To Dredge or Not to Dredge

Ripple Effect: Hardwick's Watershed Forum - Dredging

September 3, 2025

SLR

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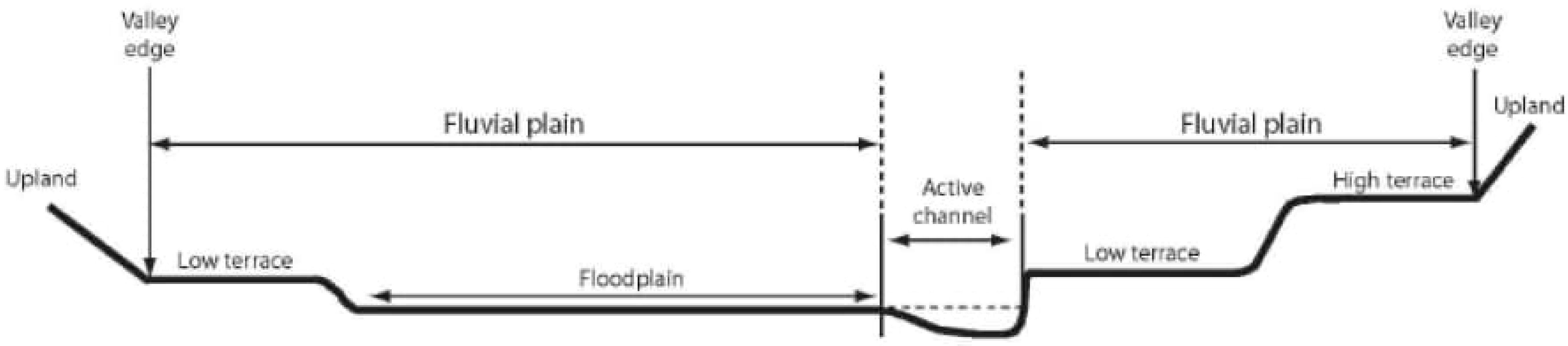
Key Points about Dredging

- Flood storage is really in the floodplain, not the channel. You cannot dredge your way out of flood risk or damages.
- Dredging leads to unstable channels that often impacts local and downstream property and infrastructure.
- Dredging is often followed by channel filling so requires ongoing maintenance and is not a long-term, widespread cost-effective solution for reducing flood risk.

Typical River Valley Cross Section



J. MacBroom, 2015

Floodplain v Channel Storage

The 100-year flood in the humid eastern United States is approximately four to six times the bankfull flood, and the floodplain system has to convey four to six bankfull flood equivalent units.

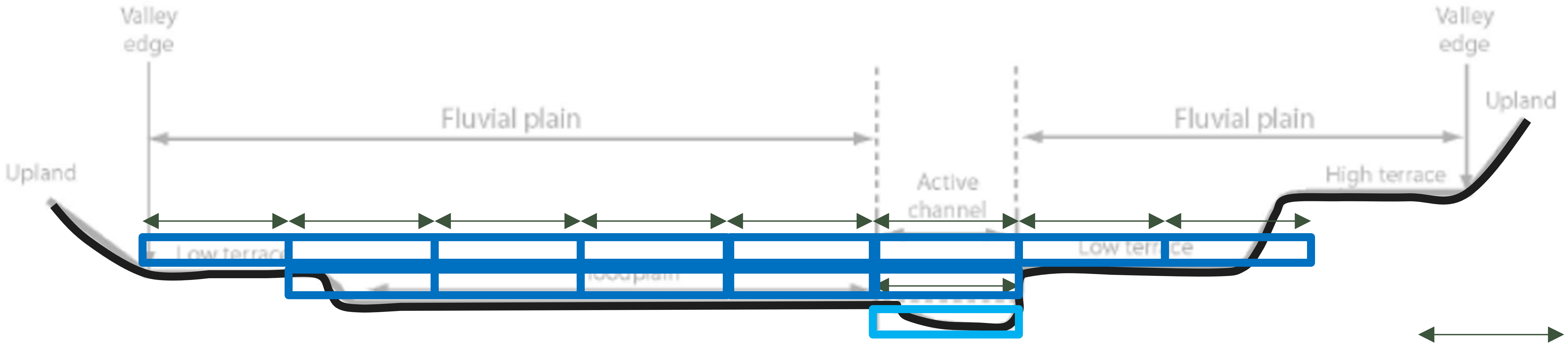
References	USGS[1] B-T 1955	CT[2] CHD 1960	Eastern US Leopold[3] 1964	Cone[4] USGS 1965	Statewide New York[5] MMI 2015	NY Catskills Region[6] MMI 2015	Deerfield River Basin[7] MMI 2014
Flow Frequency							
Mean Annual			0.35				
Bankfull	1.0		1.0	1.0	1.0	1.0	
5 Year	1.3		1.7	1.4	2.0	2.0	
10 Year	1.65		2.1	1.85	2.5	2.4	
25 Year	2.3		3.3	2.7	3.6	3.7	
50 Year	2.9		4.3	3.7	3.9	4.1	
100 Year	3.7	3.7	5.0*	5.0	4.6	4.9	5.6**
200 Year	4.2*	5.0		7.2*	5.5	5.7	
500 Year	5.7*			12*	6.4	6.6	

*Interpolated
**Post Hurricane Irene

J. MacBroom, 2015

[1] A flood flow formula for Connecticut, USGS Circular 365, Bigwood & Thomas, 1955
[2] Connecticut Highway Department, 1960, *Drainage Manual*
[3] Fluvial Processes in Geomorphology, Leopold, Wolman, and Miller, 1964
[4] Connecticut Flood Flow Formula, figure, J.W. Cone, 1965
[5] Magnitude and Frequency of Floods in New York, USGS SIR 2006-5112, Lumina
[6] Magnitude and Frequency of Floods in New York, USGS SIR 2006-5112, Lumina
[7] Draft River Assessment Report, Deerfield River Basin, MMI, 2014

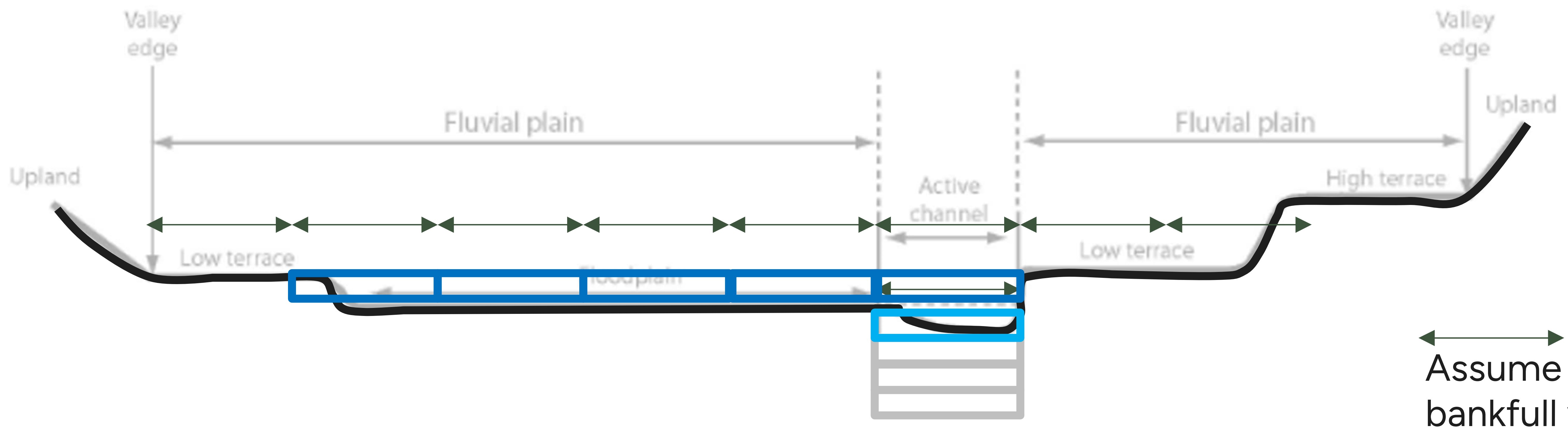
Flood Storage Sketch – No Dredging



Assume 20-foot bankfull width channel with 1-foot depth

- Bankfull Flow = 1 unit of storage (light blue box)
- 100-Year Flood Flow = 14 units of storage
- Flood velocity low due to spreading out on floodplain

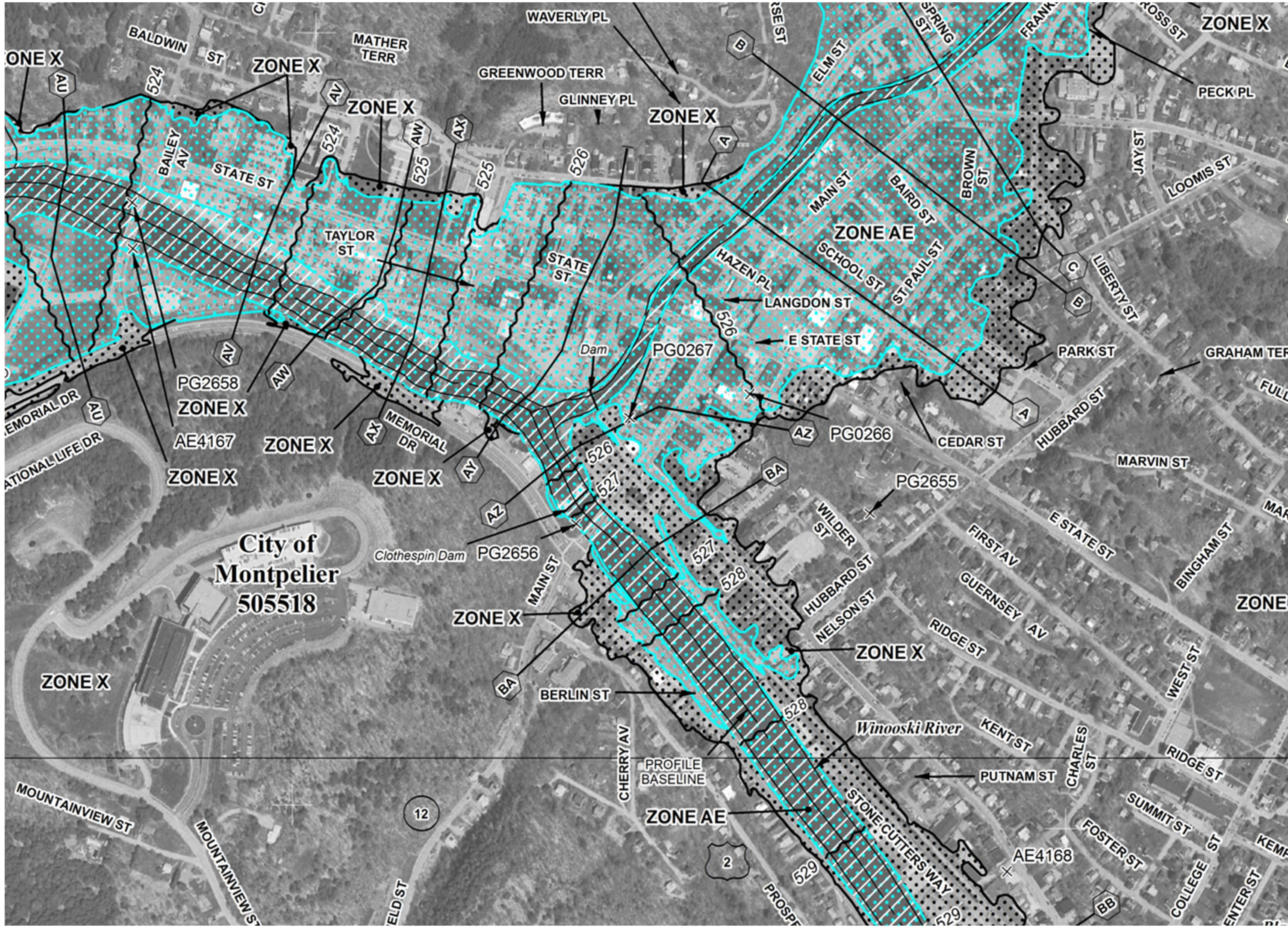
Flood Storage Sketch – With Dredging



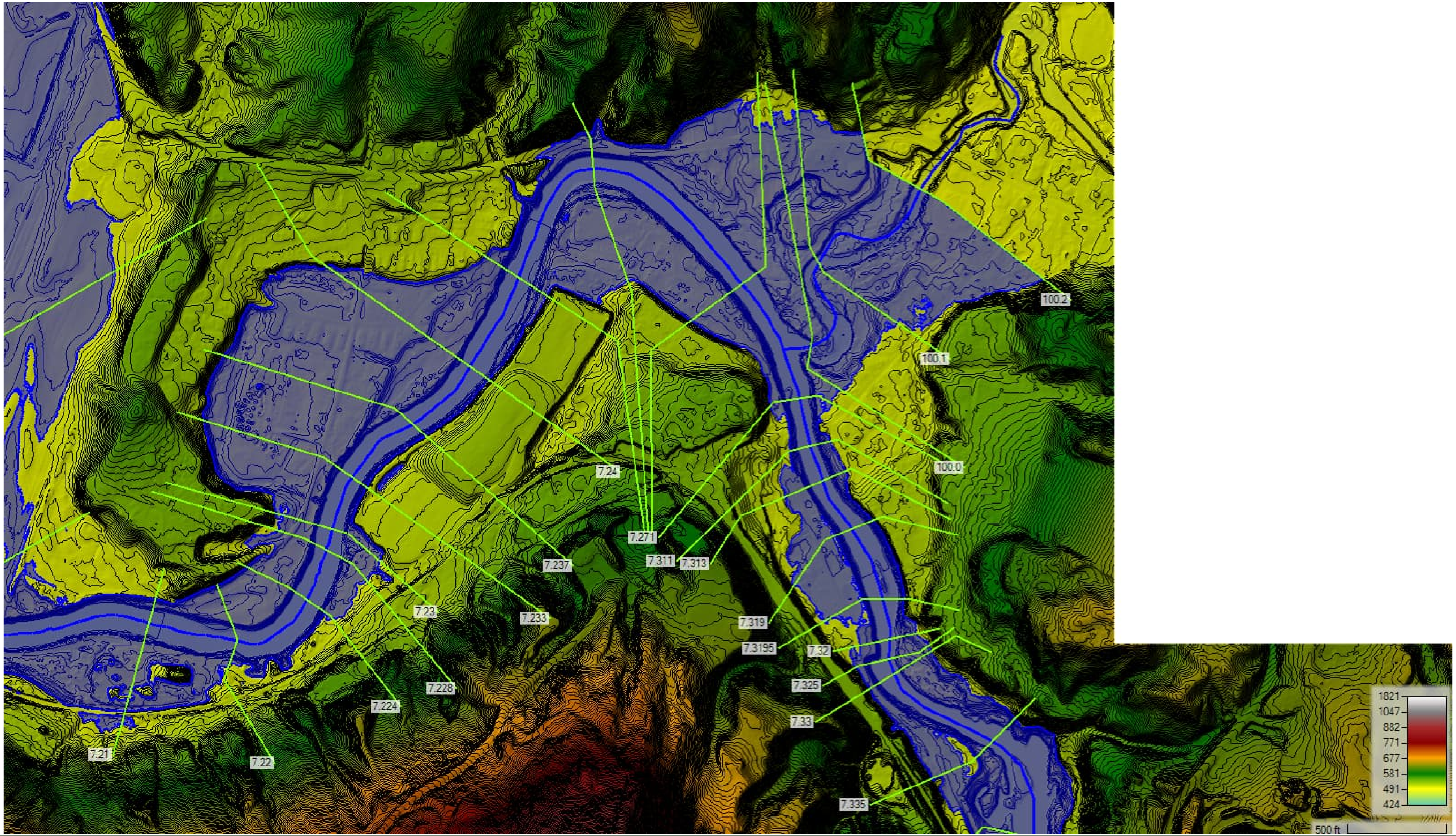
Assume 20-foot bankfull width channel with 1-foot depth

- Bankfull Flow = 4 unit of storage (light blue box plus dredged gray boxes)
- Bankfull channel less stable due to confinement of flows and increased erosion
- 100-Year Flood Flow = 9 units of storage due to loss of floodplain access
- Flood velocity higher due to loss of floodplain flow and spreading out
- Less flood storage and higher flood velocity

FEMA Flood Insurance Rate Map (FIRM)



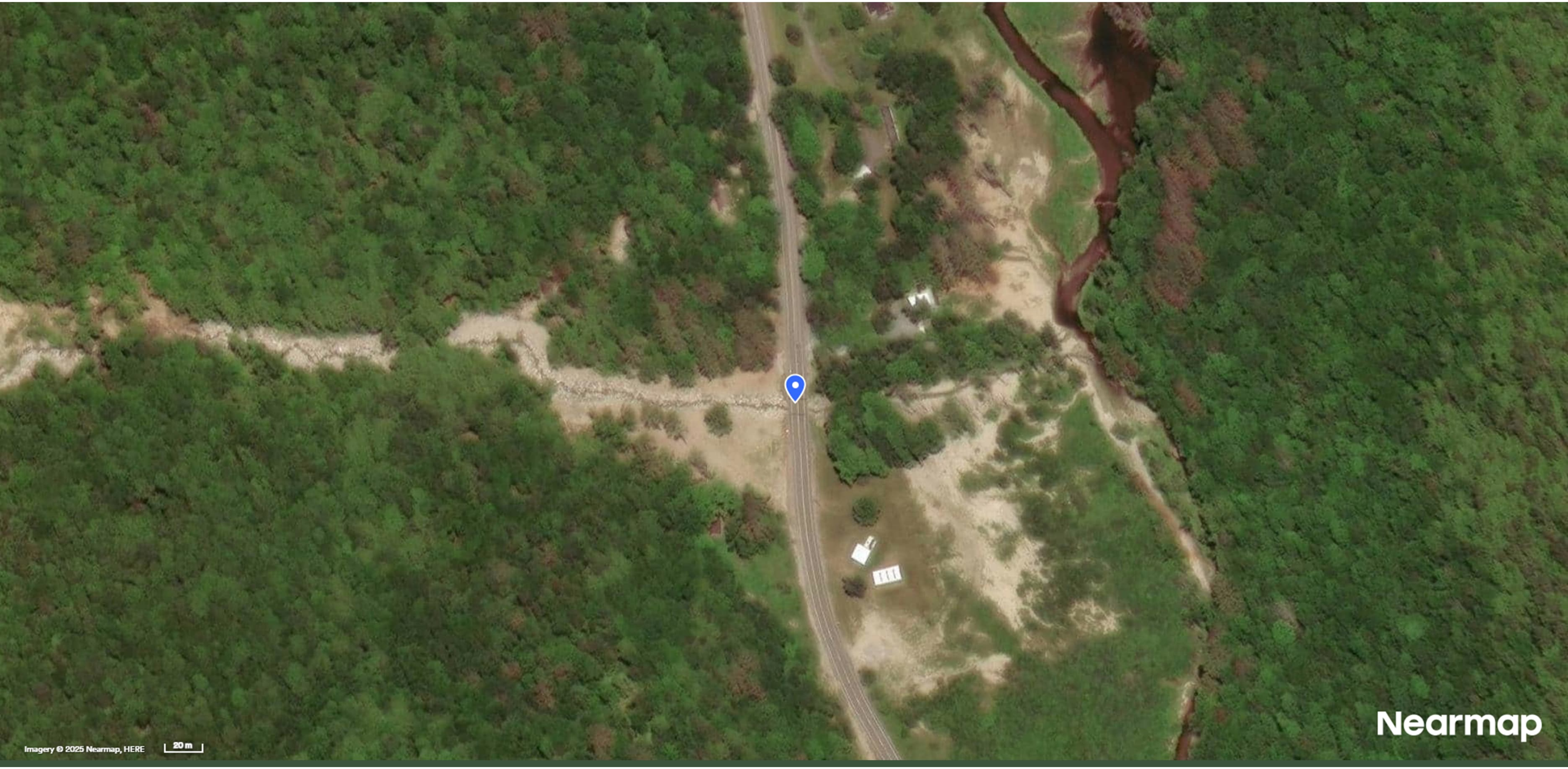
Floodplain Mapping



Places that Require Sediment Management

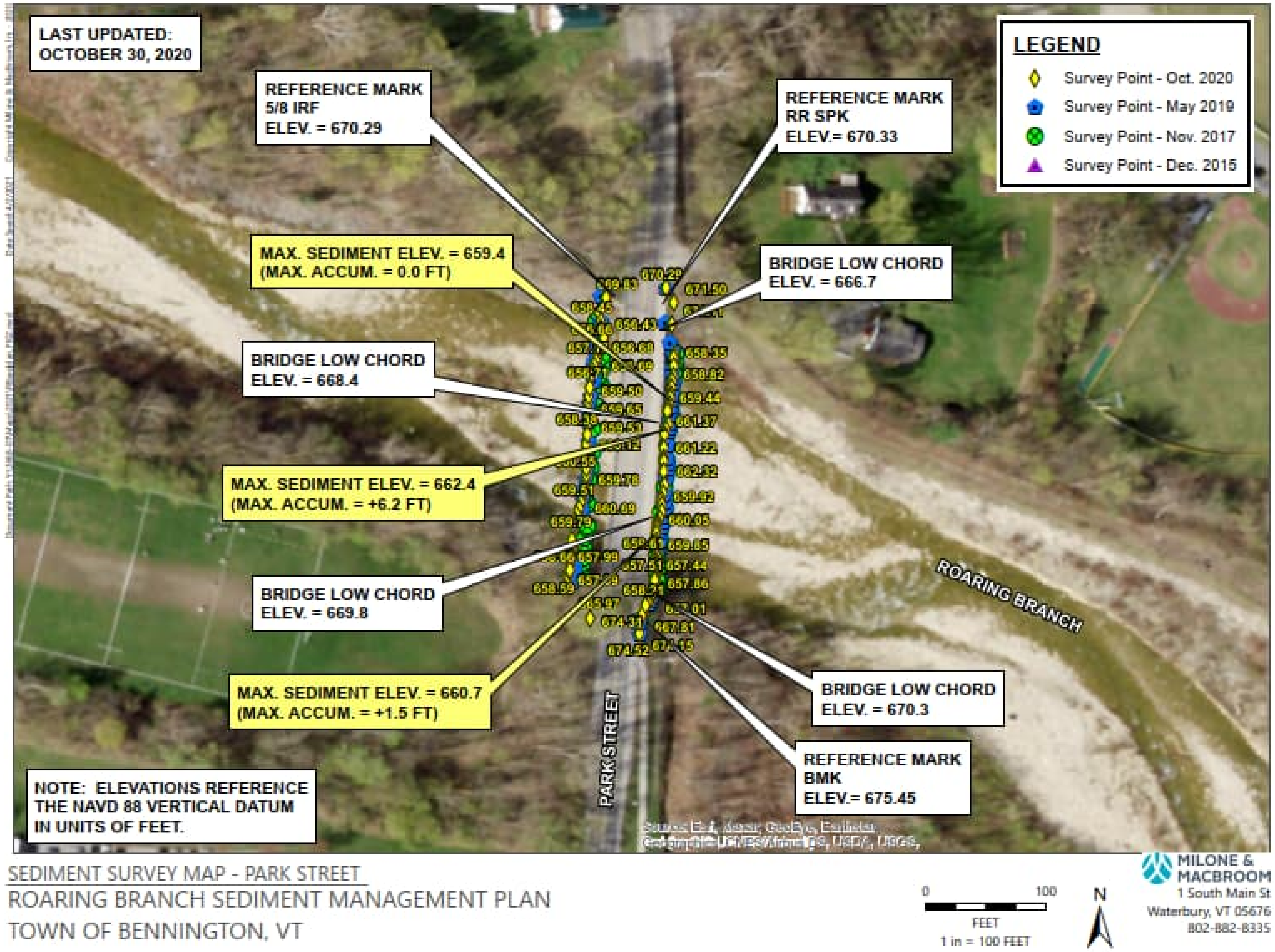
- Undersized bridges near breaks in valley slope on alluvial fans that will always be aggradational. (e.g., Park Street, Roaring Branch, Bennington)
- In the vicinity of homes and businesses on alluvial fans or near undersized bridges or culverts with high flood and erosion risk.
- When bridges, culverts, dams, or levees are knocked out of design compliance due to sediment buildup.

Alluvial Fans



Alluvial Fans

Roaring Branch Sediment Management



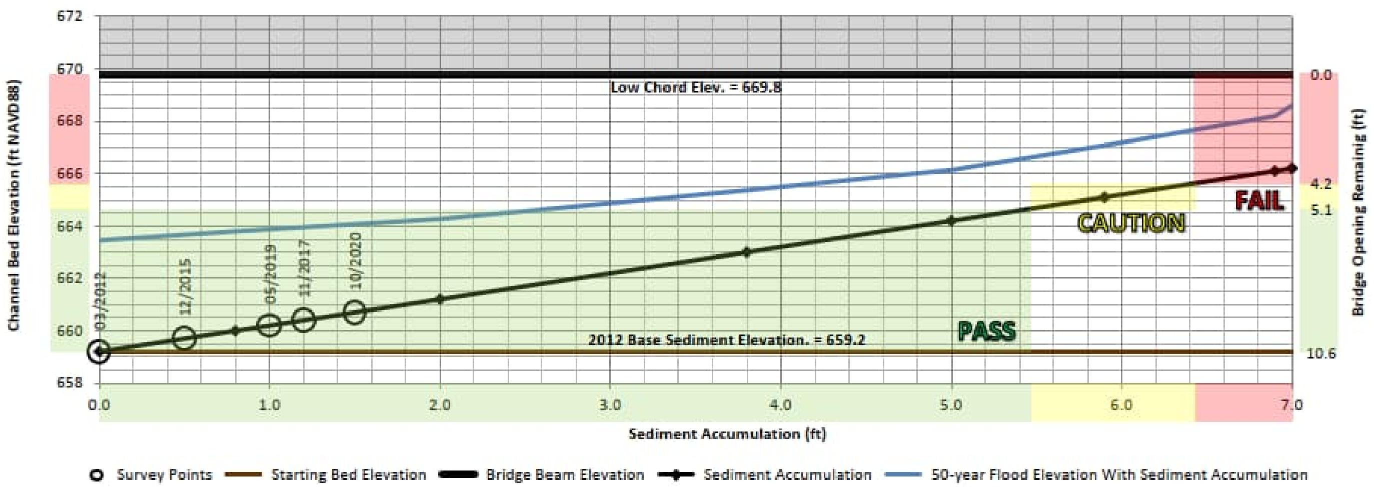
ersonville, S. Jensen, 11/1/2019

Roaring Branch Sediment Management

Park Street Bridge South Opening
Sediment Monitoring Data
Roaring Branch Sediment Management Plan

Last Updated: Oct. 30, 2020

Sediment Tracking and Threshold Plot



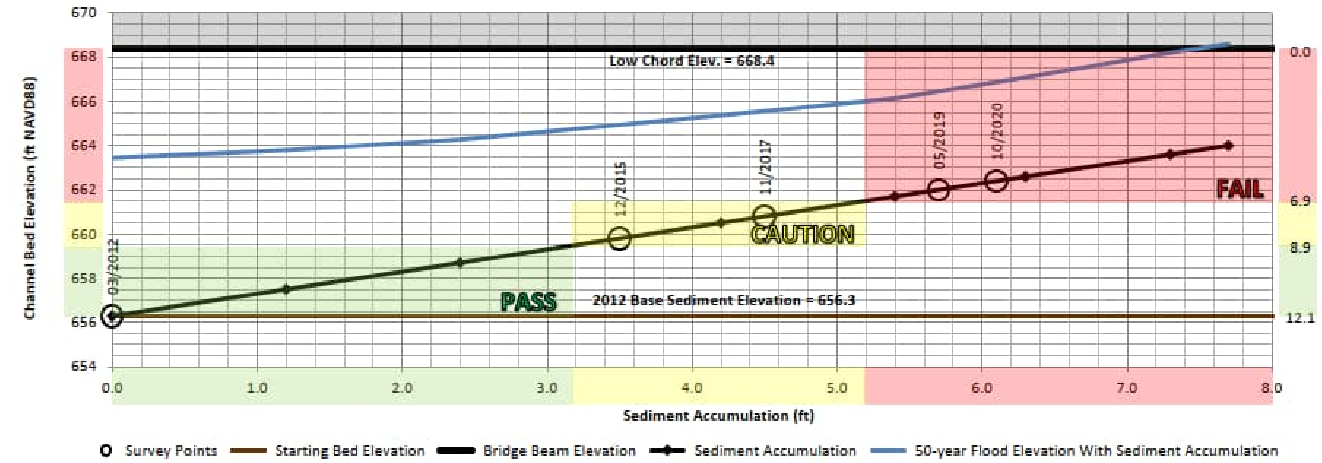
Observations

Date	Elevation (ft NAVD88)	Δ Sediment (ft) Since 2012	Notes
03/2012	659.2	0.0	2012 sediment baseline following recovery from Tropical Storm Irene.
12/2015	659.7	0.5	Sediment deposition has occurred. Normal flow (NF) channel moved to North & South openings from Center opening.
11/2017	660.4	1.2	Sediment deposition has occurred. NF channel moved to North & (primary) South openings from Center opening.
05/2019	660.2	1.0	Sediment erosion has occurred.
10/2020	660.7	1.5	Sediment deposition has occurred. Normal flow channel through South (primary) and North (secondary) spans.

Park Street Bridge Center Opening
Sediment Monitoring Data
Roaring Branch Sediment Management Plan

Last Updated: Oct. 30, 2020

Sediment Tracking and Threshold Plot

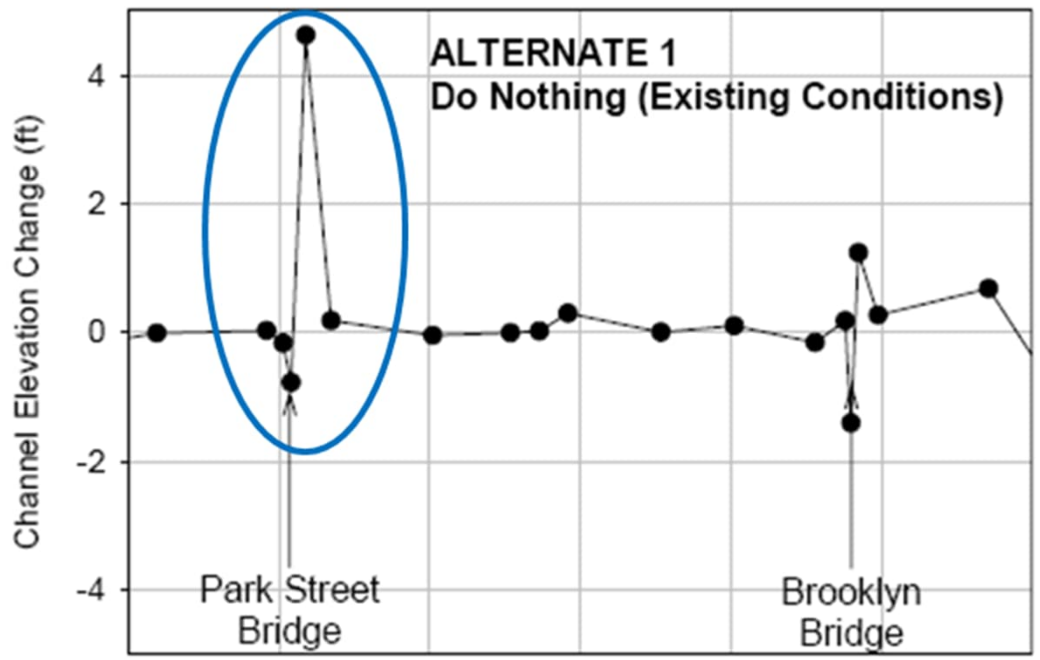


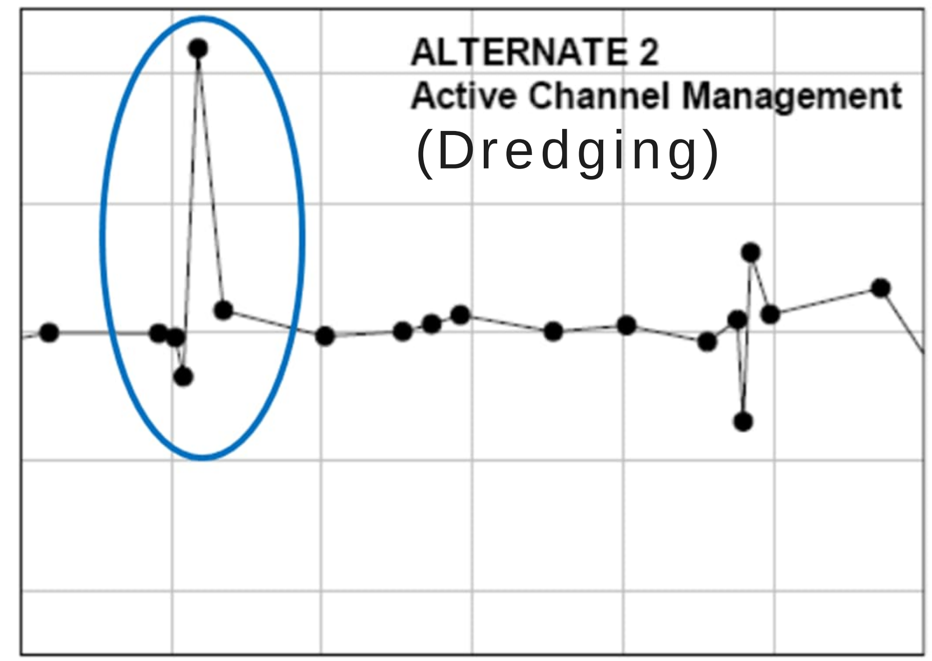
Observations

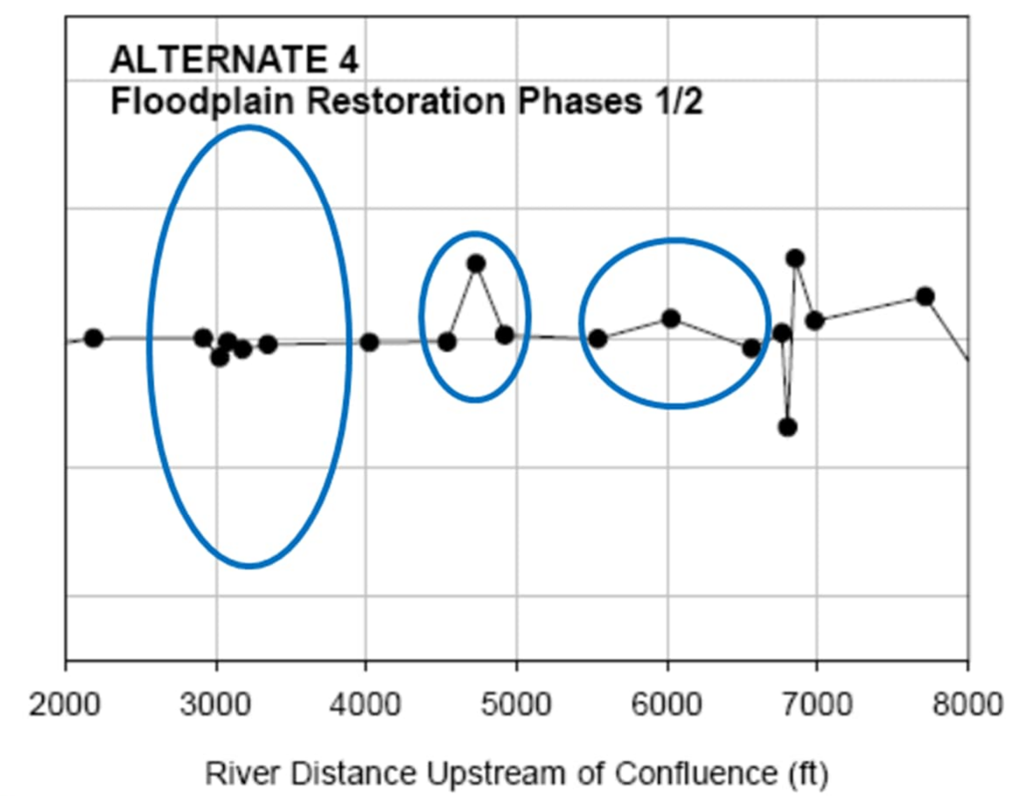
Date	Elevation (ft NAVD88)	Δ Sediment (ft) Since 2012	Notes
03/2012	656.3	0	2012 sediment baseline following recovery from Tropical Storm Irene.
12/2015	659.8	3.5	Sediment deposition has occurred. Normal flow (NF) channel moved to North & South openings from Center opening.
11/2017	660.8	4.5	Sediment deposition has occurred via bar building. NF channel continuing to move to North & South openings.
05/2019	662.0	5.7	Sediment deposition has occurred.
10/2020	662.4	6.1	Sediment deposition has occurred in Center span and around bridge piers.

Roaring Branch Sediment Transport Analysis

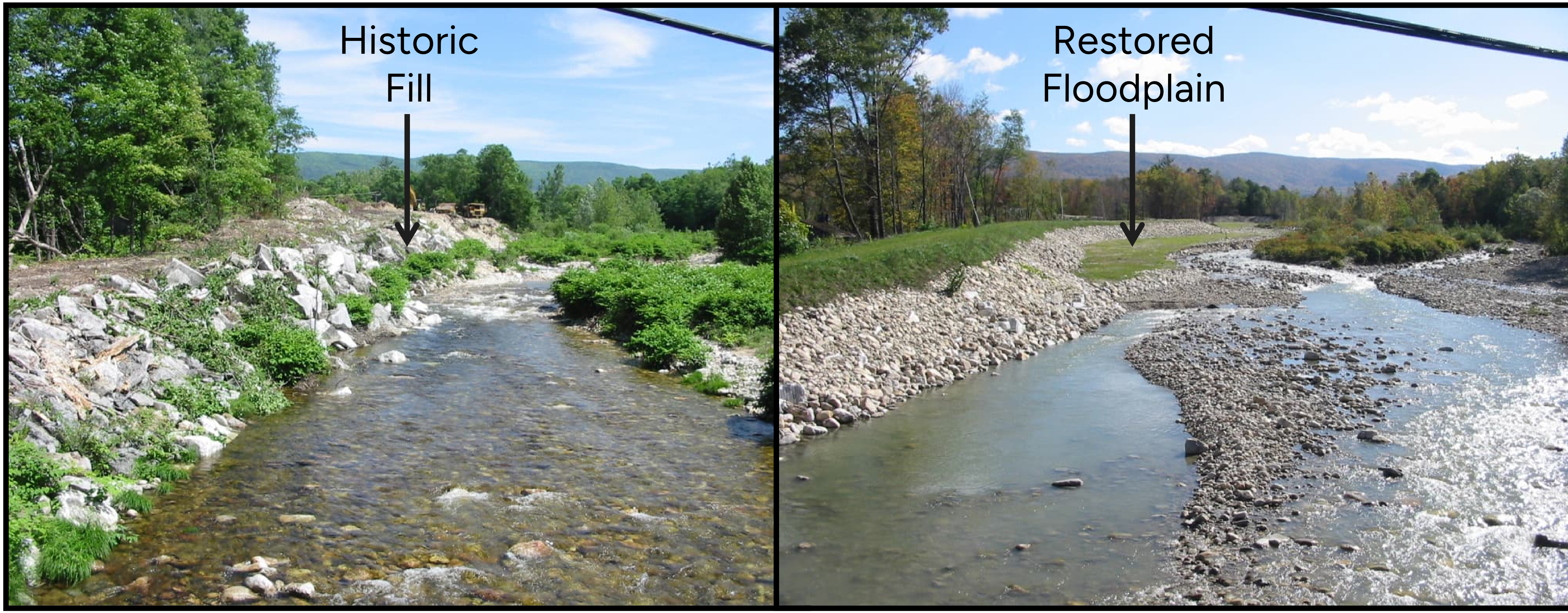
- Total Power decreases range100-700 W/m2 (948 to 167)
- Flood velocity decreases 1-4 feet per second
- Flood depth decreases 0.2-1.0 feet



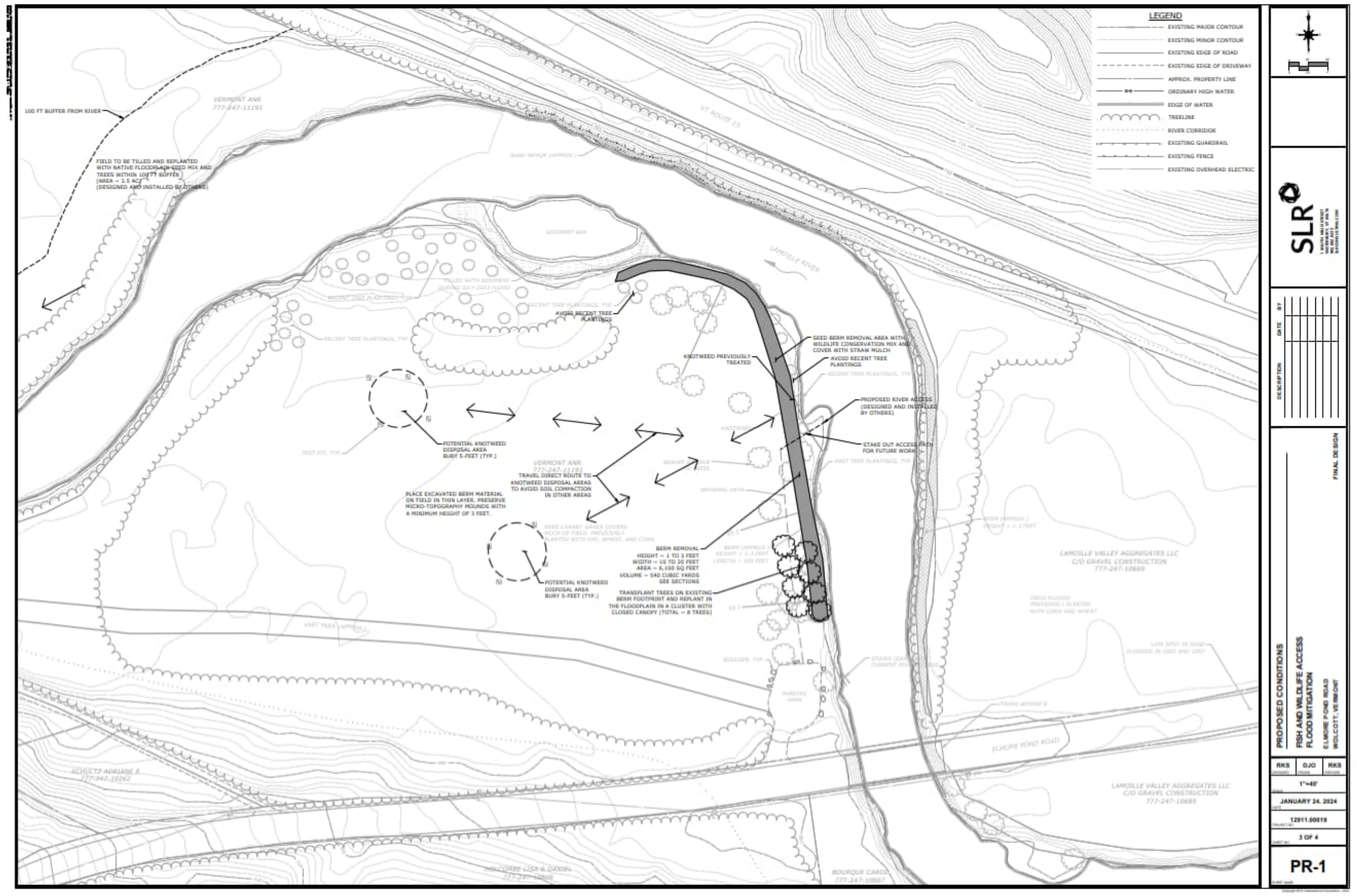




Roaring Branch Floodplain Restoration

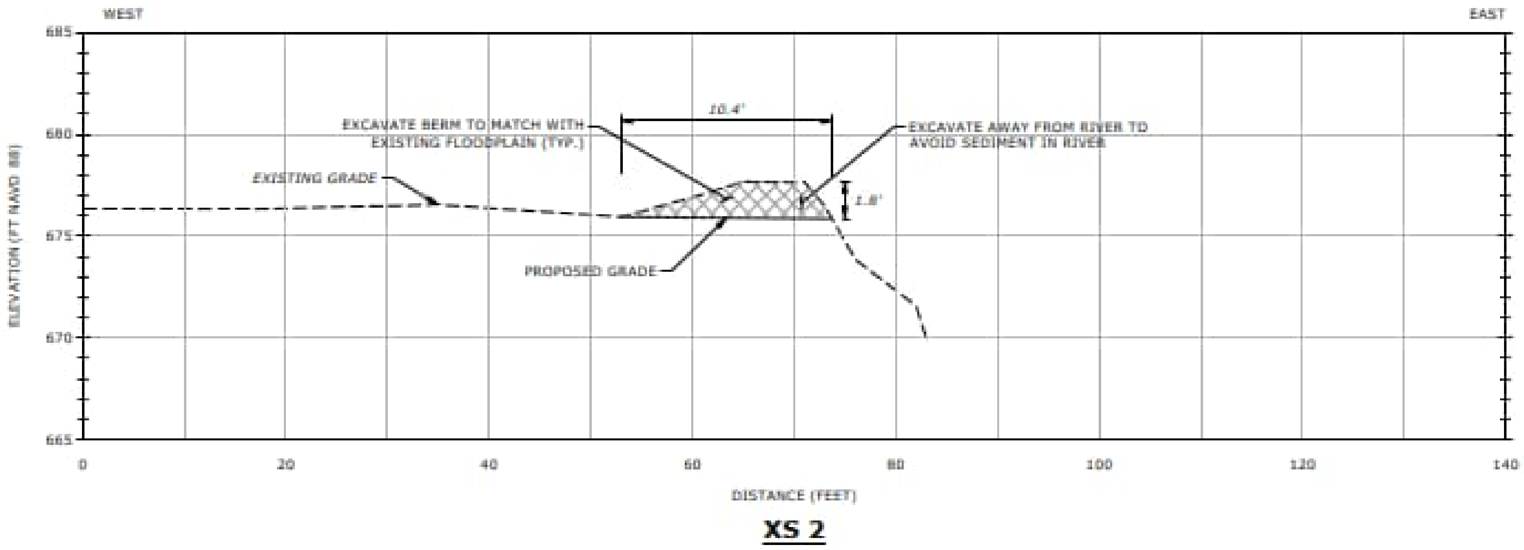


Elmore Pond Road, Flood Mitigation, Wolcott



Removal of Berm

- Reconnect floodplain
- Water can spread out
- Revegetate to slow water



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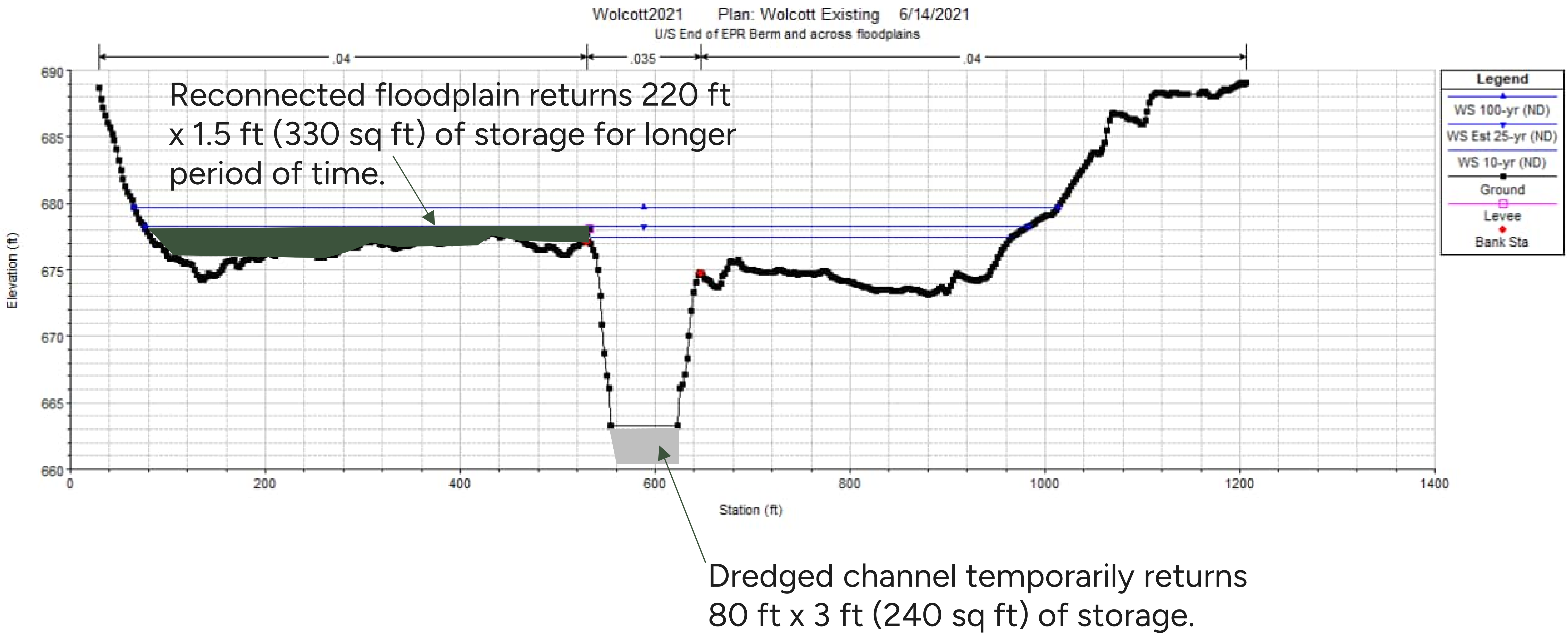


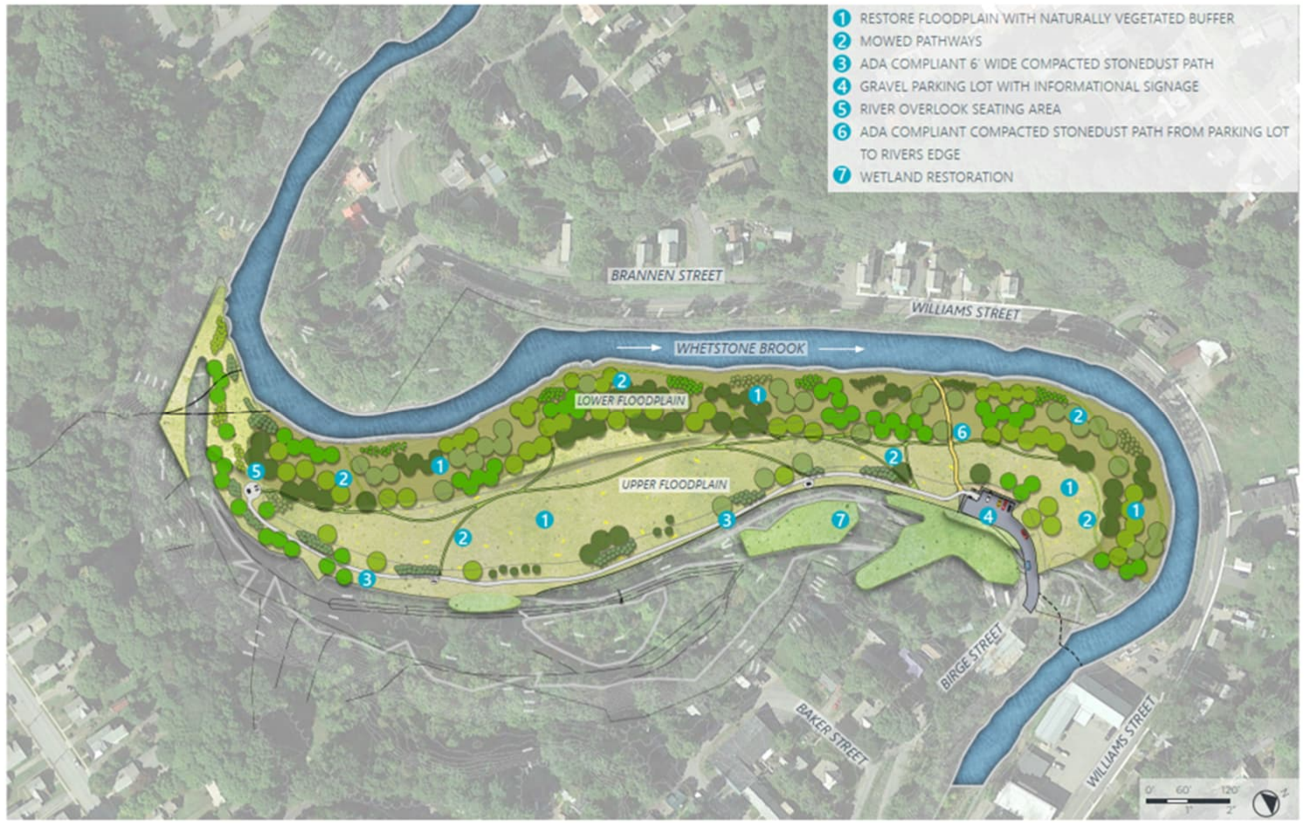
Elmore Pond Road, Flood Mitigation, Wolcott

PRE-CONSTRUCTION

POST-CONSTRUCTION

Whetstone Brook Floodplain Restoration (Kikitta Ahki)

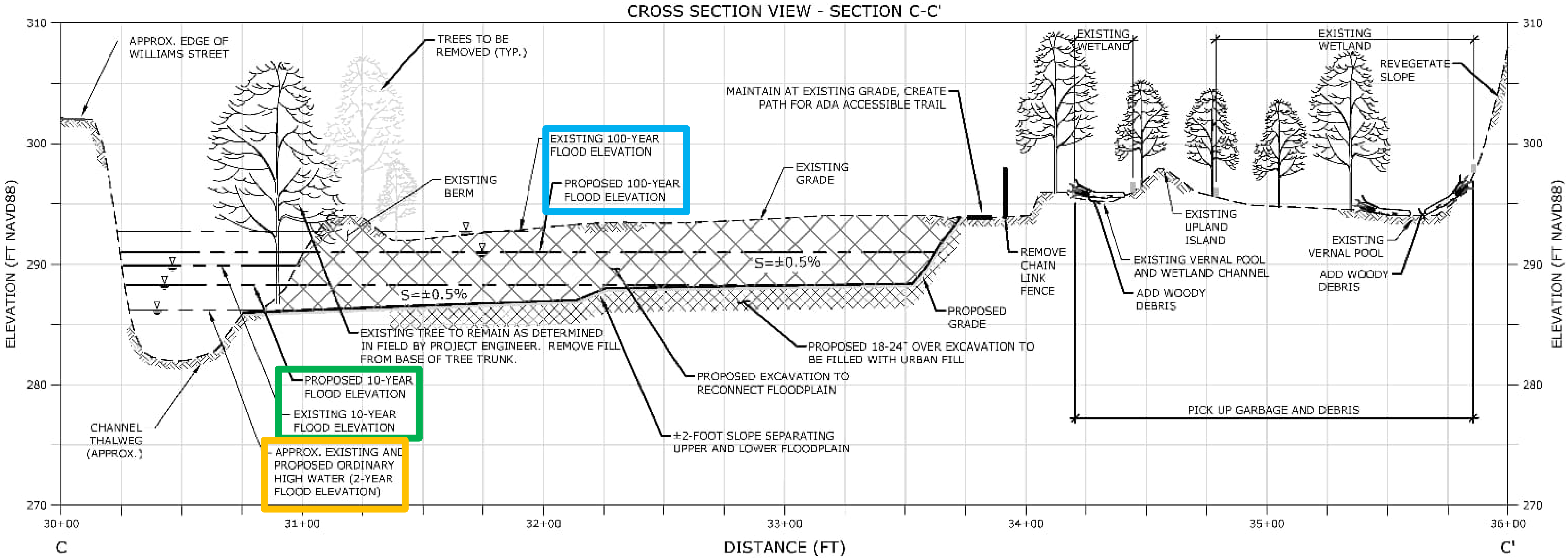
2022



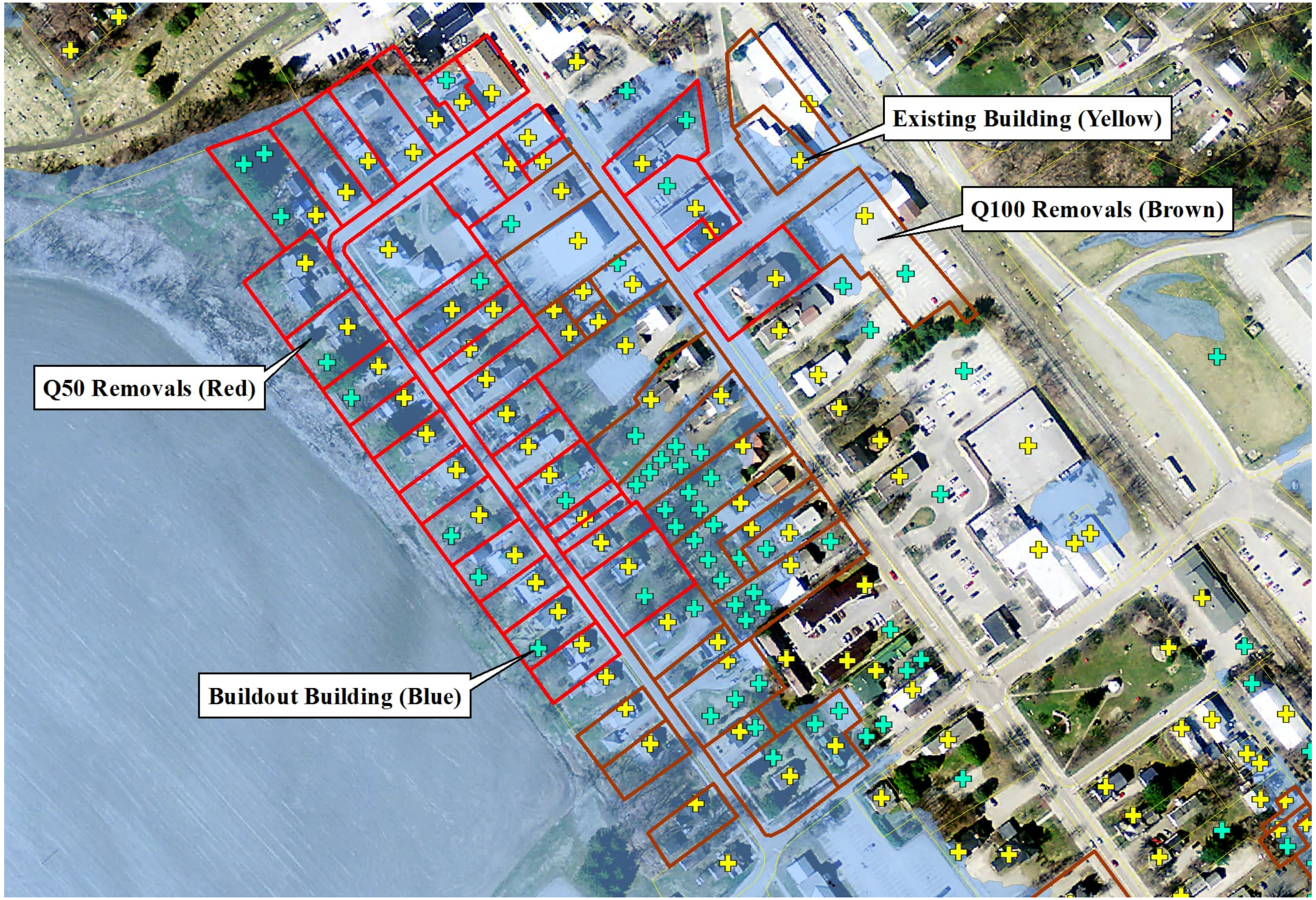
2024

2024

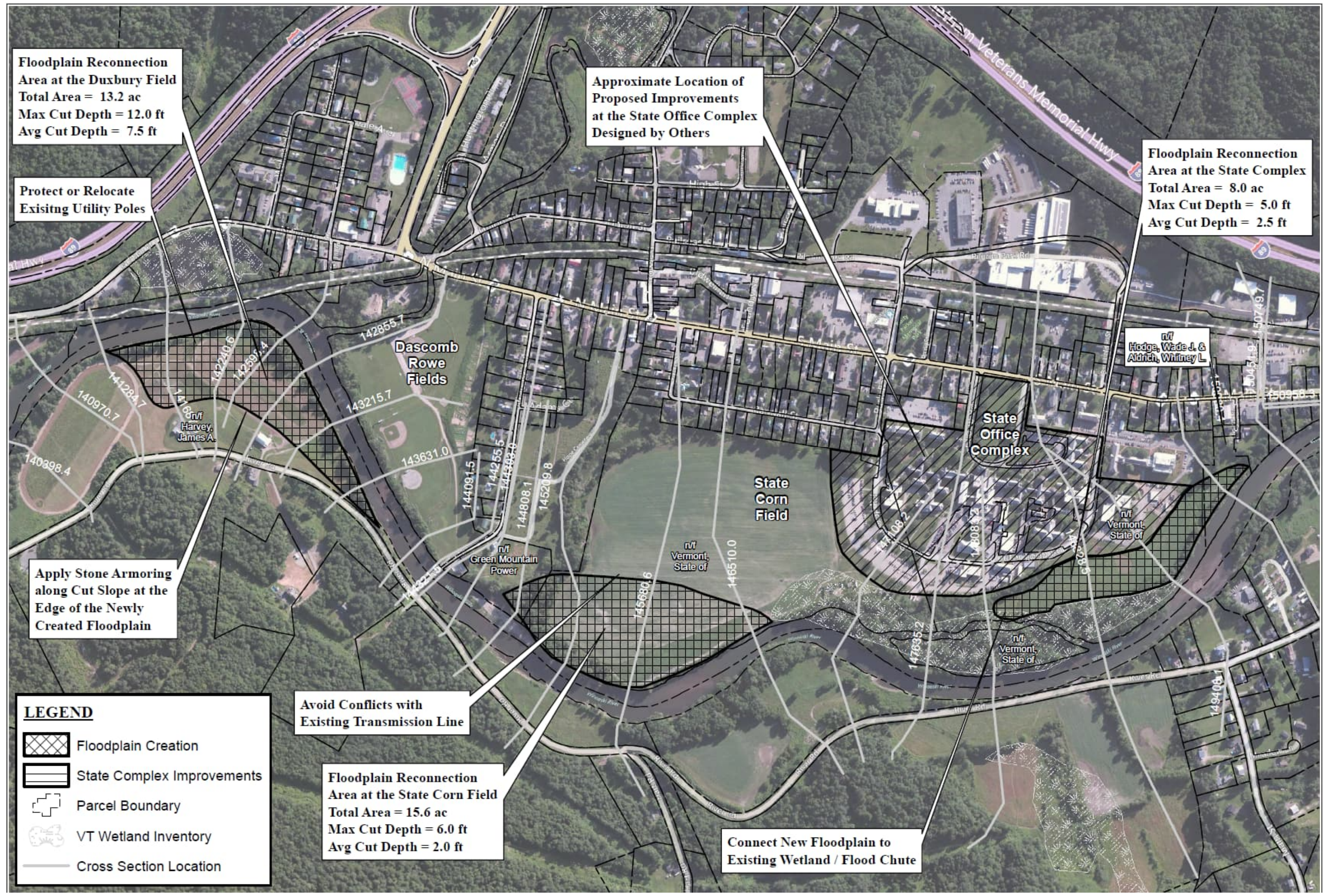
Whetstone Brook Floodplain Restoration (Kikitta Ahki)



Floodplain Economics

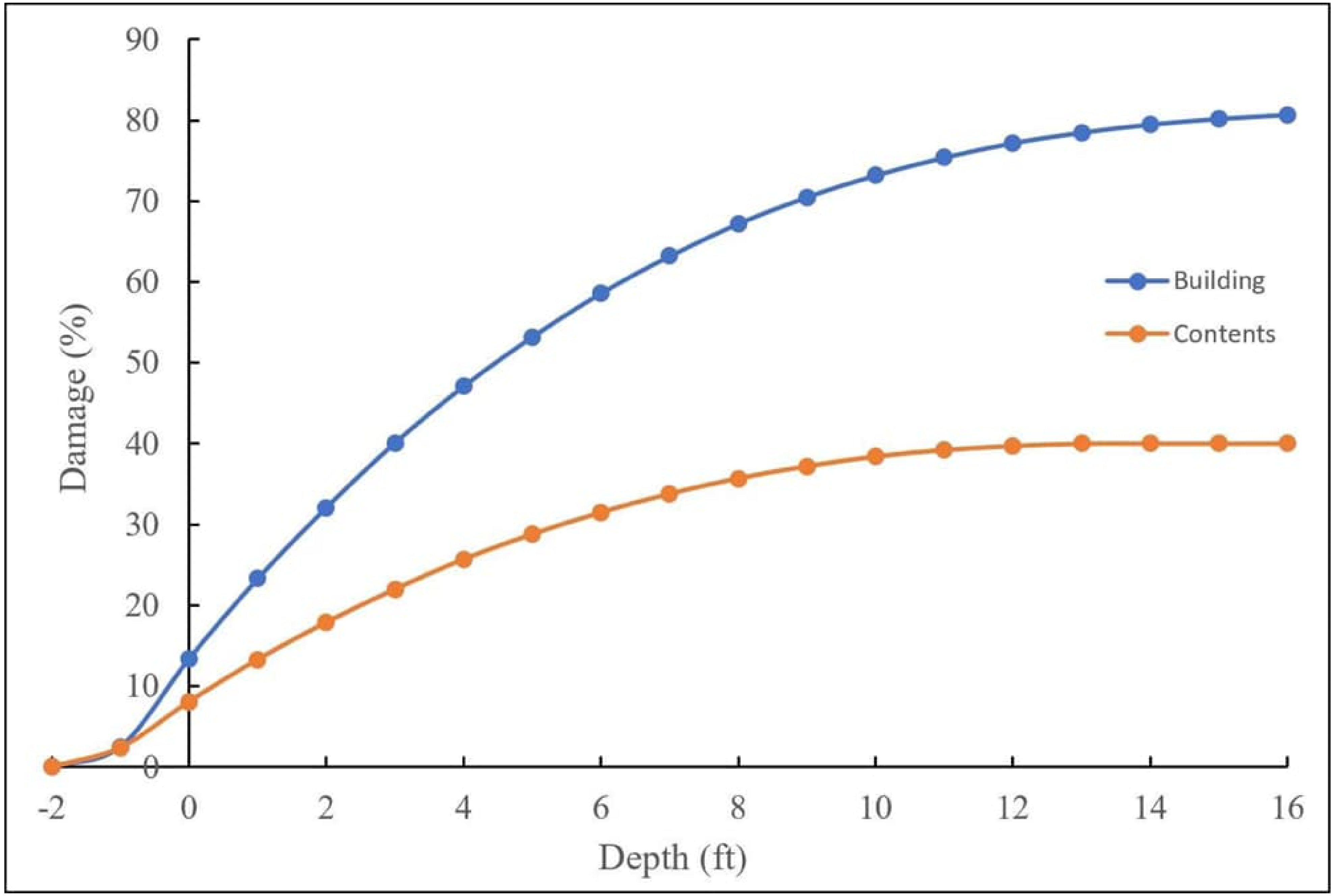


Floodplain Economics



- **$51 to $41 thousand** reduction in annualized damages
- **$2.6 million** reduction in simulated damages for a single large flood

Depth-Damage Curves



(FEMA, 2013)

Floodplain Economics

FEMA

MITIGATION POLICY – FP-108-024-01

Table I: Annual Estimated Monetary Benefits per Acre per Year

Environmental Benefit	Green Open Space	Riparian
Aesthetic Value	$1,623	$582
Air Quality	$204	$215
Biological Control	--	$164
Climate Regulation	$13	$204
Erosion Control	$65	$11,447
Flood Hazard Reduction	--	$4,007
Food Provisioning	--	$609
Habitat	--	$835
Pollination	$290	--
Recreation/Tourism	$5,365	$15,178
Storm Water Retention	$293	--
Water Filtration	--	$4,252
Total Estimated Benefits	$7,853	$37,493

III. POLICY STATEMENT:

FEMA will allow the inclusion of environmental benefits in benefit-cost analyses (BCA) to determine cost effectiveness of acquisition projects.

IV. PURPOSE:

The purpose of this policy is to identify and quantify the types of environmental benefits that FEMA will consider in the BCA for acquisition projects.

Table II: Green Open Space and Riparian Benefits Allowed in the BCA Toolkit

Land Use	Total Estimated Benefits	Total Estimated Benefits (projected for 100 years with 7 percent discount rate)
Green Open Space	$7,853 per acre per year	$2.57 per square foot
Riparian	$37,493 per acre per year	$12.29 per square foot

(FEMA, 2013)

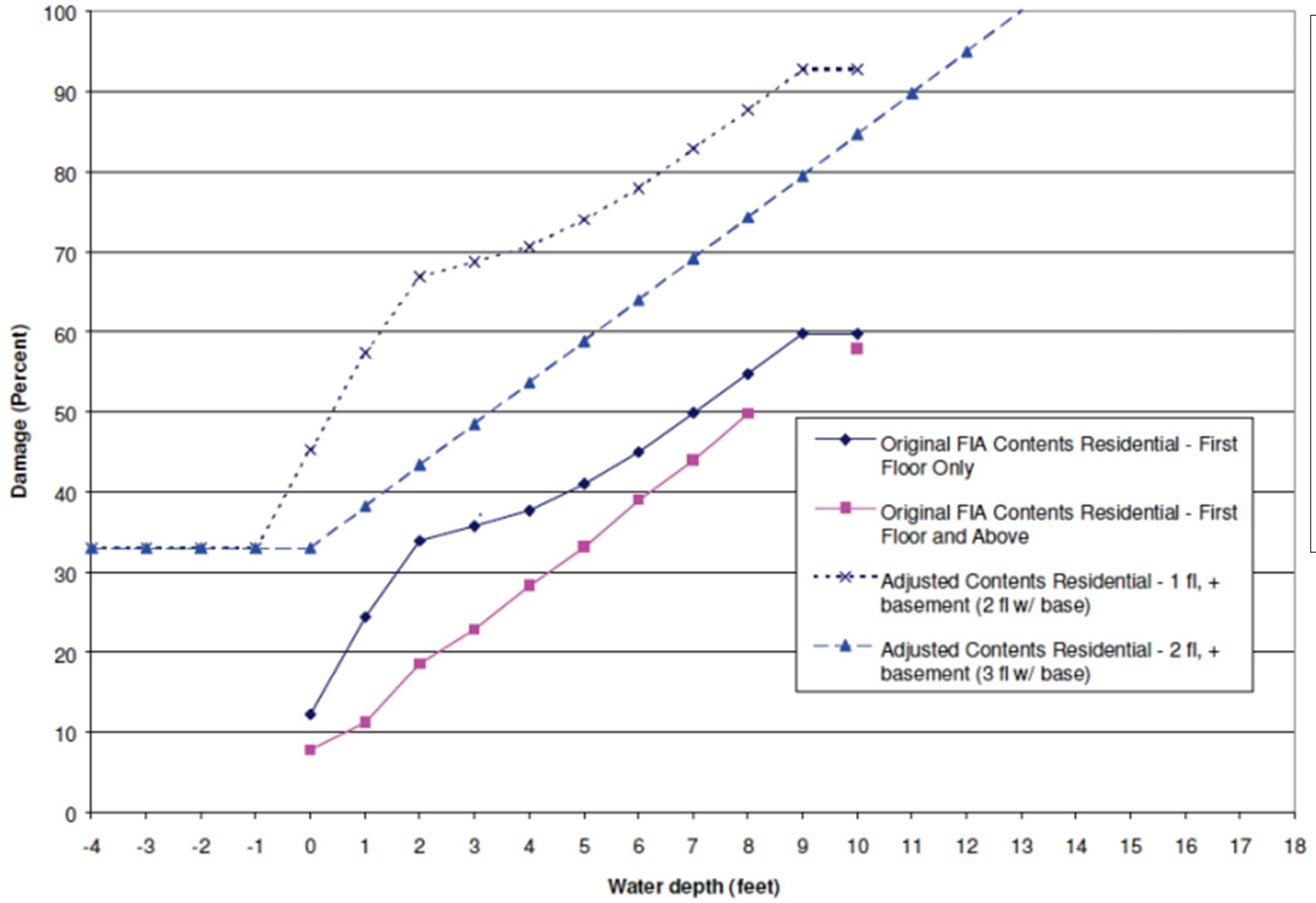
Thank You

(Lars Gange & Mansfield Heliflight, August 31, 2011)

Jeffersonville, S. Jensen, 11/1/2019

Extra Slides

Depth-Damage Curves



(FEMA, 2013)

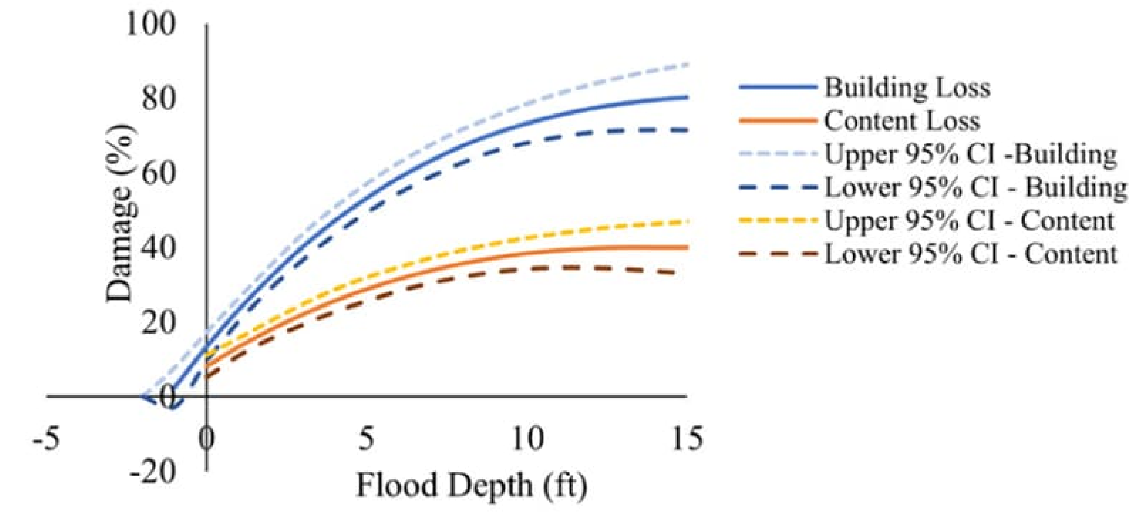
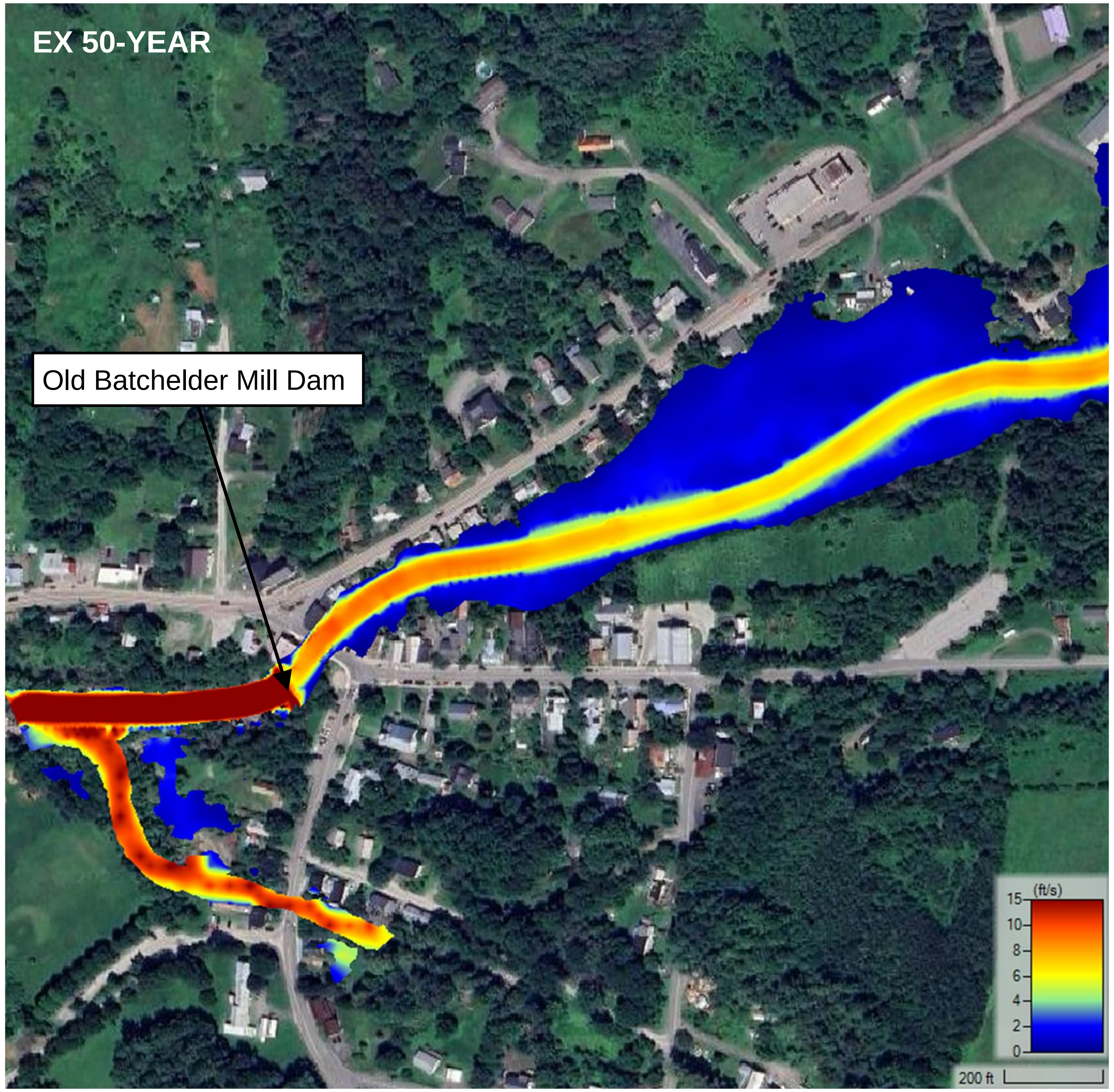


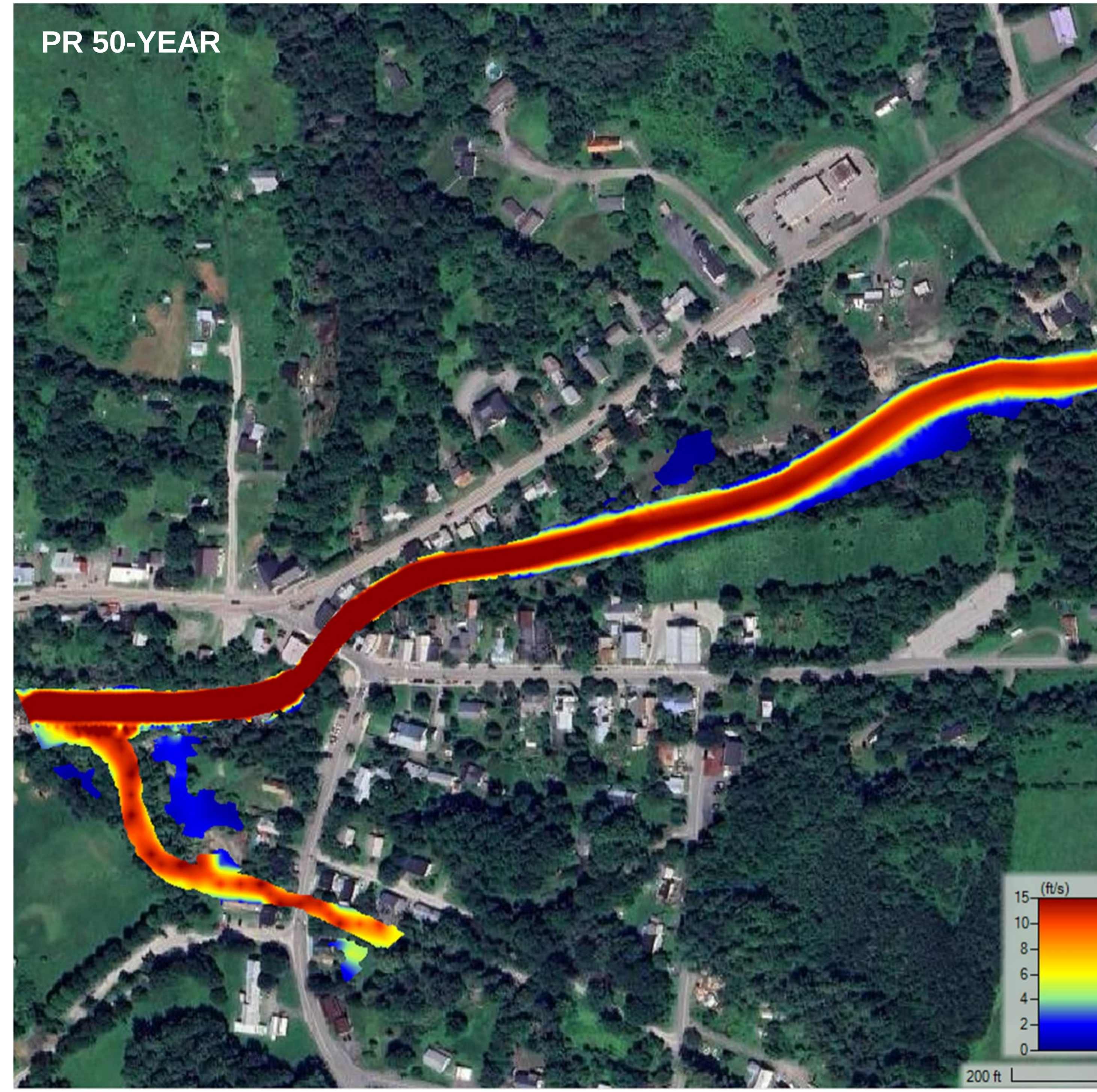
FIGURE 2
USACE (2000) DDF for a one-story home without basement.

Dog River Floodplain Restoration – Northfield

- Remove 7 damaged homes
- Remove 9,000 CY of fill in floodplain & lower land 4 feet over 3 acres
- Remove berm
- Plant restored floodplain with native vegetation

Dog Floodplain
Northfield, VT
Photo by Isaac Maddox-White
11/13/2017





WATER VELOCITIES IN VILLAGE UPSTREAM OF DAM

50-YEAR:	EX ~7-10 FT/S	PR ~14-22 FT/S
100-YEAR:	EX ~7-11 FT/S	PR ~15-24 FT/S
500-YEAR:	EX ~7-13 FT/S	PR ~17-27 FT/S

Dimensionless Flood Water Depth to Bankfull Depth Ratio

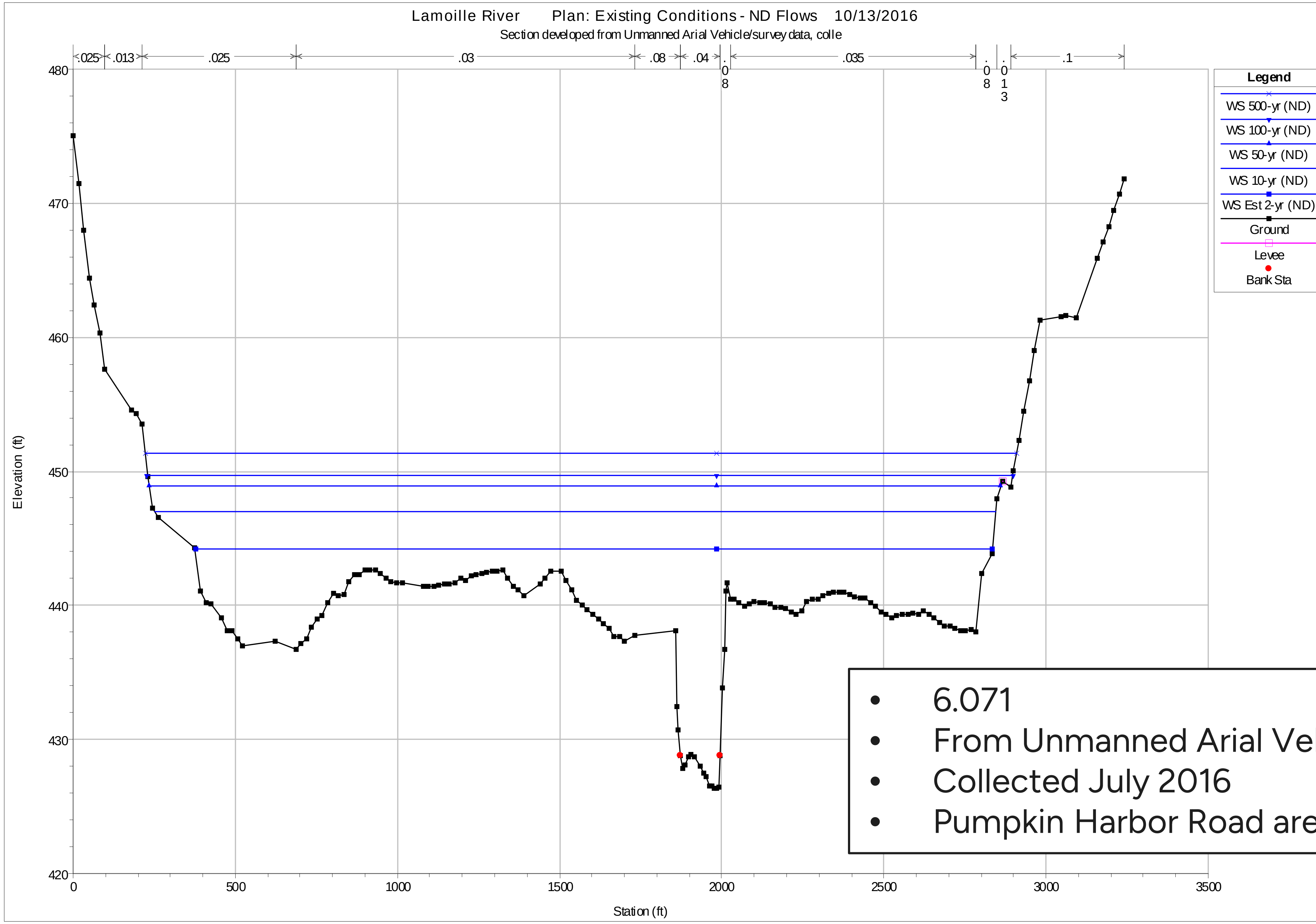
Flow Event	Eastern U.S.[1]	Idaho[2]	Puget Sound Area[3]	Red River Valley[4]
Mean Annual	0.35			
Bankfull Flood	1.0	1.0	1.0	1.0
5 Year	1.2	1.2	1.3	1.7
10 Year	1.4	1.3	1.4	2.0
25 Year	1.6			
50 Year	1.8	1.4	1.7	2.4
100 Year	2.0*	1.5	1.8	2.5
200 Year				

*Interpolated

[1] Leopold, 1964
[2] Emmett, USGS, Prof. Paper 870a, 1975
[3] Dunne and Leopold, 1978
[4] Padmanabhan, 2010

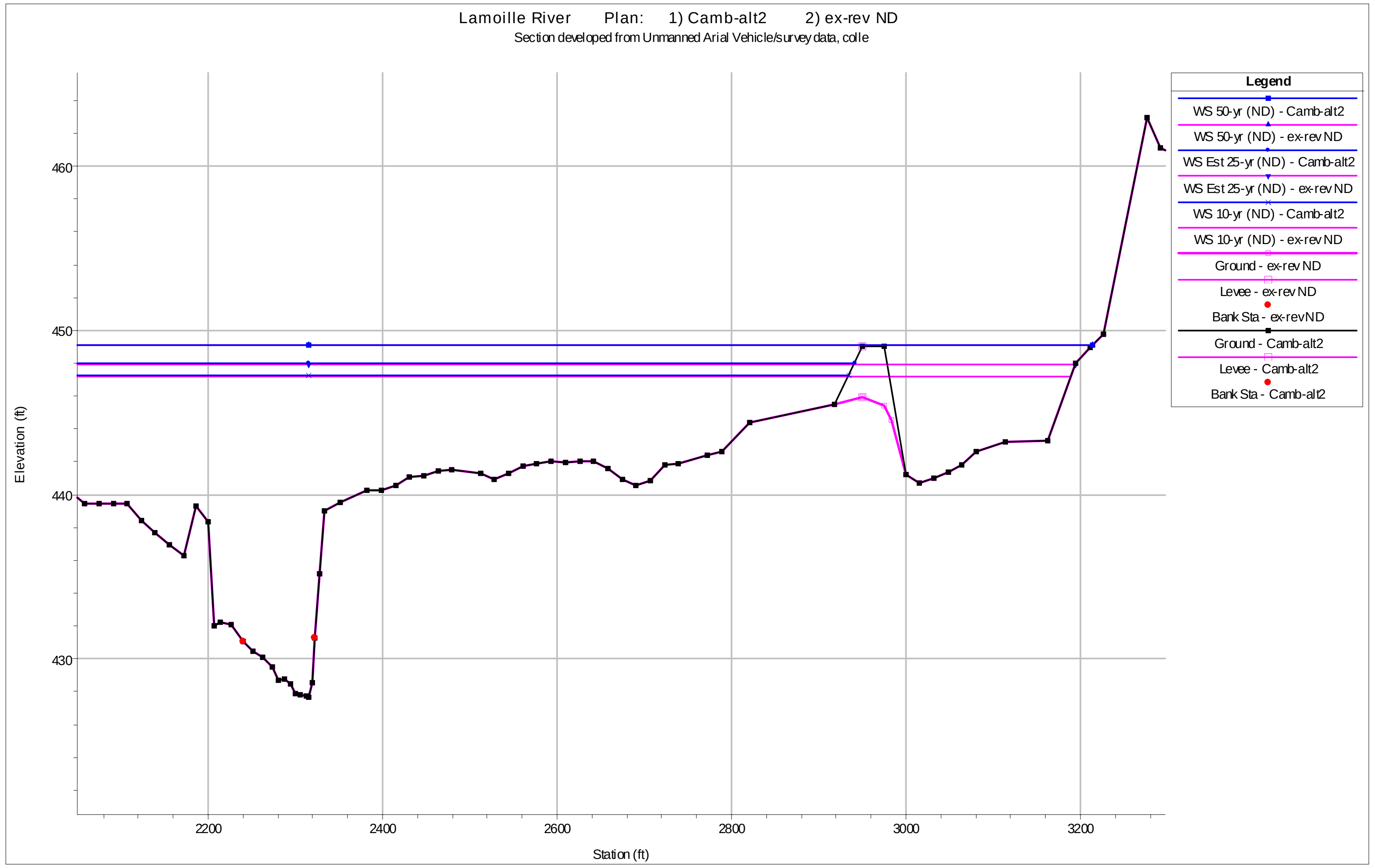
J. MacBroom, 2015

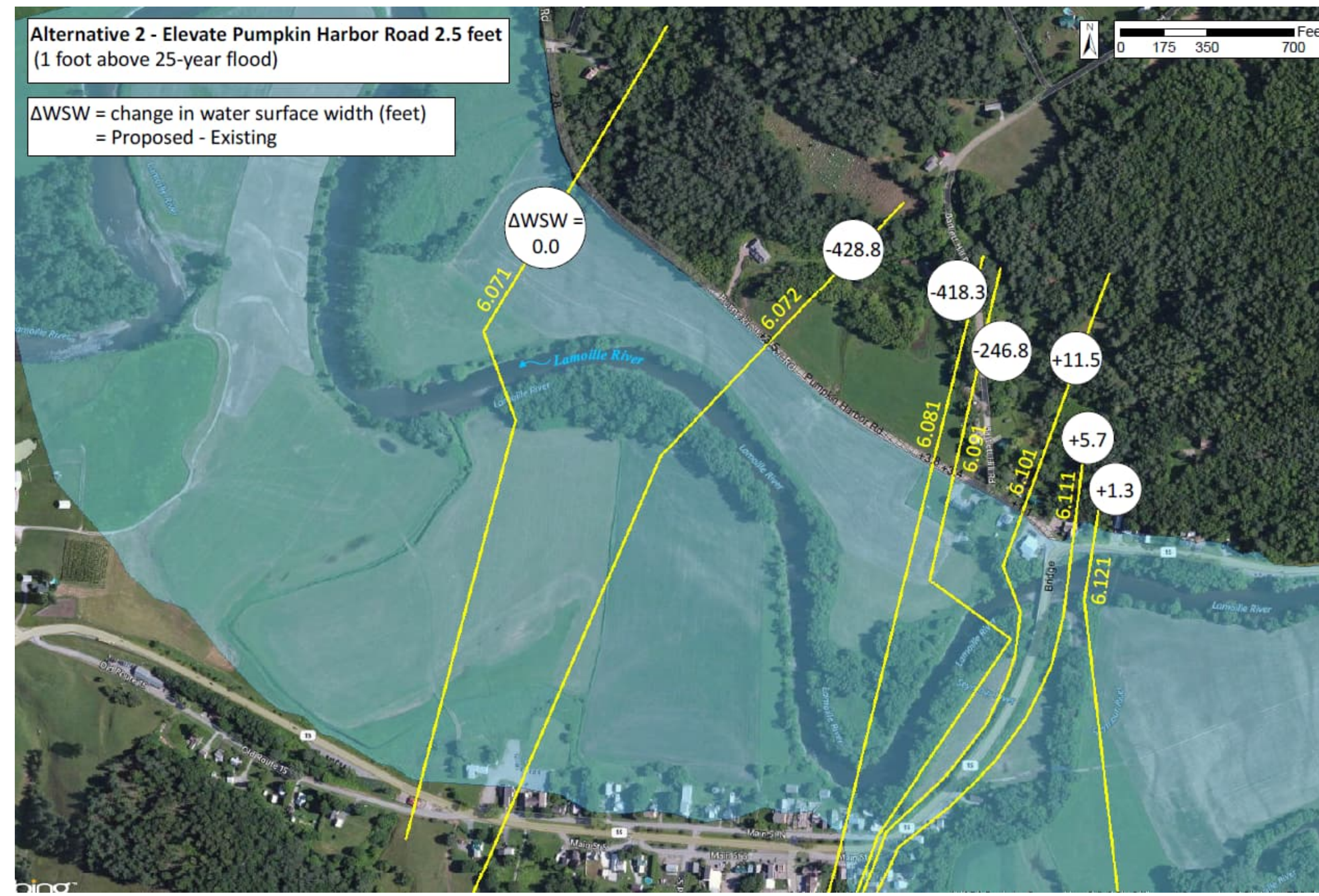
River Cross Section



- 6.071
- From Unmanned Arial Vehicle/survey data
- Collected July 2016
- Pumpkin Harbor Road area

Pumpkin Harbor Road, Cambridge





- Explored raising the road surface
- Evaluated changes in velocity, floodplain extent, water surface elevation
- Balance positive benefits and possible impacts