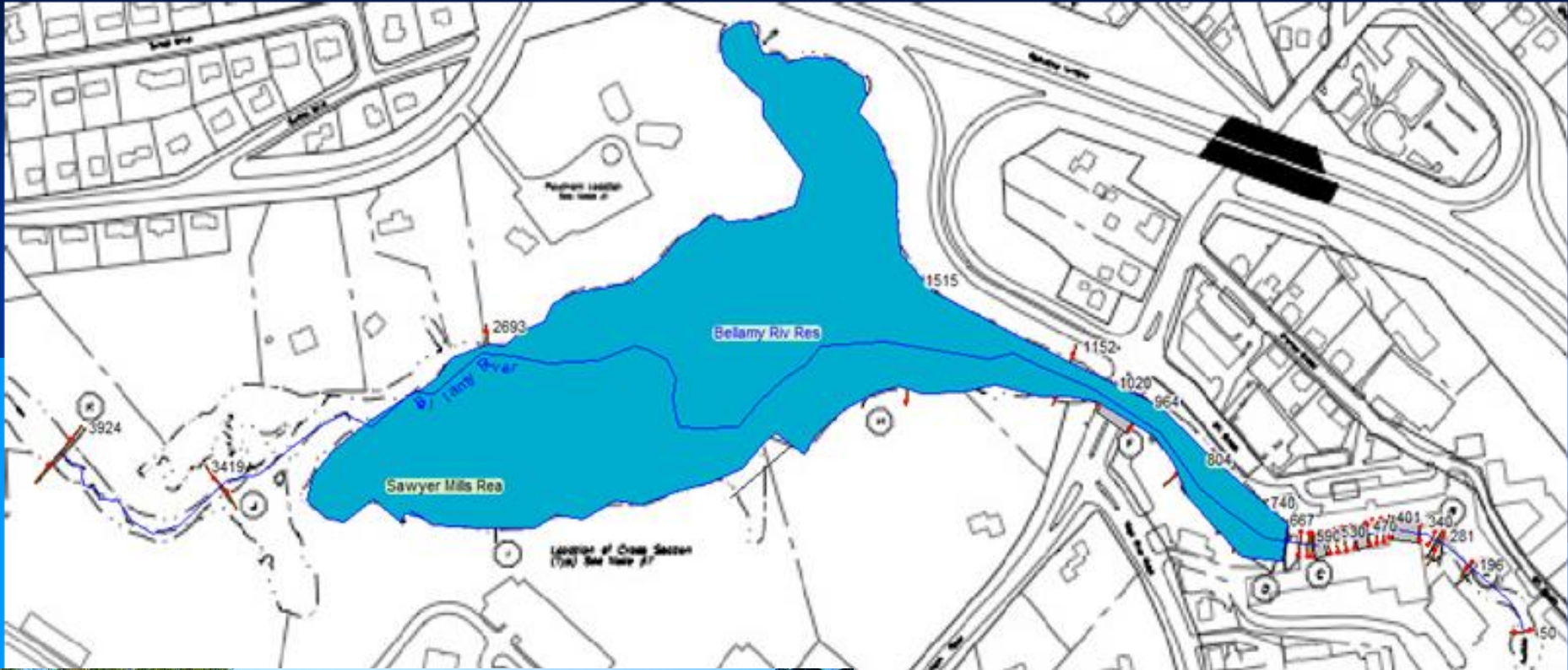
Historically the SCS Model has been utilized in accurately modeling rainfall runoff. The model includes rainfall distribution and localized precipitation data that has not been updated since 1966 and 1977.

Recent precipitation analysis indicates that rainfall extremes as well as storm frequency have changed significantly over the past 35 - 45 years. The NRCC Model incorporates the recent precipitation and frequency data updates and creates a model that is better suited to current and local climate conditions.

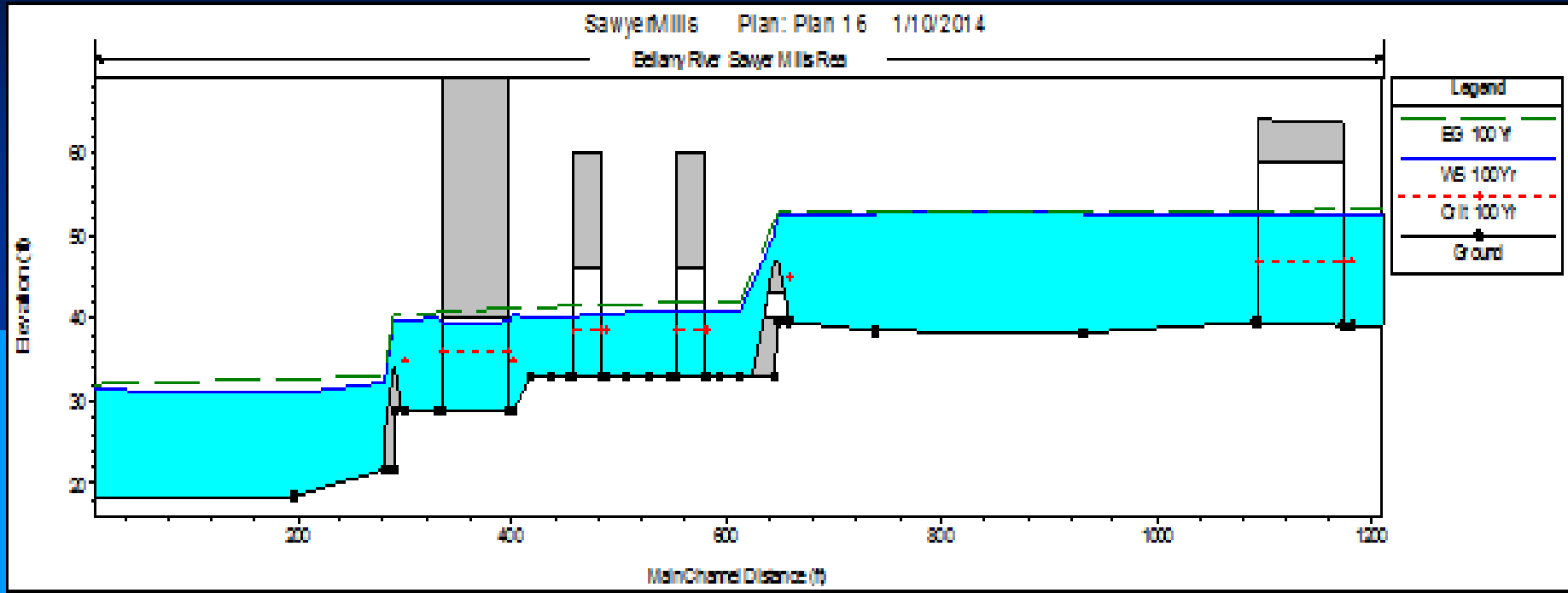
Point Of Discharge	Peak Discharge (cfs)				
	2-yr	10-yr	25-yr	50-yr	100-yr
SCS Upper Dam	314	747	1,060	1,223	1,476
NRCC Upper Dam	273	725	1,112	1,878	2,942



HYDRAULICS

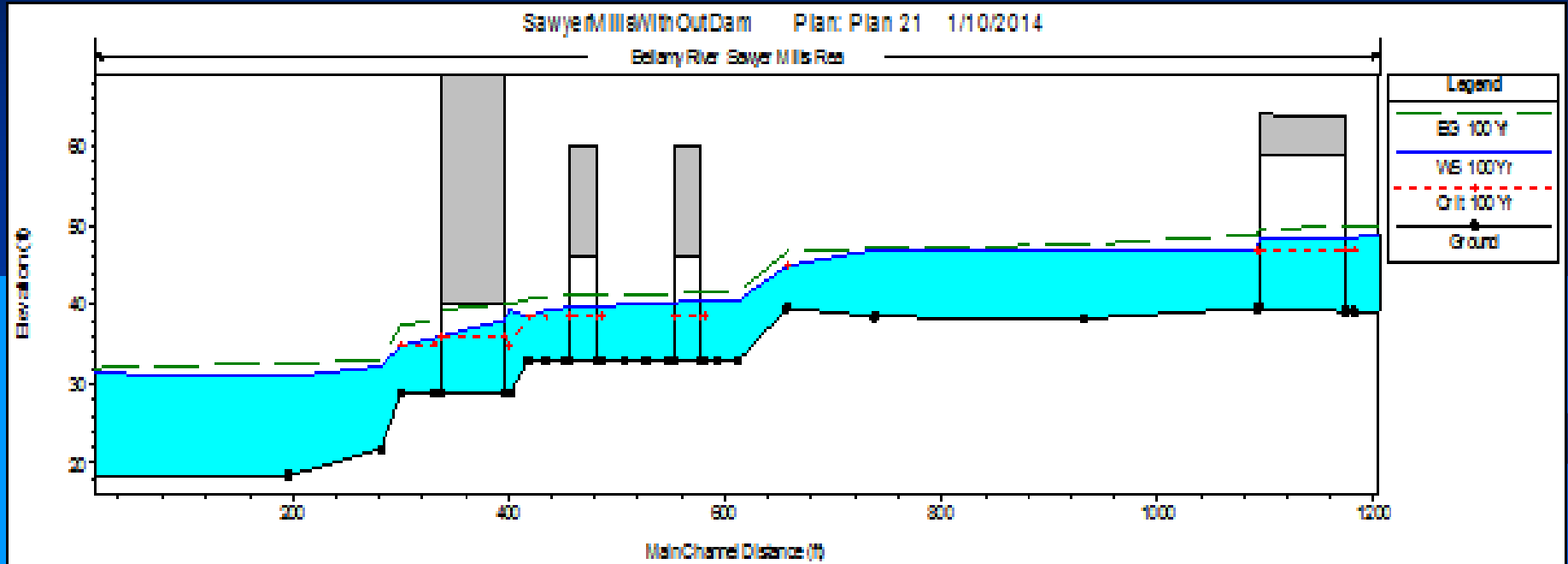


WATER SURFACE ELEVATION WITH DAM'S IN PLACE



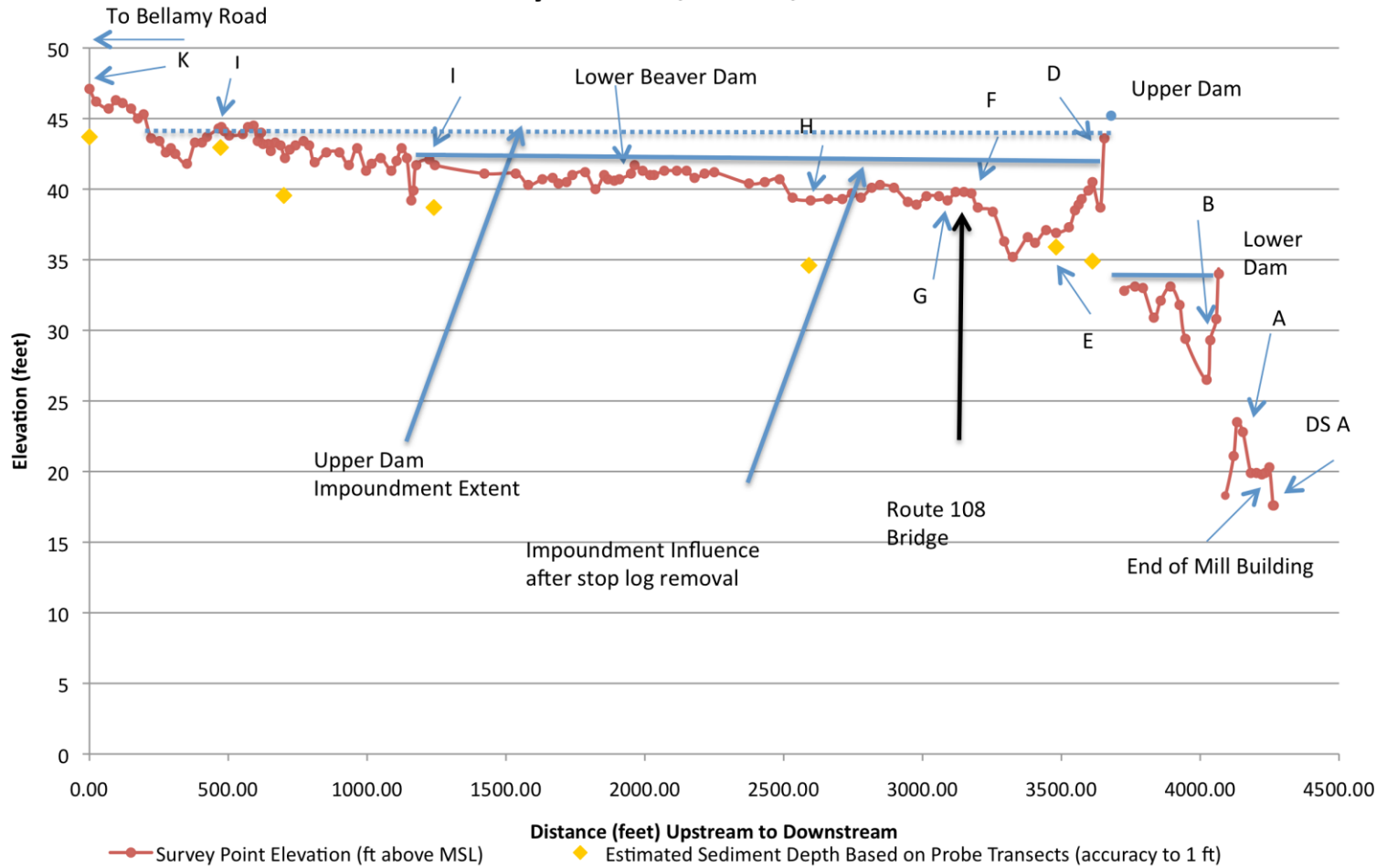
Point Of Analysis	Peak Elevation (ft)				
	2-yr	10-yr	25-yr	50-yr	100-yr
SCS Upper Dam	48	49	49.5	50	50.3
NRCS Upper Dam	48	49	50	51	53

WATER SURFACE WITH DAM'S REMOVED



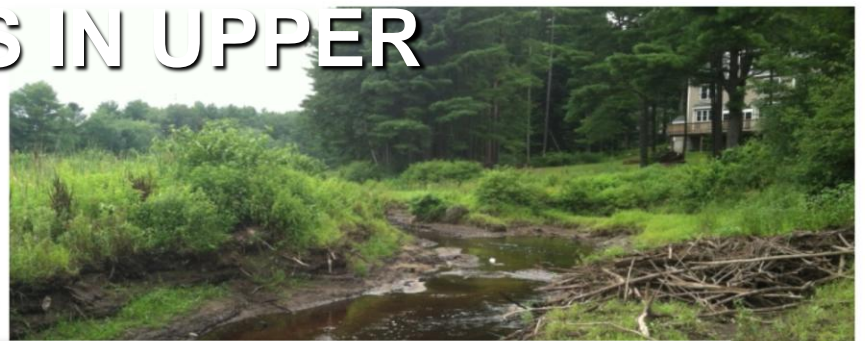
Point Of Analysis	Peak Elevation (ft)				
	2-yr	10-yr	25-yr	50-yr	100-yr
SCS Upper Dam	43	43	43	43	43.5
NRCS Upper Dam	42	43	43	44	45

Overall Longitudinal Profile Showing Cross Section Locations Sawyer's Mill, Dover, NH

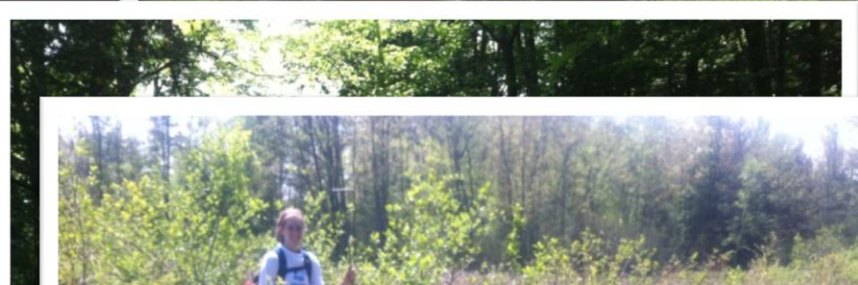


EXISTING CONDITIONS IN UPPER

IMPOUNDMENT



Sediment Bar, looking DS towards R 108 Bridge and XS-H (August 2013)

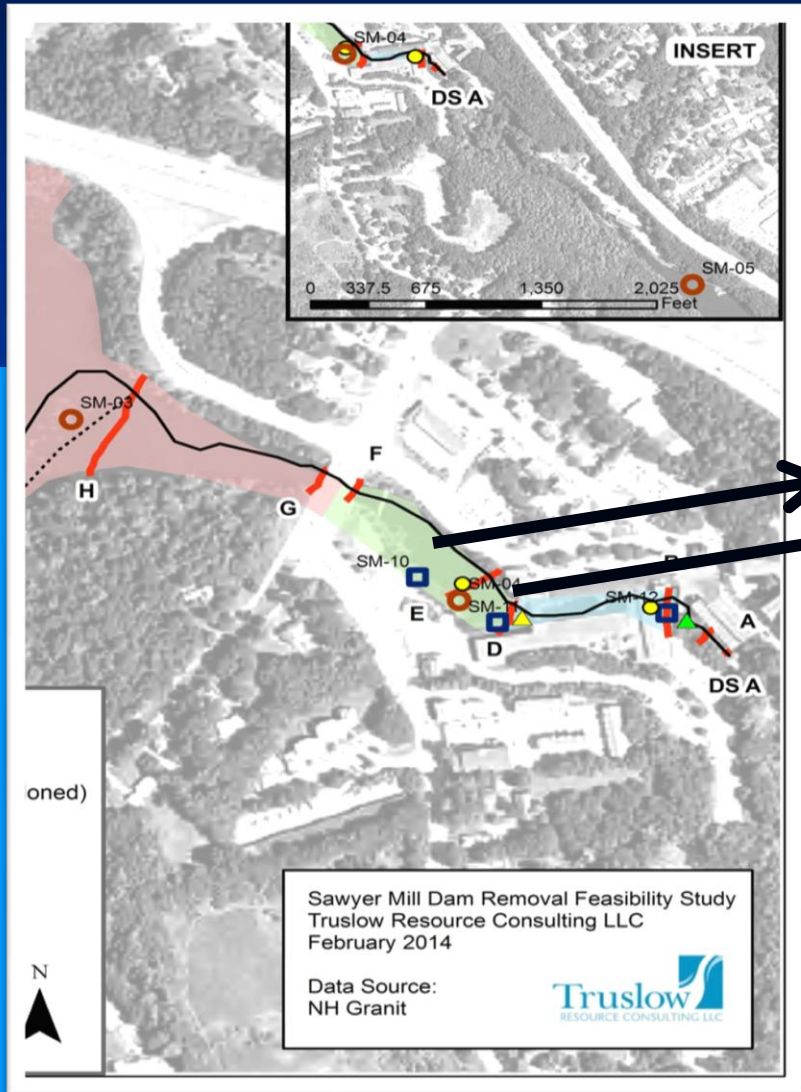


Bank erosion and downcutting (May 2013)

Looking US at XS-K and site of upstream discharge measurements (April 2013)

July 2013)

EXISTING CONDITIONS IN MIDDLE IMPOUNDMENT

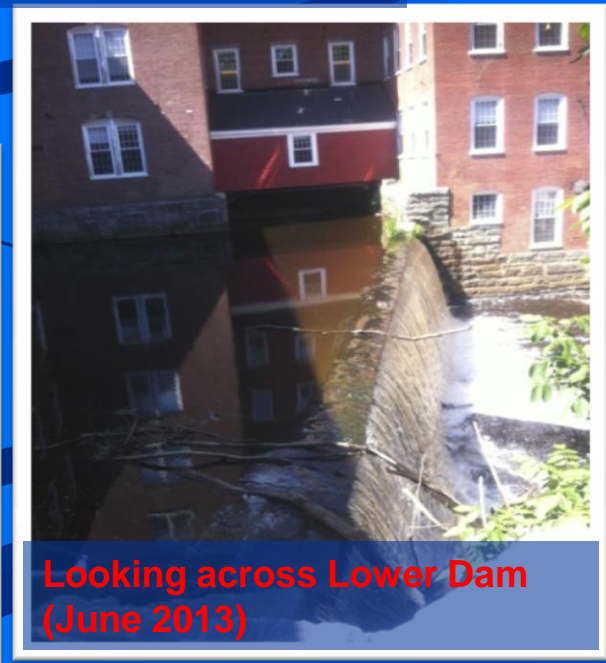
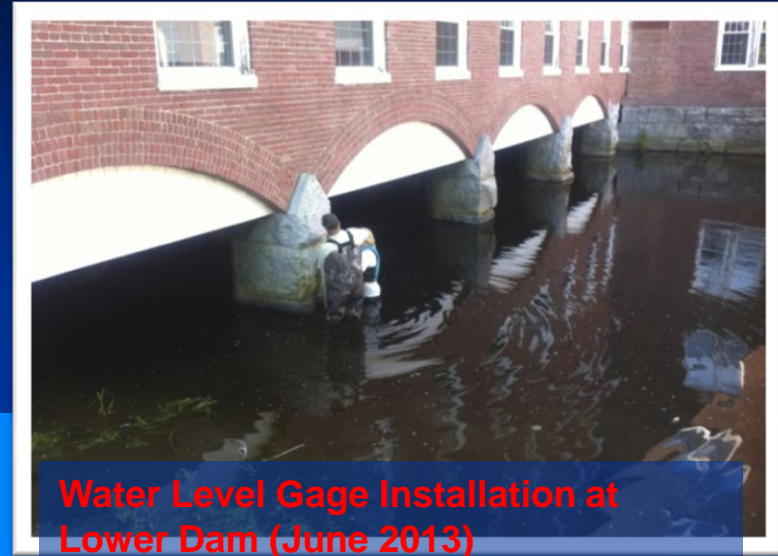
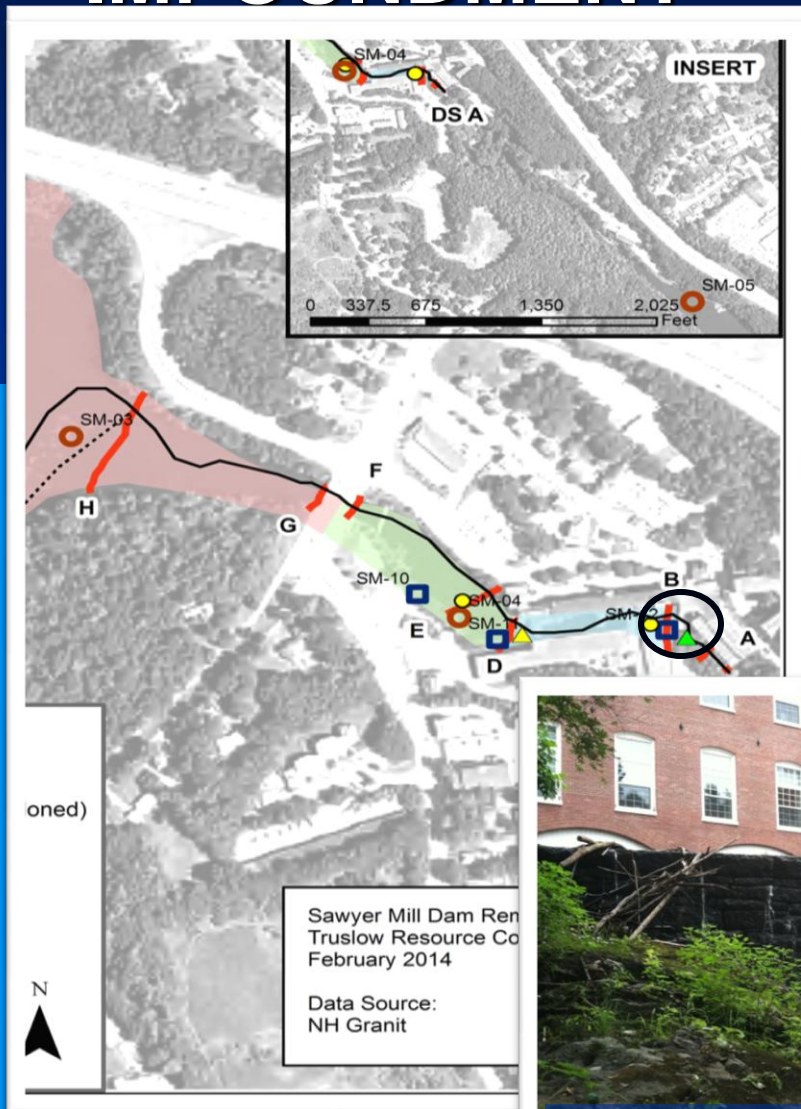


Middle Impoundment, looking US towards Rt. 108 Bridge (May 2013)

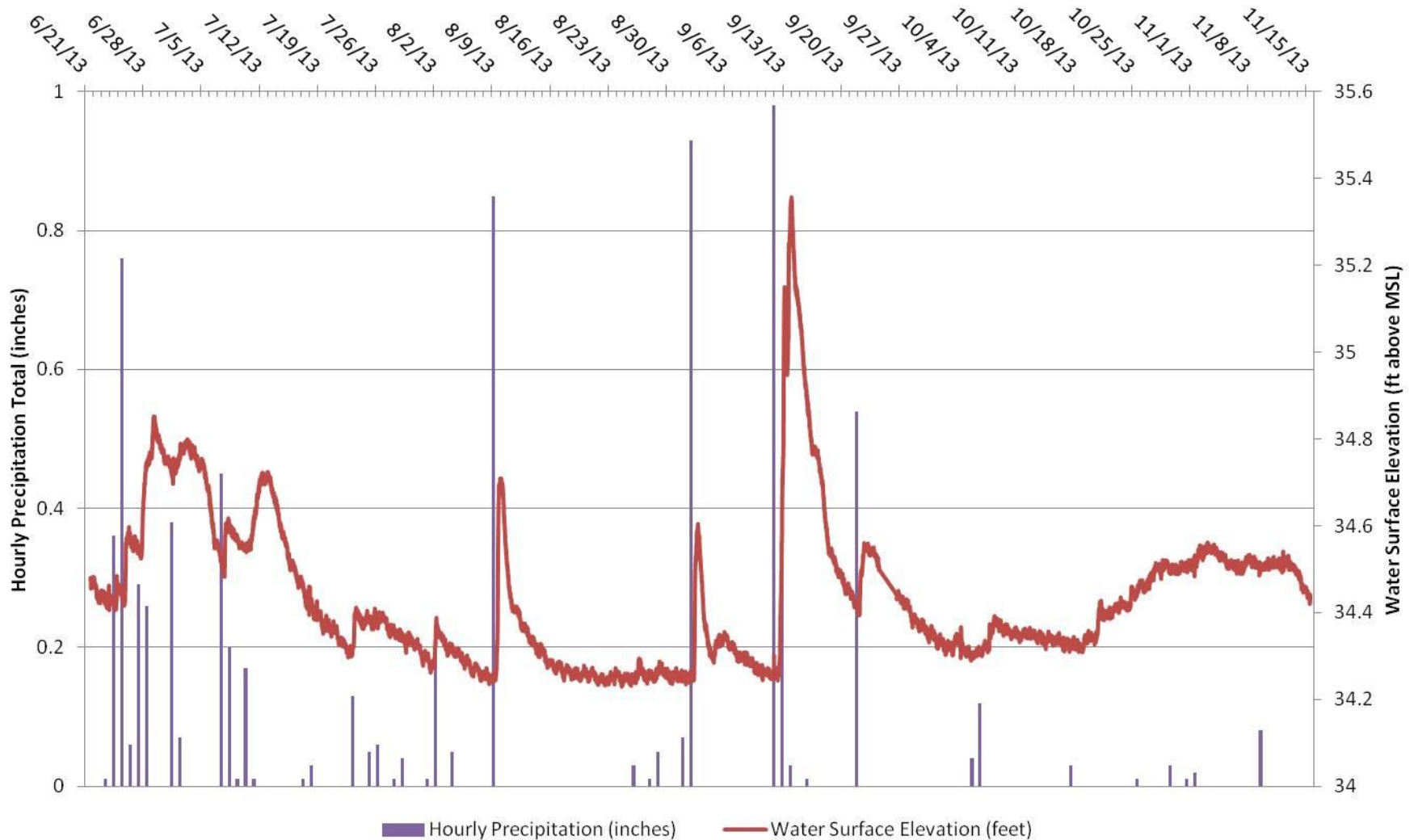


Middle Impoundment low water- sediment bar (August 2013)

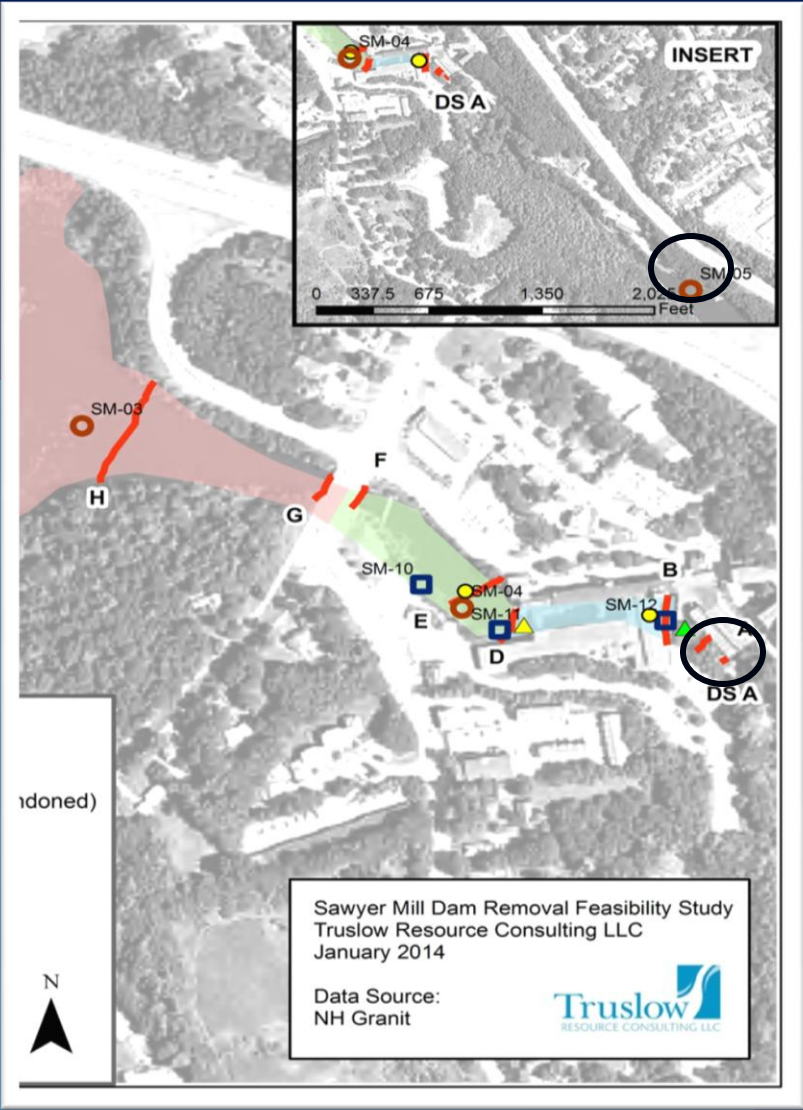
EXISTING CONDITIONS IN LOWER IMPOUNDMENT



Water Surface Elevation and Precipitation at Sawyer Mill Lower Dam June 21 to November 15, 2013

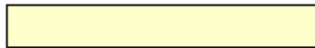


EXISTING CONDITIONS BELOW LOWER DAM



SEDIMENT QUALITY ASSESSMENT

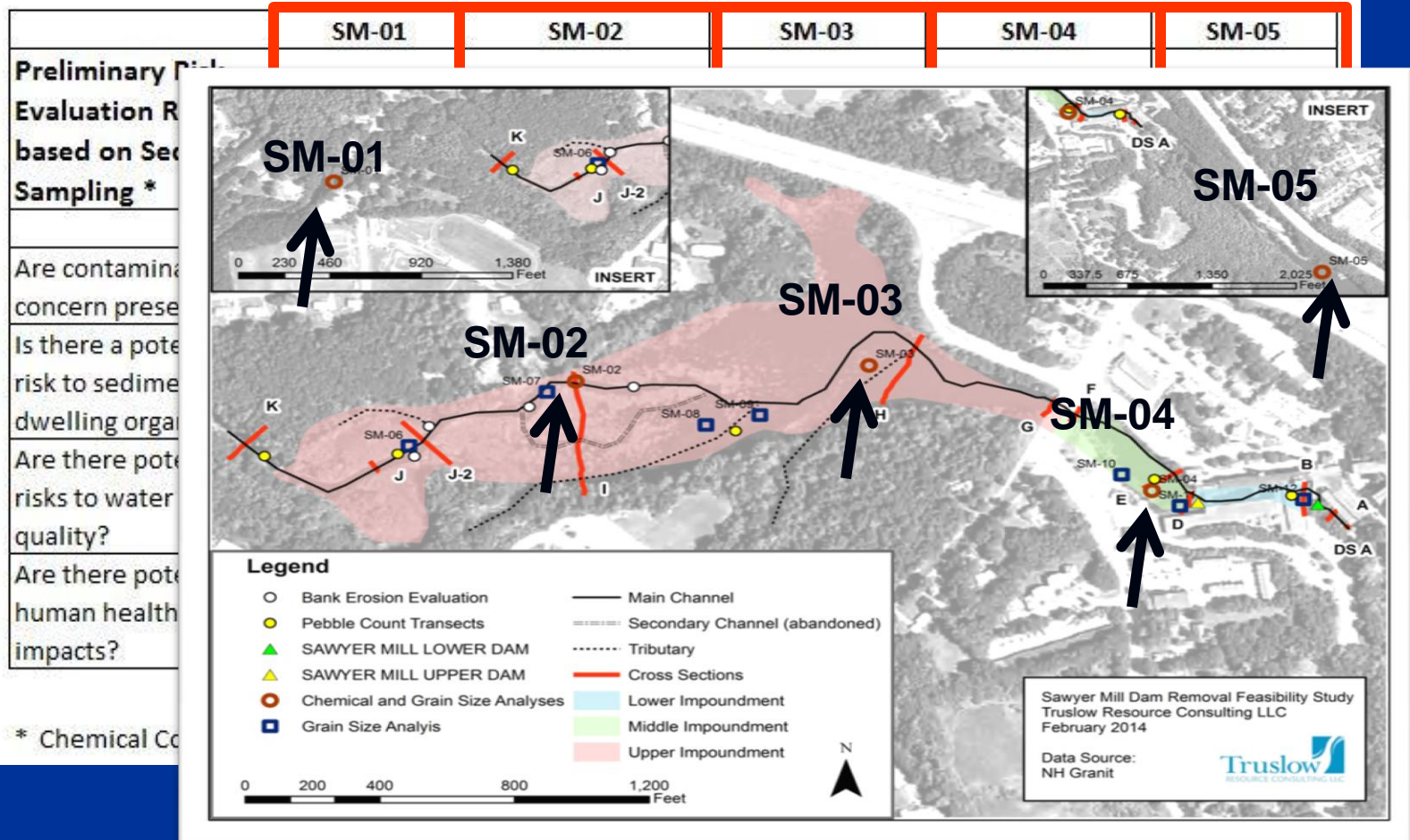
CHEMICAL PARAMETER GROUP TESTED	SM-01	SM-02	SM-03	SM-04	SM-05
	Upstream of Bellamy Road	River Bottom - Upper Impoundment	Sediment Bar - Upper Impoundment	Riverbank near Upper Dam	Bellamy River - tidal area
Volatile Organic Compounds	Sampled			Sampled	
Polyaromatic Hydrocarbons	Sampled	Sampled	Sampled	Sampled	Sampled
Pesticides	Sampled	Sampled	Sampled	Sampled	Sampled
PCBs	Sampled	Sampled	Sampled	Sampled	Sampled
Heavy Metals	Sampled	Sampled	Sampled	Sampled	Sampled



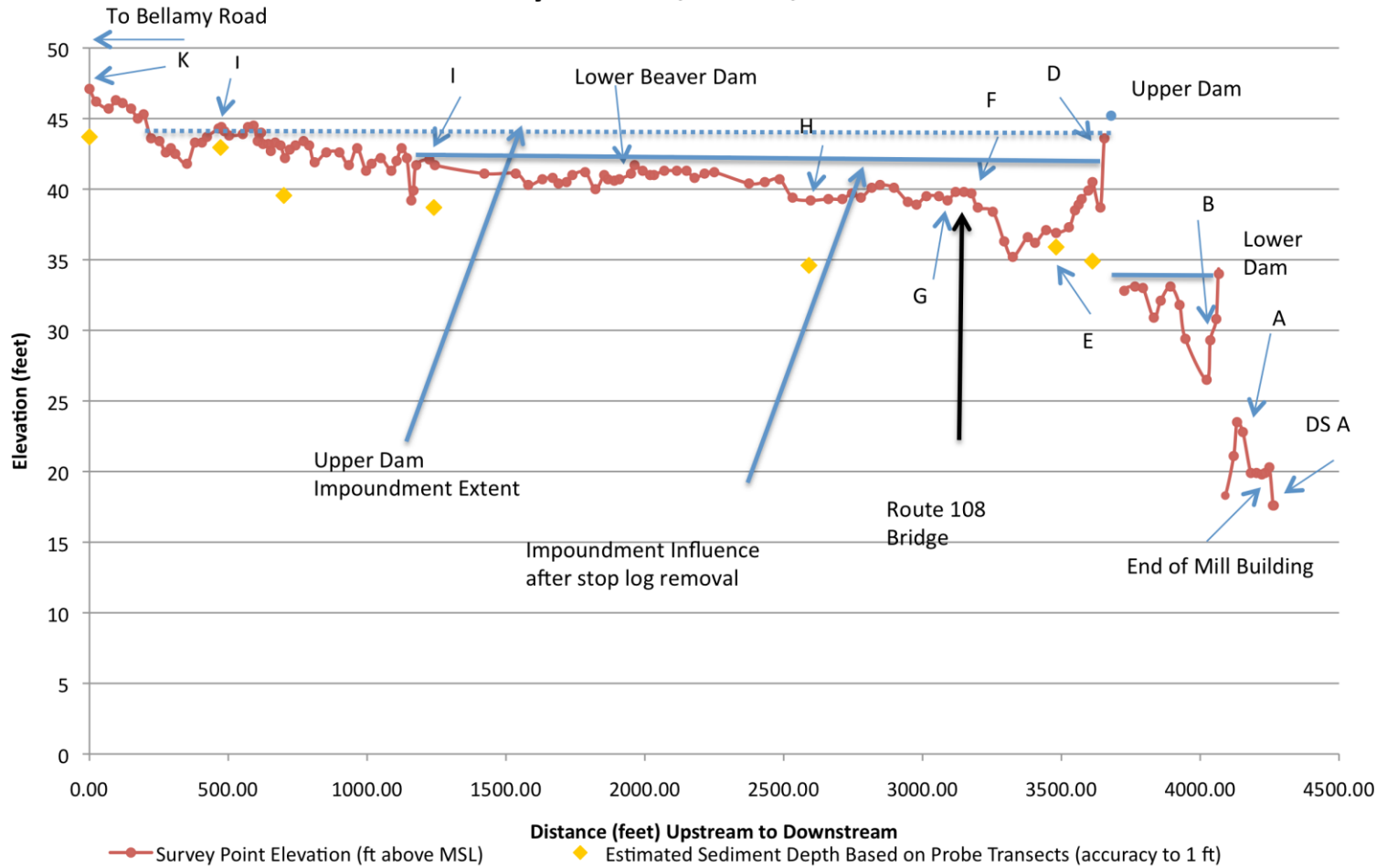
Indicates some constituents above NHDES risk factors

SEDIMENT QUALITY ASSESSMENT

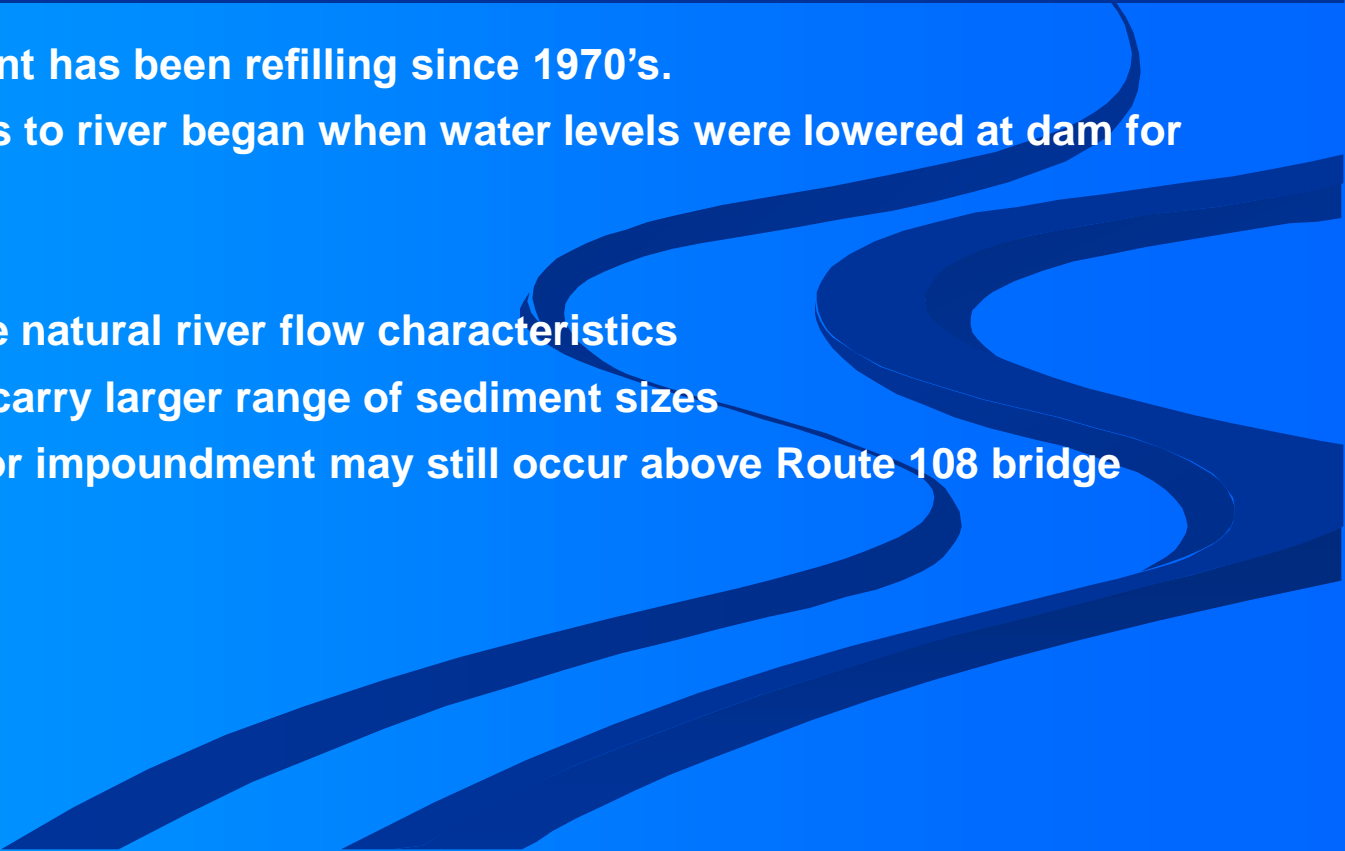
PRELIMINARY ENVIRONMENTAL RISK RESULTS - LIMITED SEDIMENT SAMPLING



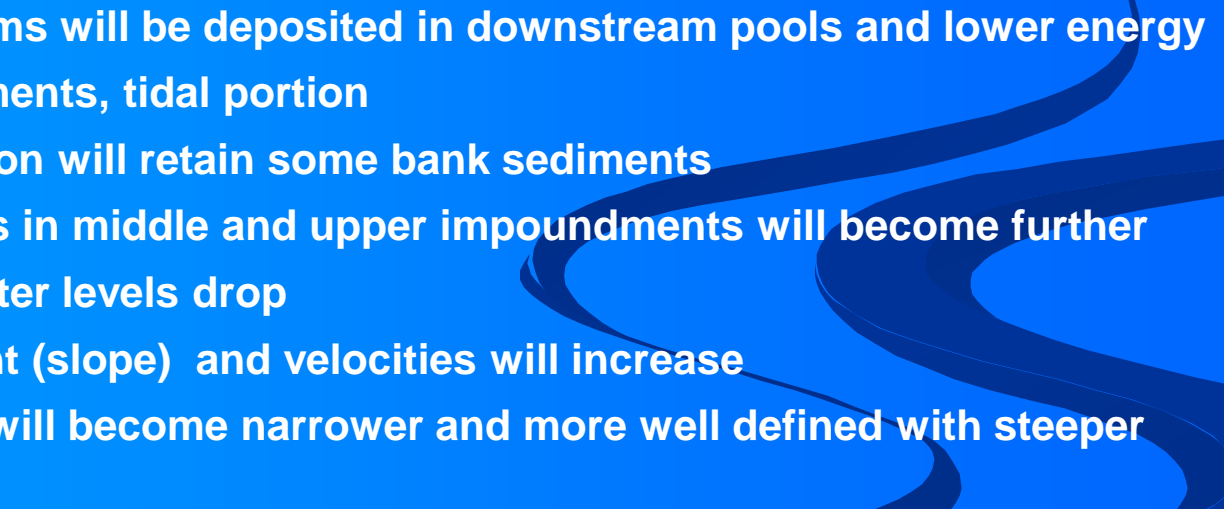
Overall Longitudinal Profile Showing Cross Section Locations Sawyer's Mill, Dover, NH



CHANGES TO RIVER FLOW AND CHANNEL

- Upper impoundment has been refilling since 1970's.
 - Additional changes to river began when water levels were lowered at dam for this study
 - after dam removal
 - More natural river flow characteristics
 - will carry larger range of sediment sizes
 - Minor impoundment may still occur above Route 108 bridge
- 

CHANGES TO RIVER FLOW AND CHANNEL (CONTINUED)

- **Sediment at dams will be deposited in downstream pools and lower energy stream environments, tidal portion**
 - **Bank stabilization will retain some bank sediments**
 - **floodplain areas in middle and upper impoundments will become further vegetated as water levels drop**
 - **Stream gradient (slope) and velocities will increase**
 - **River channel will become narrower and more well defined with steeper banks**
- 

POST-REMOVAL CHANGES

WATER RESOURCES/QUALITY

- Should have no adverse impacts on existing water supplies
- Improved dissolved oxygen and temperature conditions at most seasons due to restored flows
- Water quality/habitat impacts from contaminated sediment being assessed

WETLANDS/HABITAT

- Wetland type and extent will change especially in upper impoundment area
- Less open water habitat
- Urban setting will still impact habitat and water quality in middle and lower channel reaches
- Wetland species will transition to terrestrial plant species along river edges and floodplain
- Exotic invasives may colonize as water levels drop

POST-REMOVAL BENEFIT TO FISH PASSAGE

- Large obstructions removed (dams), falls will remain
- Modification to stream channel and steep gradient areas may still be needed after dam removal
- Water quality for aquatic species improved



Alewife



Blueback Herring



American Eel



HISTORIC AND ARCHAEOLOGICAL RESOURCES

- Under Section 106 of the National Historic Preservation Act, federal agencies are required to take into account the effects of their undertakings on historic properties.
- On behalf of the National Oceanic and Atmospheric Administration (NOAA), the lead federal agency for the proposed Sawyer's Mill Dams Removal Project, The Public Archaeology Laboratory, Inc. (PAL), is preparing a Request for Project Review (RPR) for submittal to the NH Division of Historical Resources (DHR) to initiate consultation with that agency in accordance with Section 106.
- The RPR identifies known historic and archaeological properties in the Project vicinity, recommends a preliminary Area of Potential Effects (APE) for the Project, and makes recommendations for additional historic and/or archaeological survey that may be required.
- NHDHR comments on the RPR will determine the extent of subsequent archaeological and/or historic architectural identification and evaluation surveys.



ARCHITECTURAL RESOURCES

- The Sawyer's Mill Dams are identified as contributing resources within the Sawyer Woolen Mills Historic District, a property listed in the National Register of Historic Places (National Register).
- Sawyer Woolen Mills was established in 1824, acquired by the American Woolen Company in 1899, and closed in 1954. The present mill complex was constructed in phases between 1873 and 1939. The Upper Dam is a gravity-arch type constructed of granite ashlar masonry, the Lower Dam is a gravity-type structure also constructed of granite ashlar.
- Because of the historical and physical association between the dams and the Sawyer Woolen Mills, the Project may directly or indirectly cause alterations in the character of the Sawyer Woolen Mills Historic District.
- No other historic architectural properties are likely to be affected by the Project.



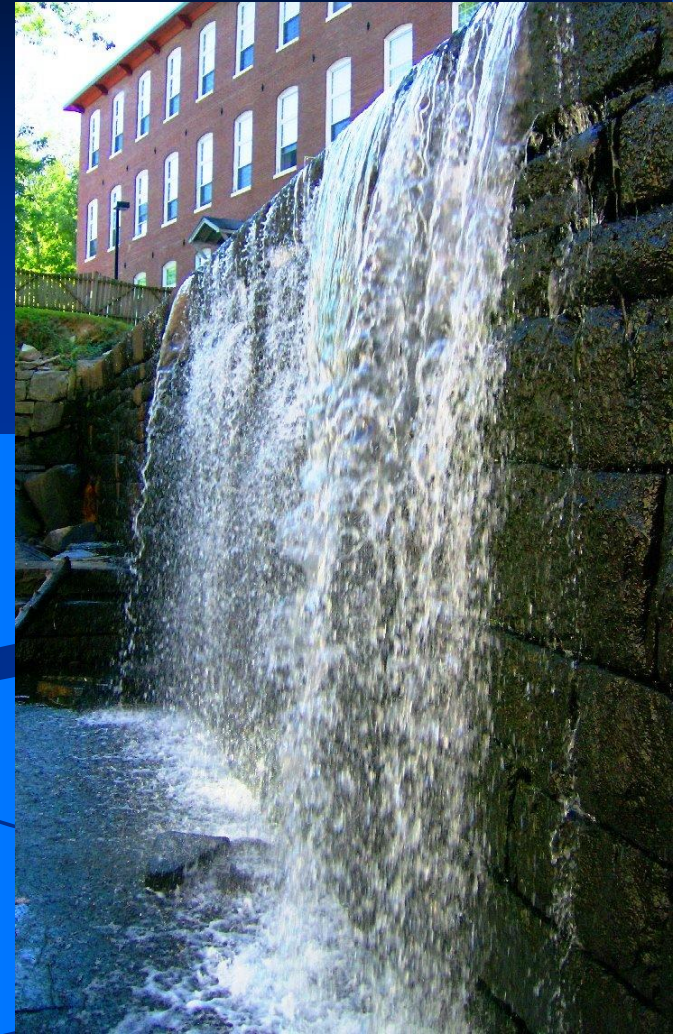
ARCHAEOLOGICAL RESOURCES

- A total of 16 previously identified archaeological sites, including one pre-contact site and fifteen post-contact sites, are located within a five-kilometer radius of the Project. None of these sites lie within the Project.
- While the riverine location of the Project likely would have made it an attractive spot for Native people, the level of historic landscape disturbance suggests a low potential for the survival of pre-contact archaeological resources.
- Archaeological features and deposits related to earlier and extant mills and dams may survive within the Project, as well as archaeological materials related to the nearby company-owned tenement houses on Charles Street. Such resources could include foundation remains, old dam and mill works remnants, and trash deposits.
- The extent of subsequent archaeological investigations will be determined in consultation with the NHDHR when a preferred Project alternative is selected and more detailed environmental modeling becomes available.



ACCOMPLISHMENTS

- Watershed and river reach evaluated for existing and proposed conditions for a wide variety of flows and events
- River modeling and dam removal concepts supported by the NH DES Dam Bureau to remove these dams from safety jurisdiction
- River modeling and dam removal concepts do indicate a good likelihood for target fish passage under many normal flow conditions for the migration seasons
- Lowering of the impoundments is already showing the benefits of vegetative stabilization of soils and sediments; and the mill owner reports reduced flooding issues



NEXT STEPS

- Finalize feasibility study
- Permitting
- Final design
- Dam removals

