FLOODPLAIN MANAGEMENT AREAS

Evaluating the Costs and Benefits of Floodplain Protection Activities in Waterbury, Vermont and Willsboro, New York, Lake Champlain Basin, U.S.A.

Presented by
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Primary Research Question

Do the benefits of floodplain protection outweigh the costs?

Benefits

- Reduction of flood damages
- Lower recovery costs
- Increased health and safety
- Enhanced ecosystem services
- Social benefits

Costs

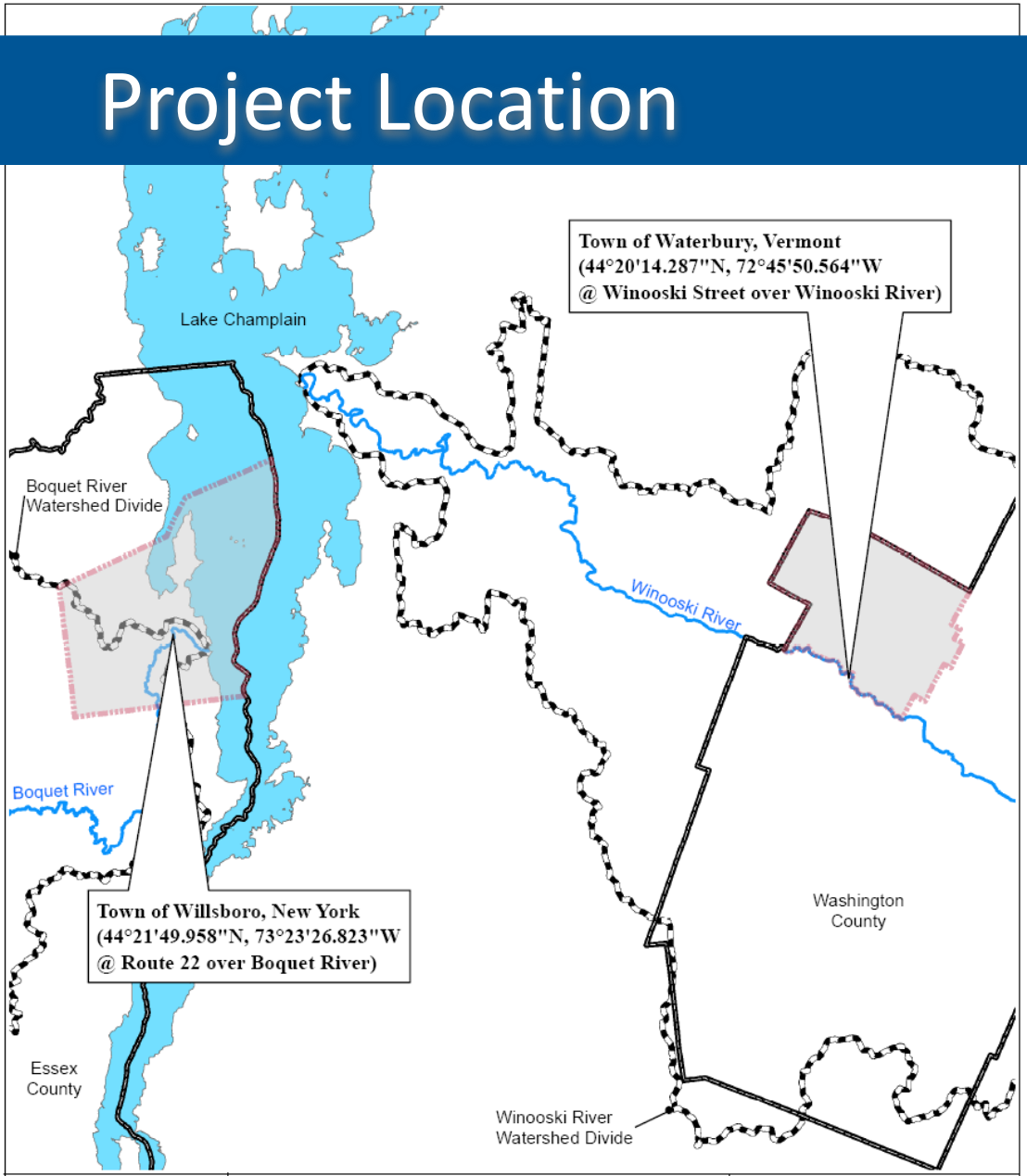
- Possible loss of economic opportunity
- Possible reduced tax base
- Floodplain restoration cost
- Increased building costs to flood-proof structures
- Recovery of structures remaining in the floodplain
- Demolitions

Hypotheses

1. The benefits of floodplain protection outweigh the costs over the long term because a complete accounting includes high-value ecosystem services.

2. Floodplain protection reduces future flood damages, improves public safety, and enhances water quality because the most at risk parcels are not developed.

Project Location



SOURCE(S):
NYS GIS Clearinghouse and VCGI

0 3 6 Miles

Project Location Map

LOCATION:
Waterbury, Vermont and Willsboro, New York

N

LCBP Costs and Benefits of Floodplain Protection

MXD: Y:\4199-05\GIS\Maps\Location Map.mxd

Map By: RAD
MMI#: 4199-05
Original: 11/7/2013
Revision: 11/14/2013
Scale: 1 inch = 5.8 miles

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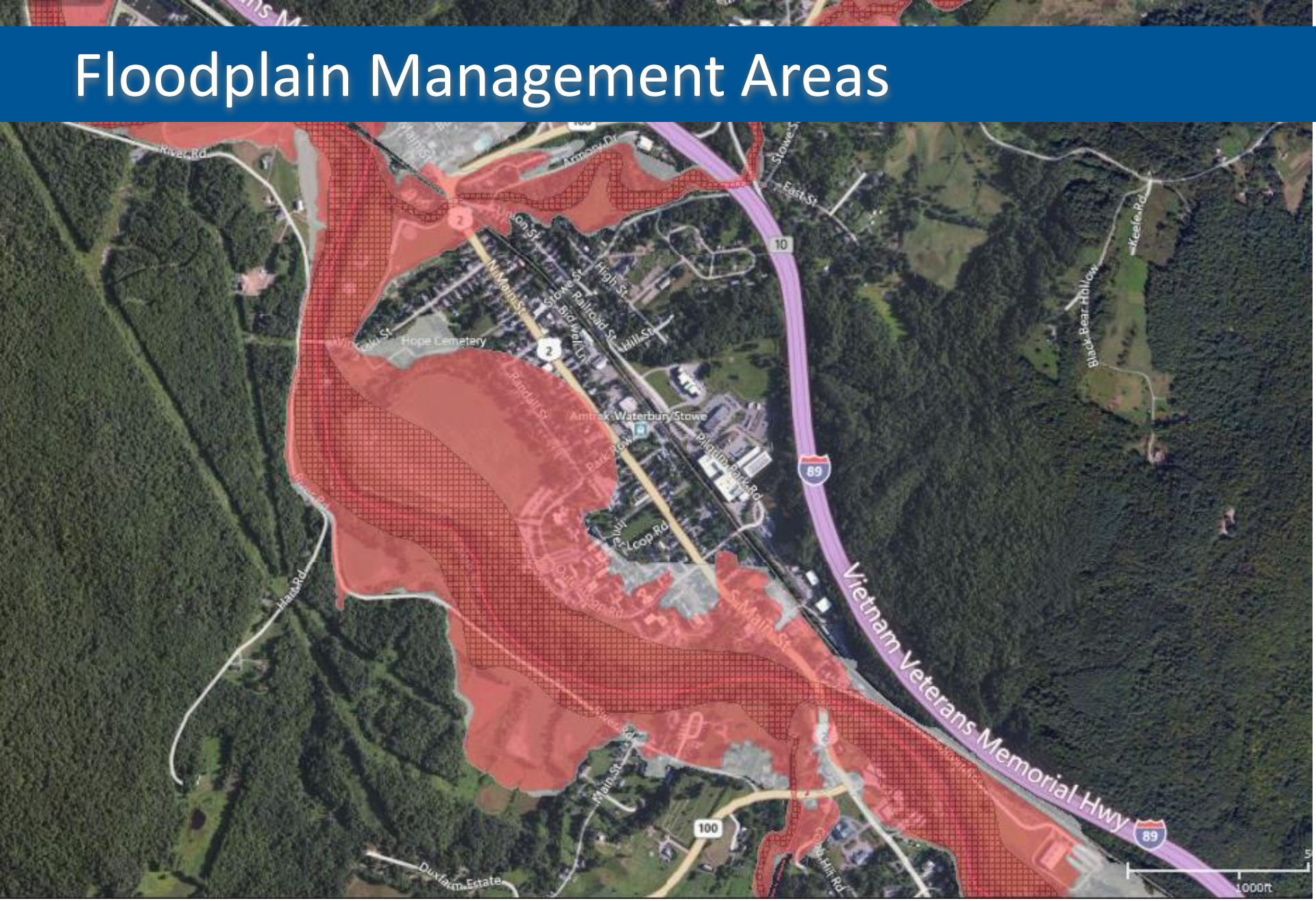
Floodplain Management Areas

1. FEMA floodway and floodplains.
2. Revised floodplains.
3. Post-restoration floodplains.
4. Downtown district.
5. River corridor.
6. Buffers.
7. Critical elevation for flooding.

Floodplain Management Areas



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Source: Slide provided by Earth Economics, 2013

SERVES

EARTH

Results for: [query string (truncated after 45 chars)]

To export this valuation please "select all" and choose the export format from the dropdown below the report table. To export specific values please click on all numeric values you want to export and choose the export format from the dropdown below.

Select all

	Agricultural		Forest		Lakes/Rivers		Saltwater Wetland or Salt		Temperate		Wetland	
Acres:	300		245		150		678		50		34	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Aesthetic and Recreational							$231.31	$462.63				
Gas and Climate Regulation									$39.08	$59.82		
Habitat Refugium and Nursery							$5.87	$734.74				
Water Regulation											$2.389.20	$7.395.13
Total by Cover Type	$29.25	$29.25	$0.18	$0.18	$6,215.89	$6,215.89	$237.18	$1,197.37	$39.08	$59.82	$2.389.20	$7.395.13

Annualized values by acre ($/acre/year) | **Annualized values ($/year)** | Asset values per acre ($/acre) | Total asset values ($)

View totals only for: default

Click here to view with rows & columns switched

select export format: Microsoft Excel Export

 | Help, Comments, Questions?

Save Query

FEMA

June 18, 2013

MITIGATION POLICY – FP-108-024-01

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 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

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

Build-out Analysis

Residential Development Potential Under Full Build-Out

Under Full Build-Out Scenario						
	Vacant/AG Land	Underdeveloped Land	Total Yield			
Zone	Total Net Buildable Vacant/Ag 20% Deduct [6] (Acres)	Total Net Buildable Underdeveloped 20% Deduct [6] (Acres)	Total Net Buildable Land	Dwelling Units from Vacant/Ag Land	Dwelling Units from Underdeveloped Lots	Total Potential Dwelling Units
RS-20	262.6	142.2	404.8	487	202	689
RS-12	45.8	64.9	110.7	128	118	246
RS-8	0.7	0.5	1.2	1	1	2
R-12	50.3	18.0	68.3	264	68	332
RU-20	205.9	125.3	331.2	567	272	839
R	1.2	1.2	2.4	4	2	6
R 5.1 [4]	4.8	18.9	23.7	31	85	116
R 5.2 [4]	14.3	25.4	39.7	105	111	216
R8 [4]	22.1	29.7	51.8	111	90	201
R-20 Noank	12.2	7.8	20.0	17	9	26
Single Family Zones < 1 Acre	**619.9**	**433.9**	**1,053.8**	**1,715**	**958**	**2,673**
R-40 Noank	70.1	29.2	99.3	71	18	89
RU-80	36.6	139.8	176.4	8	59	67
RU-40	992.5	275.7	1,268.2	996	237	1,233
Single Family Zones > 1 Acre	**1,099.2**	**444.7**	**1,543.9**	**1,075**	**314**	**1,389**
RMF-16	3.6		3.6	45		45
RMF-12	31.1		31.1	368		368
RMF-8	3.6		3.6	28		28
RM	3.9		3.9	27		27
Multi-Family Zones	**42.2**	**N/A**	**42**	**468**	**N/A**	**468**
Total [5]	**1,761.3**	**878.6**	**2,639.7**	**3,258**	**1,272**	**4,530**

[1] *Includes privately owned vacant land and agricultural land*

[2] *Single family residential parcels with 3 times the minimum lot size by right*

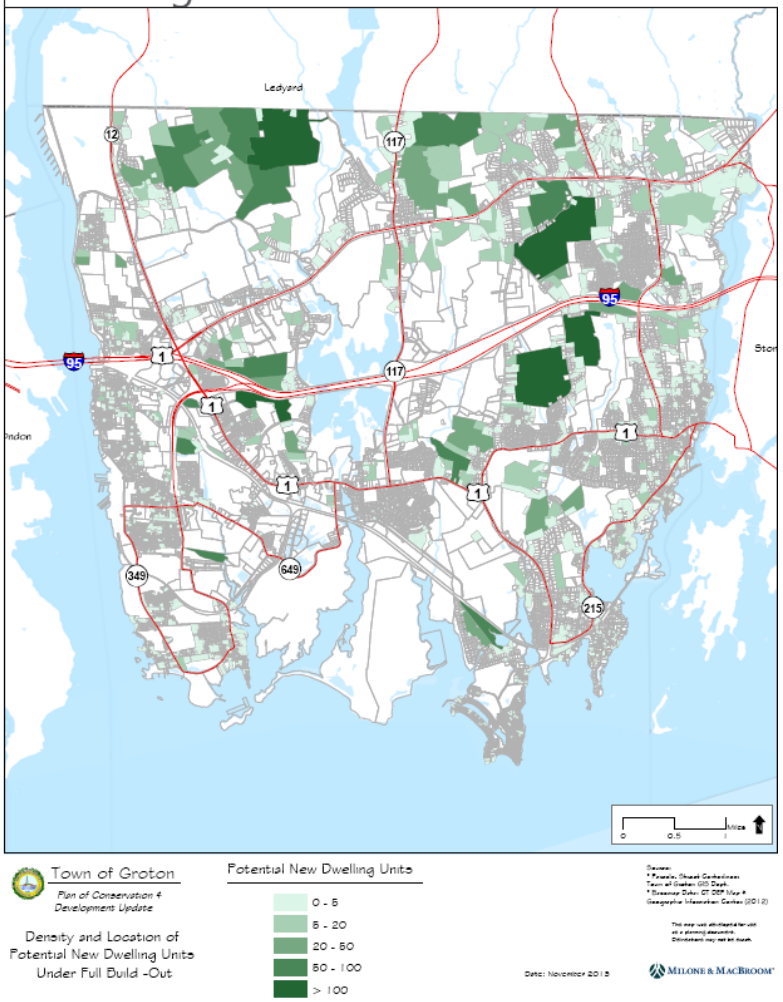
[3] *Contrained land is summed as follows: 100% 100 year flood plain, Inland Waterways, Watercourses; 80% Steep Slopes >25%; 35% Moderate Slopes 15% to 24%*

[4] *For Residential Zones in the City of Groton there are no defined Dwelling Units per Acres, therefore it was assumed that there could be 1 Unit per Minimum Lot Size. These zones may allow 2 Units per Building by Right, so the number of Potential Dwelling Units may be underestimated.*

[5] *Totals may be off due to repeated compound computer rounding at the parcel level*

[6] *Reflects deduction of 20% from Unconstrained Vacant, Agricultural & Underdeveloped land included in Build-Out.*

Density and Location of Potential Dwelling Units



Floodplain Management Regulations

Waterbury, VT

- 1 foot of freeboard above the BFE for houses
- 2 feet of freeboard or flood-proofing for non-residential buildings
- Basements are not allowed within the SFHA
- No filling can take place in the floodway unless an engineering analysis is performed to confirm no change in flood levels

Willsboro, NY

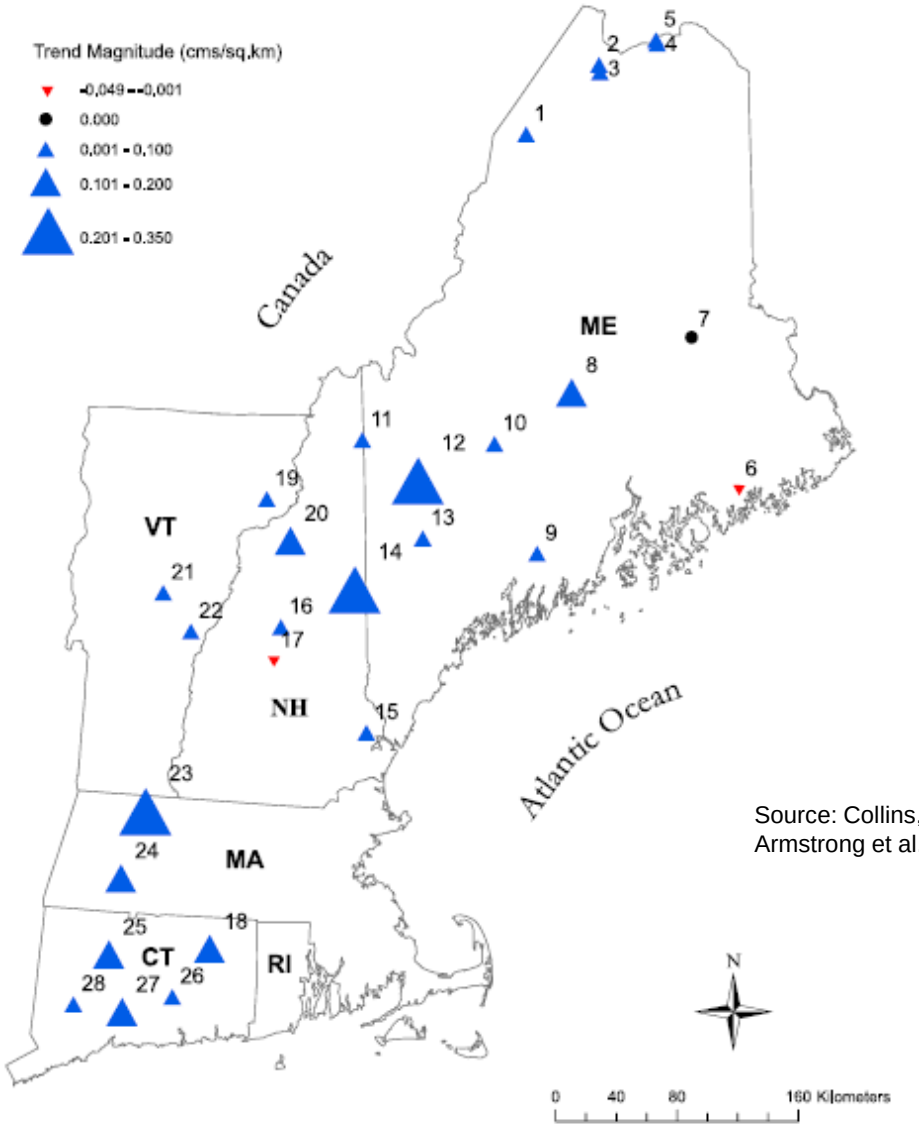
- Flood protection elevation 1 foot above the 100-year flood
- Lowest floor above the flood protection elevation
- Utilities in non-residential buildings above the flood protection elevation

VT Draft Floodplain Rules (Act 138)

1. Ensure compliance with National Flood Insurance Program floodplain management criteria;
2. Exceed NFIP criteria by:
   a. Prohibiting new encroachments in the River Corridor;
   b. Requiring the lowest floor of residential structures to be elevated at least two feet above the published base flood elevation (BFE);
   c. Requiring the lowest floor of non-residential structures be elevated at least two feet above BFE or be dry-flood-proofed to at least 2 feet above BFE;
   d. Requiring new and substantially improved critical facilities in the flood hazard area regulated under the rule to be elevated or dry floodproofed to the 500-year flood elevation or 2 feet above BFE, whichever is higher;
   e. Prohibiting storage of new toxic, flammable, or hazardous materials in the flood hazard area and river corridor (replacement fuel tanks needed to serve existing development are allowed provided they meet anchoring and elevation requirements);
   f. Requiring a No Adverse Impact (NAI) analysis and certification for development in flood hazard areas outside of the floodway, demonstrating no increase in flood elevations, velocities, or decrease in flood hazard area storage volume

3. The rule waives the NAI certification requirement for infill and redevelopment in Designated Centers(downtowns,village centers, etc) and farm production areas, in an effort to discourage encroachment along open floodplains, so long as other applicable floodplain management criteria are adhered to and the development does not encroach closer to the river than pre-existing development;

Hydrology



Source: Collins, 2009 and Armstrong et al., 2011

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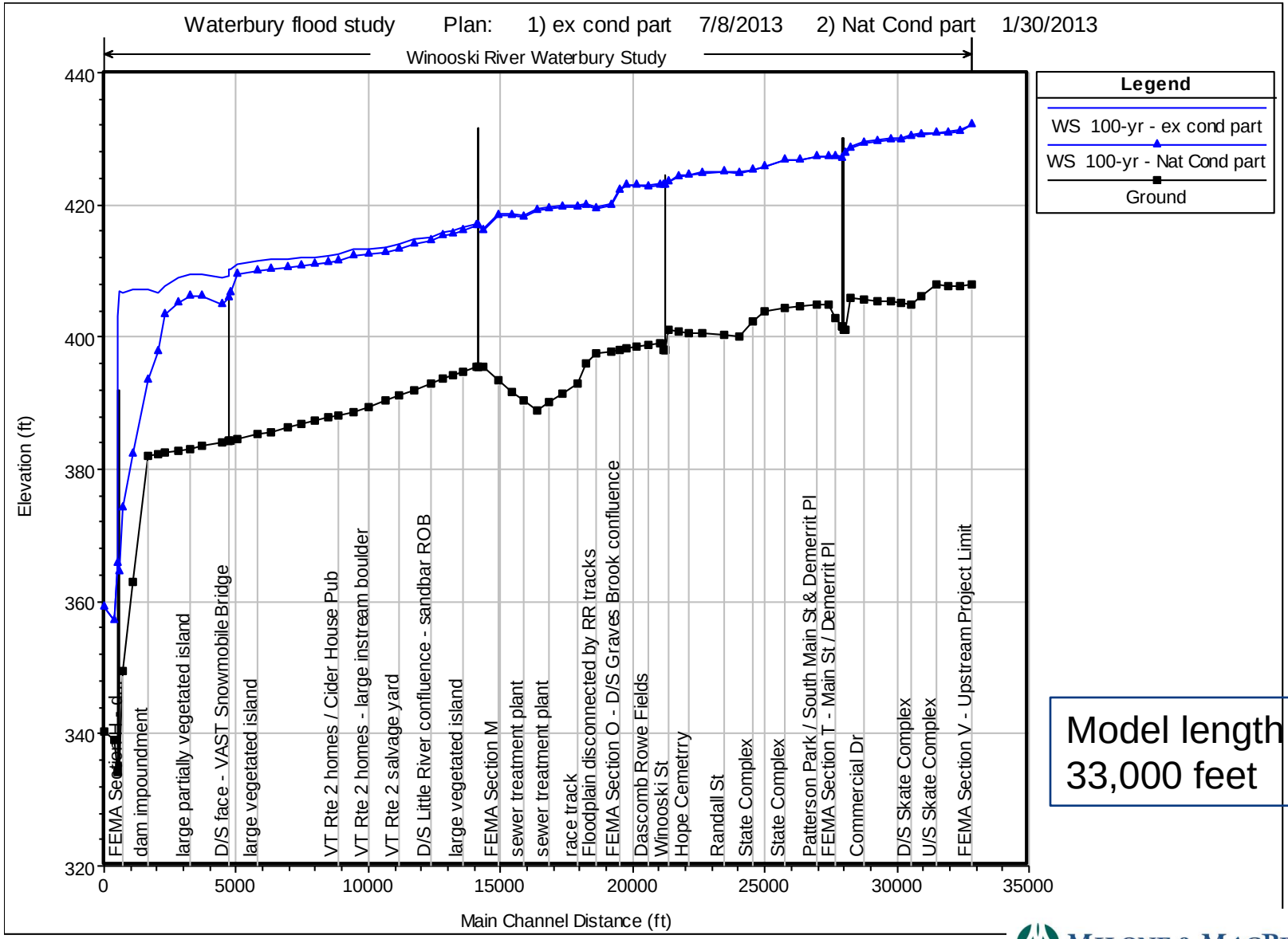
Hydraulics – Winooski River



Model length ~ 33,000 feet

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Consider Floodplain Restoration

Damage Modeling – HAZUS (and BCA)

Model Inputs

- 2000 census data and information on structures and infrastructure (Default)
- Input flood levels, floodplain limits, and DEMS (Hydraulics and topography)
- Values of infrastructure and buildings (Town records)
- Detail high-value buildings and essential facilities (Town records)
- Relate ground to first floor elevation (Field data)

Damage Modeling – HAZUS (and BCA)

Accuracy

- HAZUS provides estimates for large areas while BCA provides more accurate estimates for specific buildings
- Range of uncertainty is factor of 2 with good inventories of built environment , demographics, and economics
- Census block analysis. The methodology has been tested against actual events and provided a credible estimate of aggregated losses, but less accurate estimates of local partial damages.
- Results presented in 2006 dollars. Plan to make spreadsheet and perform net present value to get values to 2014 and 2114.

Damage Modeling – HAZUS (and BCA)

Primary Use

- Provide a baseline damage level to which proposed solutions may be compared
- Evaluate the cost-effectiveness of various proposals to mitigate flooding risk
- Using HAZUS-MH results as a comparison point, rather than an absolute value, will eliminate concerns regarding uncertainty

DELIVERABLE SCHEDULE:

Table ID	Task #	Deliverable	Date(s)
1	6.1	QAPP	January 10, 2014 to LCBP. Approval anticipated February 14, 2014.
2	6.2	Quarterly reports	Submitted to LCBP within ten days of December 31, 2013; March 31, 2014; June 30, 2014; September 30, 2014; and December 31, 2014.
3	1.0	Research	March 31, 2014
4	2.0	Floodplain management alternatives	April 30, 2014
5	3.0 & 4.0	Hydrolgy and hydraulics	May 30, 2014
6	5.0	Damage modeling	September 30, 2014
7	6..3	Interim report	November 14, 2014
8	6.4	Final report	December 31, 2014

		2013 Dec		2014 Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
1.0 Research																											
1.1	GIS map																										
1.2	Literature review / annotated bibliography																										
1.3	Ecosystem benefit ROV																										
1.4	Document archive								3																		
2.0 Floodplain Management Alternatives																											
2.1	Delineation, GIS mapping, and meeting																										
2.2	Identify key environmental and social aspects of alternatives																										
2.3	Build-out analysis																										
2.4	Floodplain Management Alternatives																										
2.5	Meet with Towns and revise alternatives									4																	
3.0 Hydrology																											
3.1	Flood frequency analysis to predict current flows																										
3.2	Predict future flows																										
4.0 Hydraulics																											
4.1	Existing conditions model updates																										
4.2	Existing conditions GIS floodplain mapping																										
4.3	Proposed conditions modeling																										
4.4	Proposed conditions GIS floodplain mapping												5														
5.0 Damage Cost Estimates																											
5.1	Data collection																										
5.2	Hazus existing conditions model																										
5.3	Hazus proposed conditions model																										
5.4	Tabulate and review data																										
5.5	Meet with the Town																				6						
6.0 Reporting and Communications																											
6.1	QAPP			1		1																					
6.2	Quarterly progress reports		2						2						2						2						2
6.3	Interim report																							7	REV		
6.4	Final report																										8