TECHNICAL MEMORANDUM

TO: Waterbury Flood Study Project Team

FROM: Milone & MacBroom, Inc.

DATE: November 4, 2013
Revised December 10, 2013

RE: **Winooski Street Bridge Restriction Study**
Phases II and III Summary
MMI #4942-01

Introduction:

The purpose of this memorandum is to summarize work completed during Phases II and III of the *Winooski Street Bridge Restriction Study*, also known as the *Waterbury Flood Study*. Refinements were made to the hydraulic alternatives analysis and the conceptual design of the preferred alternative was completed. The hydraulic modeling in Phase I was refined to include field survey conducted as part of this project to confirm initial findings in the alternatives analysis and refine the preferred alternative. The alternatives analysis conducted in Phase II focused on a sub-set of the alternatives explored during Phase I that appeared to reduce flood levels in Waterbury and Duxbury during modeled large floods. The analysis was expanded to include new ideas for flood reduction and to begin evaluating the feasibility of implementation.

Phase II of the project included tasks to support an application for a FEMA Hazard Mitigation Grant to fund implementation of the preferred alternative. Results from the updated hydraulic model were used to support an initial benefit cost analysis completed by FEMA. Phase III included conceptual design of the preferred alternative that included an initial ballpark engineer's opinion of probable construction cost.

Numerous coordination meetings were conducted during Phases II and III, including project team meetings, presentations to the Waterbury and Duxbury Selectboards, meetings with landowners, and site visits with utility companies. A meeting was held with the Vermont Department of Buildings and General Services (BGS) to discuss proposed floodplain restoration efforts and coordinate with on-going renovations of the State Office Complex.

Data Collection:

As recommended at the completion of Phase I where a possible flood reduction alternative was identified, field survey was conducted to refine the model input data. Seventeen cross sections were surveyed including the river channel and adjacent floodplain areas at key locations within the study reach in May of 2013 by Little River Survey Company, LLC of Stowe, Vermont (Figure 1 and full-size attachment). The surveyed sections were primarily located within the reach beginning at the Waterbury Sewer Treatment Plant and the Duxbury (Harvey's) Farm Field extending upstream to the State Office Complex.

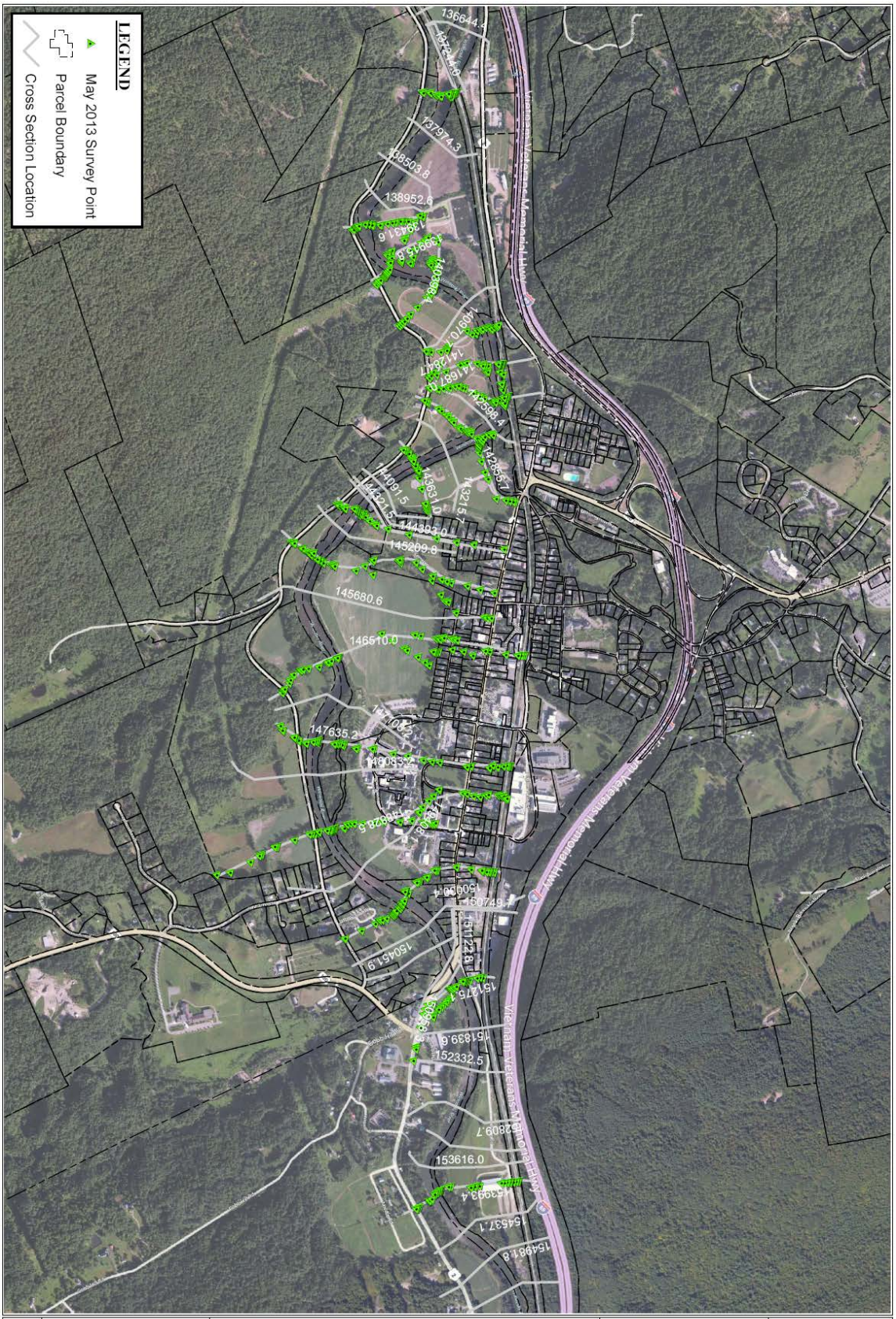

Figure 1	Map By: BMC MMI#: 4942-01-3 MXD: WaterburyStudy_Fig1.mdx 1st Version: October 8, 2013 Revision: --- Scale: 1" = 1000'	OVERVIEW MAP - SURVEY UPDATES WATERBURY FLOOD STUDY WATERBURY, VERMONT	SOURCE(S): Vermont River Management Program Vermont Center for Geographic Information Bing Maps Aerial 0 250 500 1000 Feet	Engineering, Landscape Architecture and Environmental Science MILONE & MACBROOM® 1 South Main Street, 2nd Floor Waterbury, Vermont 05676 (802) 882-8335 Fax (802) 882-8346 www.miloneandmacbroom.com

Five existing cross sections were extended through Waterbury Village and across South Main Street to provide additional topographic information in areas that are not covered by existing LIDAR data that were used to develop the effective FEMA hydraulic model. The areas around the extended cross sections have experienced flooding in the past and may lie in the FEMA 100-year floodplain even though the effective flood maps show these areas to be outside of the floodplain.

The cross section geometry of the hydraulic model was updated with the new field survey data. The revised cross sections generally had a similar shape, but some differences existed especially in the dimensions of the wet channel (Figure 2).

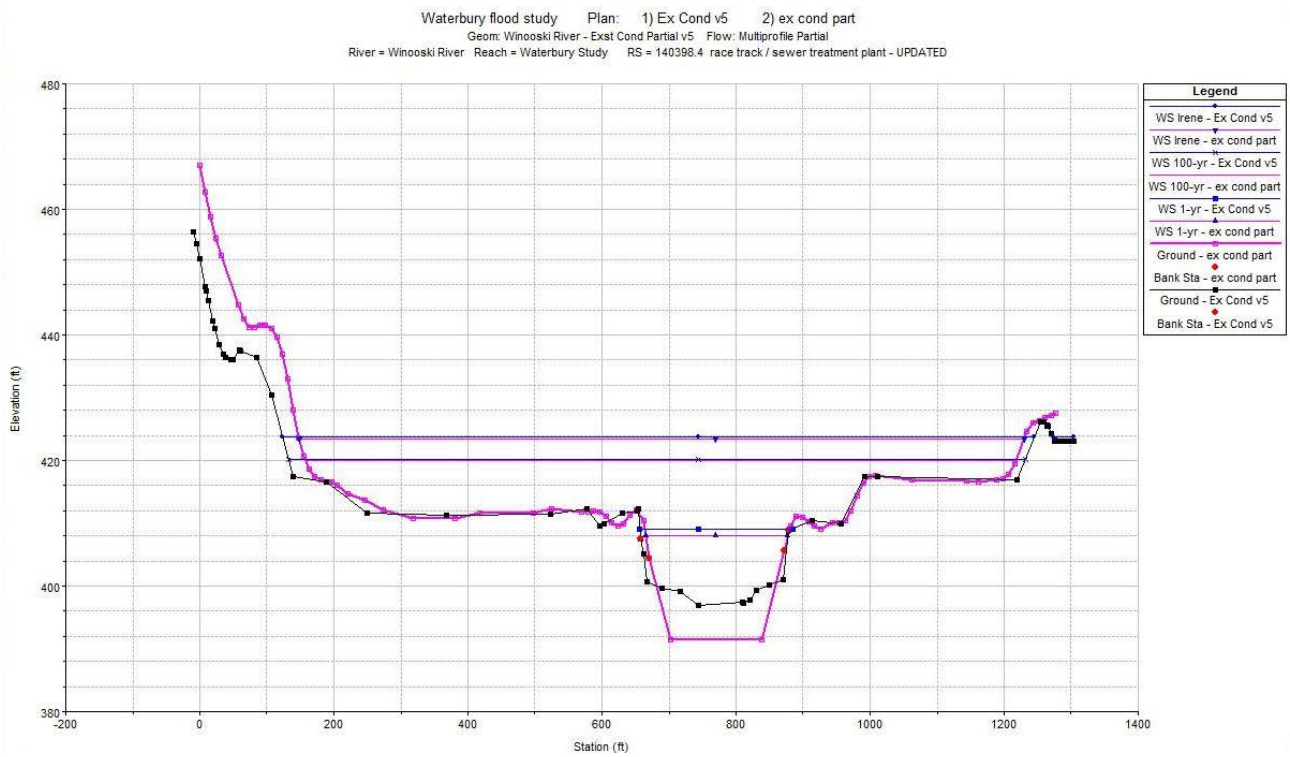

Figure 2: Comparison of Hydraulic Model Existing Cross Section Based on LIDAR (purple) and New Field Survey (Black).

The results of the updated existing conditions hydraulic model show subtle changes in the flood water surface profiles (Table 1). The updated model resulted in a small increase in flood water surface elevations at the downstream end of the study reach compared to the original hydraulic model. Flood water levels generally decreased upstream of the State Office Complex in the model updated with field survey compared to the original model developed mostly using LIDAR.

Table 1: Comparison of Existing Conditions Flood Levels in the Original LIDAR-Based Model (Phase I) and the Updated Model with New Field Survey (Phase II)

Location	100-year Storm			500-year Storm		
	Phase I (NAVD88)	Phase II (NAVD88)	Difference (feet)	Phase I (NAVD88)	Phase II (NAVD88)	Difference (feet)
Railroad Bridge (U/S)	417.1	417.1	0.0	420.2	420.2	0.0
Sewer Treatment Plant	419.4	419.5	+0.1	423.0	423.2	+0.2
Duxbury Horse Track	420.2	420.5	+0.3	423.8	424.0	+0.2
Duxbury Farm Field	423.1	423.1	0.0	426.8	426.8	0.0
Dascomb Rowe Field	423.1	423.1	0.0	426.7	426.6	-0.1
Hope Cemetery	424.6	424.8	+0.2	428.4	428.3	-0.1
State Corn Field	425.1	425.4	+0.3	428.9	428.8	-0.1
State Office Complex	426.9	426.7	-0.2	430.3	429.7	-0.6
South Main St Bridge (D/S)	427.4	427.0	-0.4	430.8	429.8	-1.0
South Main St Bridge (U/S)	428.8	428.6	-0.2	433.4	432.6	-0.8
Upstream Study Limit	432.2	432.1	-0.1	436.1	435.6	-0.5

Updated Alternatives Analysis:

The broad list of alternatives explored during Phase I was consolidated to a sub-set of alternatives that were initially found to be the most effective at reducing water levels during large floods. These alternatives were re-evaluated and refined with the updated hydraulic model during Phase II. The alternatives selected for further study were all variations of floodplain restoration (Alternative 2) explored during Phase I (Table 2). The Phase I assessment showed that the incised river primarily needs more access and storage on the floodplain to lower flood levels.

Table 2: List of Phase II Alternatives

Alternative 2 Variations	**Proposed Change(s)**
Alternative 2A	Reconnect floodplain at Duxbury Farm Field, lowered to a level equal to a 2-yr storm event.
Alternative 2C-1	Reconnect floodplain at Duxbury Farm Field, lowered to a level equal to a 1-yr storm event.
Alternative 2C-2	Reconnect floodplain at Duxbury Farm Field excluding the horse riding ring, lowered to a level equal to a 1-yr storm event.
Alternative 2D-1	Reconnect floodplain at Duxbury Farm Field, at a portion of the State Corn Field, and at the State Office Complex, lowered to a level equal to a 1-yr storm event.
Alternative 2D-2	Reconnect floodplain at Duxbury Farm Field excluding the horse riding ring, at a portion of the State Corn Field, and at the State Office Complex, lowered to a level equal to a 1-yr storm event.
Alternative 2D-3	Reconnect floodplain at Duxbury Farm Field excluding the horse riding ring and along River Road in Duxbury, lowered to a level equal to a 1-yr storm event.
Alternative 2D-4	Reconnect floodplain at Duxbury Farm Field excluding the horse riding ring, at a portion of the State Corn Field, and along River Road in Duxbury, lowered to a level equal to a 1-yr storm event.
Alternative 2D-5	Reconnect floodplain at Duxbury Farm Field excluding the horse riding ring, at a portion of the State Corn Field, and at the State Office Complex excluding the forested wetland, lowered to a level equal to a 1-yr storm event.
Alternative 2D-6	Reconnect floodplain at Duxbury Farm Field excluding the horse riding ring, at a portion of the State Corn Field, at the State Office Complex excluding the forested wetland, and along River Road in Duxbury, lowered to a level equal to a 1-yr storm event. Also incorporates the planned State Office Complex improvements.

The updated hydraulic modeling confirmed that lowering of the Duxbury farm fields to restore floodplain is the most effective alternative to reduce flood levels along this stretch of the Winooski River. Establishing floodplain at this location was a part of each alternative showing flood reduction investigated in Phase II. Variations of this area were explored including lowering the pasture and riding track areas different amounts. Flood reduction benefits still take place when lowering just the pasture area and leaving the riding track area as existing.

The hydraulic modeling shows that the channel geometry adjacent to the Duxbury farm field and lack of floodplain access is causing a back-up of water that submerges the outlet of the Winooski Street Bridge during large floods. The water pushing up through the bridge appears to create backwatering that carries upstream towards South Main Street. Once the backed up water is released by lowering the floodplain at the Duxbury fields, the tailwater at Winooski Street is reduced by more than one foot and the flood depths lower upstream through the State Office Complex. This study began with a focus on the suspected constriction at the Winooski Street Bridge, yet the hydraulic model shows that additional flood conveyance and storage created by lowering the Duxbury farm fields downstream of the bridge reduces the build-up of water along the study reach.

In addition to the farm field in Duxbury, some lands behind the State Office Complex in Waterbury were confirmed to have some local flood reduction potential. Lowering a portion of the State Corn Field between the edge of the river and the existing utility lines that traverse the field reduced local flood levels. Additionally, a portion of the hay field located behind the State Office Complex further upstream would be lowered to create additional flood storage. Each floodplain restoration area would be lowered to approximately the 1-year flood level and thus would inundate every year. The results of the hydraulic model indicate that floodplain restoration behind the State Office Complex is effective at providing flood depth reduction locally that would benefit both Waterbury and Duxbury.

Floodplain restoration in the forested wetland behind the State Office Complex initially appeared to provide flood reduction benefits. Input from the Vermont Rivers Program provided firsthand knowledge that the forested wetland was already well connected to the river channel and flooded every year. This information raised questions about the validity of the survey and LIDAR data collected within the forested wetland. A site walk was conducted and it appeared that the survey data were high compared to the actual terrain within the forested area. The surveyor was contacted and some of the data were corrected. The corrected survey data corroborated observations of regular flooding at the site and confirmed that there was not a large amount of additional flood storage available. In addition, the forested area contains a Class 2 wetland according to the Vermont State Wetland Inventory. Impacts to this area are not justified for the minimal amount of additional flood storage available.

Based on discussions with project team members and local officials during Phase II of the project, a floodplain restoration alternative along River Road in Duxbury was evaluated. Under this alternative River Road was relocated further away from the Winooski River and new floodplain areas were created. The model showed limited reduction in flood levels due to the fact that the area along River Road is low and already floods frequently every year or two. Restoration of the floodplain along the Duxbury side of the Winooski River is less effective in this area because little flood storage would be added to the system.

During Phase II the proposed improvements under way at the State Office Complex were incorporated into the alternatives to model future conditions with possible floodplain restoration alternatives. The future conditions were incorporated into the alternatives analysis by modifying the geometry of the cross sections that pass through the State Office Complex based on the grading shown on design plans for the Complex renovations. Floodplain restoration areas adjacent to the State Office Complex were blended with the proposed improvements where the two touched.

Ballpark engineer's opinions of probable construction costs were prepared for each of the alternatives explored during Phase II. The cost opinions were used to provide some of the information needed as part of the HMGP funding application submitted by the Central Vermont Regional Planning Commission. An updated alternatives matrix was prepared that summarizes the areas explored under each alternative, the estimated flood reduction at different locations along the study reach, and the ballpark cost opinion for several of the alternatives (Table 3).

Preferred Alternative:

The preferred alternative includes:

- Floodplain restoration at the Duxbury (Harvey's) Farm Field;
- Floodplain restoration at the State Corn Field; and
- Floodplain restoration at the hay field located behind the State Office Complex.

The model results indicate that flood depth reductions range from 1.1 to 0 feet for the 100-year flood and 1.2 to 0 feet for the 500-year flood (Table 3). Flood reductions are less than in Phase I model results primarily due to the updates in cross sectional geometry showing a lower existing floodplain in some areas, and thus less available storage increase under proposed restoration.

Table 3: Existing Conditions vs. Preferred Alternative Conditions

Location	100-year Storm			500-year Storm		
	Existing (NAVD88)	Preferred (NAVD88)	Difference (feet)	Existing (NAVD88)	Preferred (NAVD88)	Difference (feet)
Railroad Bridge (U/S)	417.1	417.1	0.0	420.2	420.2	0.0
Sewer Treatment Plant	419.5	419.5	0.0	423.2	423.2	0.0
Duxbury Horse Track	420.5	420.5	0.0	424.0	424.0	0.0
Duxbury Farm Field	423.1	422.2	-0.9	426.8	425.6	-0.8
Dascomb Rowe Field	423.1	422.0	-1.1	426.6	425.4	-1.2
Hope Cemetery	424.8	424.1	-0.7	428.3	427.6	-0.7
State Corn Field	425.4	424.5	-0.9	428.8	428.0	-0.8
State Office Complex	426.7	426.3	-0.4	429.7	429.2	-0.5
South Main St Bridge (D/S)	427.0	426.6	-0.4	429.8	429.3	-0.5
South Main St Bridge (U/S)	428.6	428.3	-0.3	432.6	432.1	-0.5
Upstream Study Limit	432.1	431.9	-0.2	435.6	435.4	-0.2

Conceptual Design:

Under the preferred alternative, approximately 13.2 acres of floodplain area would be created at the Duxbury farm field (Alternative 2C-2) (Table 4, Figure 3, and full-size attachment). The maximum cut depth would be 12 feet, while the average cut depth would be approximately 7.5 feet. The slope at the rear of the newly created floodplain would be armored to protect against erosion during future flooding events. The horse track would remain at its current elevation and a smooth transition would take place from the lowered floodplain, around the horse track, and back to the river. Given that this area washed out during Irene, the transition from the floodplain back to the more confined river bank would need to be armored with large stone to resist erosion. The ballpark engineer's opinion of probable cost for the Duxbury farm field portion of the preferred alternative is approximately $3.2 million dollars (Table 5).

Several meetings were held between the project team and the Harveys who own the Duxbury farm field where floodplain restoration is proposed. The preferred alternative was described along with some options for compensation for restoration of some of their land to floodplain. A land use conflict exists in that the Harveys pasture and train horses on the Duxbury farm field and discussions indicate that this use is not compatible with inundation of the field as it ruins the hay for the horses. Although lowering of the horse track improves flood reduction in the upstream river reach, the track was not included in the preferred alternative as this area is currently used for training horses and cannot be inundated and sustain limited flood damage.

Some options have been discussed with the Harveys such as swapping lands in the area and compensation, but no agreement has been made about implementing this alternative. Discussions suggest that the Harveys are not interested in changing the use of their land at this time. Future discussions should take place to confirm their interest level now and moving forward. The parcel of land should be targeted for river corridor conservation for future floodplain restoration of both the pasture and horse track area. Activity on this land will require willing participation by the Harveys or future landowners.

A Velco transmission line exists at the Duxbury farm field and two large laminated wood utility structures are located on the property in the area where floodplain restoration is preferred. Some erosion took place at these structures during Irene. The two structures would need to be armored and possibly lowered to protect them from flood hazards if floodplain restoration takes place and the structures remain in their current location. The structures could also be moved if the floodplain restoration project moves forward. Resolution of the Velco utility structures will be an important part of future design.

A presentation was given to the Duxbury Selectboard at a special meeting on August 21st, 2013. The hydraulic modeling, alternatives analysis, and preferred alternative were reviewed. The Selectboard was asked to provide a letter of support for the project but declined to do so due to their desire to dredge the river rather than restore floodplain. The main source of apprehension to supporting the project was the concern that support could lead to the need for a future financial investment to maintain restored floodplain.

The State Corn Field at the back of the State Office Complex would provide an additional 23.6 acres of floodplain combined (Preferred Alternative) (Table 4, Figure 3, and full-size

attachment). The maximum cut depth within the State Corn Field area would be 6 feet with an average cut depth of approximately 2 feet. Within the State Office Complex floodplain restoration area on the upstream hay field, the maximum cut would be 5 feet with an average cut of 2.5 feet. The ballpark cost opinion with all three areas combined is approximately $4.4 million dollars (Table 6).

The land in Waterbury where the preferred alternative would take place is managed by the State of Vermont. As part of Phase II, a meeting was conducted on July 9th, 2013 with staff from BGS to review the alternatives analysis and preferred alternative. BGS supports the project and is willing to participate with floodplain restoration at the State Corn Field and possibly the hay field at the back of the State Office Complex.

A field trip was conducted with Green Mountain Power to review utility conflicts with their infrastructure located around the State Office Complex. No conflicts appear to exist in the preferred floodplain restoration areas. A line and series if structures are located in the State Corn Field, yet these are located just beyond the preferred floodplain lowering. The power company indicated that a conflict did not seem to exist with the implementation of the project.

A project update was given to the Waterbury Selectboard on August 5th, 2013 that included a review of the preferred alternative. There appeared to be general support for the project. An inquiry was raised about funding and required match to implement the project.

Hydrology:

A study of the flood flow and inundation area during Tropical Storm Irene was initiated by the United States Geological Service (USGS) regional office as Phase II of this project advanced. Data sharing and coordination took place. Initial results of the USGS study estimate that the flood flow experienced in the Winooski River through the study reach during Irene was 59,200 cubic feet per second (cfs). The previously calculated flow rate summarized in the Phase I memorandum was estimated to be approximately 56,200 cfs, or approximately 5% less than the preliminary value calculated by the USGS. The close agreement between the two estimations performed using different data inputs suggests a good approximation exists for the Irene flow at the project site. As a comparison, the published FEMA peak flow rate for the 100-year flood is 42,400 cfs and the 500-year flood is 57,100 cfs.

HMGP Application & BCA:

A Hazard Mitigation Grant application was completed and submitted during Phase II. The application package was coordinated and prepared by the Central Vermont Regional Planning Commission with support of the project team.

Milone & MacBroom, Inc. provided information regarding the extent of the flooding during the 10-year, 50-year, 100-year, and 500-year floods. The effective FEMA existing floodplains were delineated from the original FEMA hydraulic model used during Phase 1 of this study. Phase II modeling suggests that the floodplains need to be updated using the model with field survey and additional topographic data in the floodplain that is slated for collection in Fall 2013. The revised floodplain mapping will confirm where the existing floodplain exists and allow for a

more accurate picture of the expected changes to the floodplain when implementing the preferred alternative. The approximate flood extents were used to prepare the initial FEMA benefit-cost analysis. Engineer's opinions of probable costs were prepared and submitted along with the application materials. Updates to the cost have been made since the initial submission.

FEMA prepared initial benefit-cost analysis with information from the hydraulic modeling and estimations on maximum damages. A maximum possible benefit of $3 million was identified indicating that funding of the project with a similar cost could be possible. If a grant is awarded, the next steps would be refinement of the benefit-cost analysis and then advancing design. At the time of drafting this memorandum the HMG application process is still underway.

Floodplain Delineation & Depth Change Mapping:

The 10-year, 50-year, 100-year, and 500-year proposed floodplains were delineated based on the results of the preferred alternative hydraulic modeling. The floodplain boundaries were drawn using topography based on the available LIDAR data. In the area where a gap in the LIDAR data exists, a floodplain boundary was approximated based on the recent cross section survey and approximate contours developed using the Vermont HydroDEM (Digital Elevation Model) created by the Vermont Center for Geographic Information (VCGI).

Comparison of the existing and proposed 100-year and 500-year floodplain boundaries indicates that the extent of flooding with the preferred alternative in place will generally decrease in Duxbury and Waterbury along the study reach from the Dascomb Rowe Fields up through the Waterbury Ice Center. Reduction in the area flooded was estimated to be 11 acres during the 100-year storm and 17 acres during the 500-year storm if the preferred alternative is implemented.

The modeled reduction in flood depth when implementing the preferred alternative was mapped for the 100-year flood (Figure 4) and the 500-year flood (Figure 5). The change in flood depth in the floodplains was created by subtracting the existing flood depths from the proposed flood depths with the preferred alternative in place. Negative numbers indicate a reduction in flood depths and the results are shown as a color gradation with 0.2 foot increments in flood depth change. The largest decrease in flood depth takes place in the vicinity of Dascomb Rowe Fields. Reductions in flood depth decrease moving upstream to the Ice Center, yet improvements are visible throughout the reach. Flood depths increase at Butler Pond and along the Harvey lands where floodplain is proposed to be lowered. Change in flood depth mapping could not be created in the area where approximate floodplain delineations were created.

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Table 4: Alternatives Analysis Summary

Modeling Change / Modification	Alternate No. 2A	Alternate No. 2C-1	Alternate No. 2C-2	Alternate No. 2D-1	Alternate No. 2D-2	Alternate No. 2D-4	Alternate No. 2D-5	Alternate No. 2D-6	Preferred Alternative
Duxbury Field Floodplain Reconnection (2-yr depth)	✓								
Duxbury Field Floodplain Reconnection (1-yr depth)		✓	✓	✓	✓	✓	✓	✓	✓
with lowered Horse Riding Track (1-yr depth)		✓		✓					
State Complex Floodplain Reconnection (1-yr depth)				✓	✓				
Revised State Complex Floodplain Reconnection (1-yr depth)							✓	✓	✓
State Office Complex Site Improvements								✓	✓
State Corn Field Floodplain Reconnection (1-yr depth)				✓	✓	✓	✓	✓	✓
River Road Relocated / Fields in Duxbury (1-yr depth)						✓		✓	
Patterson Park, Duxbury	-0.3	-0.4	-0.3	-1.1	-1.0	-0.5	-0.5	-0.6	-0.4
Intersection of Main Street and River Road, Duxbury	-0.3	-0.4	-0.4	-1.1	-1.0	-0.5	-0.5	-0.6	-0.4
River Road bend, Duxbury / State Complex, Waterbury	-0.4	-0.6	-0.6	-0.9	-0.8	-0.8	-0.9	-1.0	-0.9
Randall Street, Waterbury	-0.5	-0.8	-0.7	-1.0	-0.9	-0.9	-0.8	-0.9	-0.8
Dascomb Rowe Park, Waterbury	-0.7	-1.1	-1.0	-1.1	-1.0	-1.0	-1.0	-1.0	-1.0
Draft Opinion of Probable Construction Costs									
Subtotal	$2,077,000	$3,405,000	$2,827,000	$6,875,000	$6,297,000				$3,851,000
Engineering and Permitting	$100,000	$100,000	$100,000	$125,000	$125,000				$125
Contingency	$207,700	$340,500	$282,700	$687,500	$629,700				$385,100
Total	$2,384,700	$3,845,500	$3,209,700	$7,687,500	$7,051,700				$4,361,100

NOTE: Flood depth reductions shown in feet and based on the modeled 100-year flood.

Table 5: Ballpark Engineer's Opinion of Probable Costs – Duxbury Farm Field

Description	Unit	Quantity	Unit Price ($)	Amount ($)
SITE PREPARATION				
MOBILIZATION	LS	1	15,000	15,000
SEDIMENT AND EROSION CONTROLS	LS	1	20,000	20,000
FLOODPLAIN RESOTRATION				
CLEARING AND GRUBBING	AC	18	5,000	90,000
EARTH EXCAVATION AND HAULING	CY	234,600	10	2,346,000
ARMOR EDGE OF FLOODPLAIN	CY	11,250	20	225,000
UTILITY MOVE OR ARMOR	LS	1	50,000	50,000
SITE RESTORATION				
FINAL GRADE, SEED, MULCH	AC	18	4,500	81,000
SUBTOTAL				**$ 2,827,000**
ENGINEERING AND PERMITTING				**$ 100,000**
CONSTRUCTION CONTINGENCY (10%)				**$ 282,700**
TOTAL				**$ 3,209,700**

Table 6: Ballpark Engineer's Opinion of Probable Costs – Combined Preferred Alternative

Description	Unit	Quantity	Unit Price ($)	Amount ($)
SITE PREPARATION				
MOBILIZATION	LS	1	15,000	15,000
SEDIMENT AND EROSION CONTROLS	LS	1	20,000	20,000
FLOODPLAIN RESOTRATION				
CLEARING AND GRUBBING	AC	45	5,000	225,000
EARTH EXCAVATION AND HAULING	CY	311,300	10	3,113,000
ARMOR EDGE OF FLOODPLAIN	CY	11,250	20	225,000
UTILITY MOVE OR ARMOR	LS	1	50,000	50,000
SITE RESTORATION				
FINAL GRADE, SEED, MULCH	AC	45	4,500	202,500
SUBTOTAL				**$ 3,851,000**
ENGINEERING AND PERMITTING				**$ 125,000**
CONSTRUCTION CONTINGENCY (10%)				**$ 385,100**
TOTAL				**$ 4,361,100**

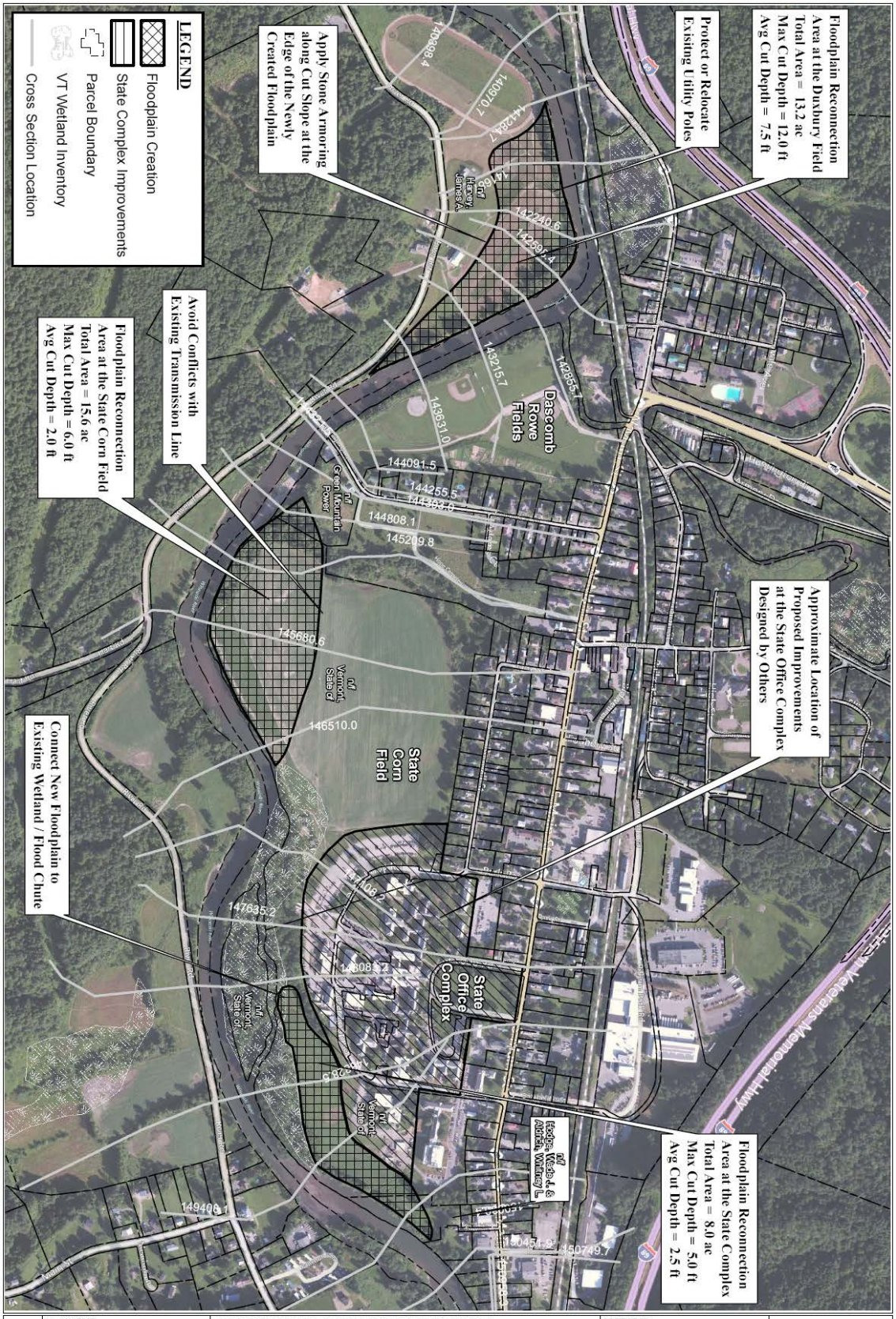

Figure 3	Map By: BMC MMI#: 4942-01-3 MXD: WaterburyStudy_Fig3.mdx 1st Version: July 10, 2013 Revision: October 8, 2013 Scale: 1" = 500'	CONCEPT PLAN - PREFERRED ALTERNATE WATERBURY FLOOD STUDY WATERBURY, VERMONT	SOURCE(S): Vermont River Management Program Vermont Center for Geographic Information Bing Maps Aerial 0 125 250 500 Feet	Engineering, Landscape Architecture and Environmental Science MILONE & MACBROOM® 1 South Main Street, 2nd Floor Waterbury, Vermont 05676 (802) 882-8335 Fax (802) 882-8346 www.miloneandmacbroom.com

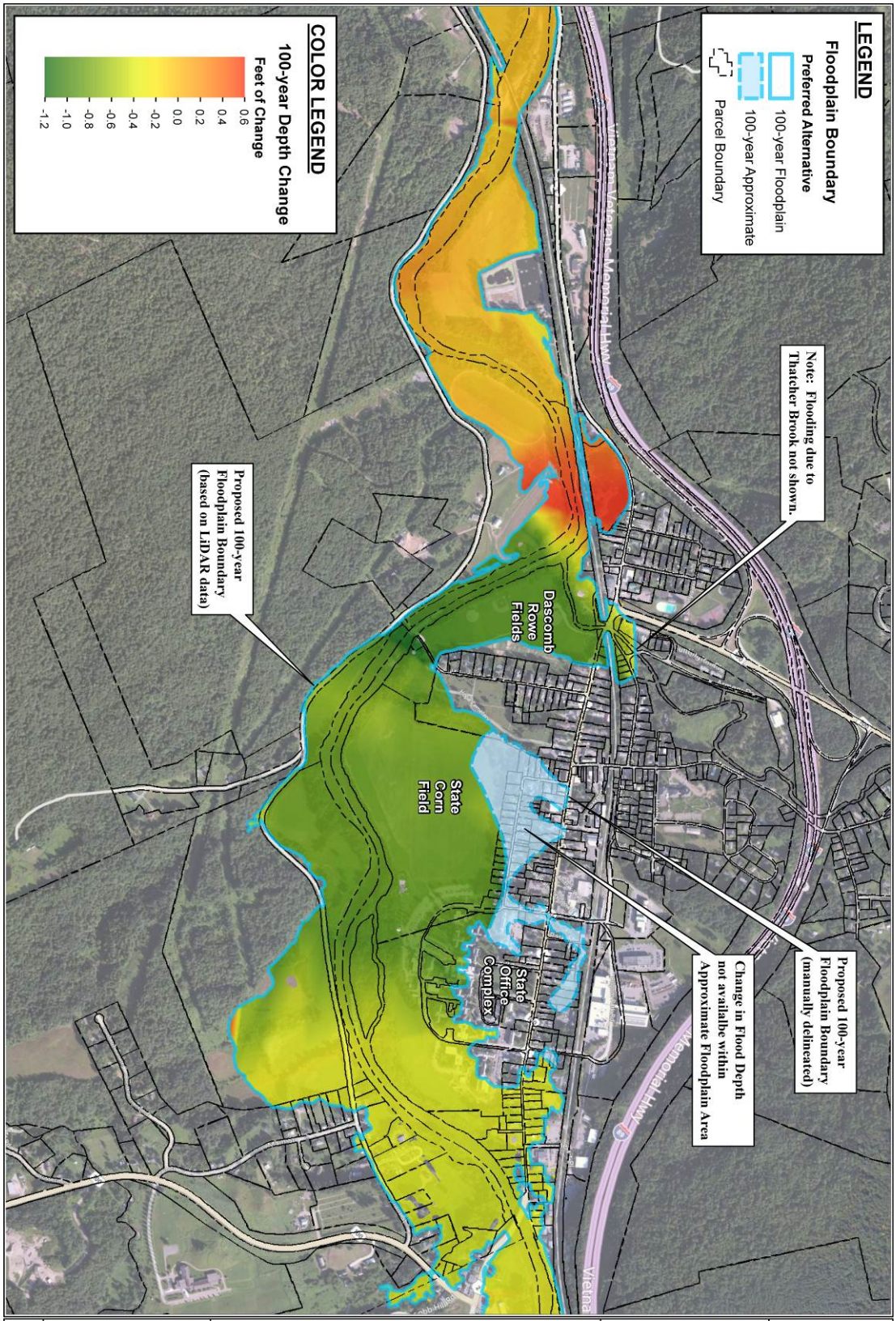

Figure 4	**Map By:** BMC **MMI#:** 4942-01-3 **MXD:** WaterburyStudy_Fig4.mdx **1st Version:** December 6, 2013 **Revision:** --- **Scale:** 1" = 800'	**FLOOD DEPTH CHANGE MAP - PREFERRED ALTERNATE** **WATERBURY FLOOD STUDY** **WATERBURY, VERMONT**	**SOURCE(S):** Vermont River Management Program Vermont Center for Geographic Information Bing Maps Aerial 0 200 400 800 Feet	Engineering, Landscape Architecture and Environmental Science MILONE & MACBROOM® 1 South Main Street, 2nd Floor Waterbury, Vermont 05676 (802) 882-8335 Fax (802) 882-8346 www.miloneandmacbroom.com

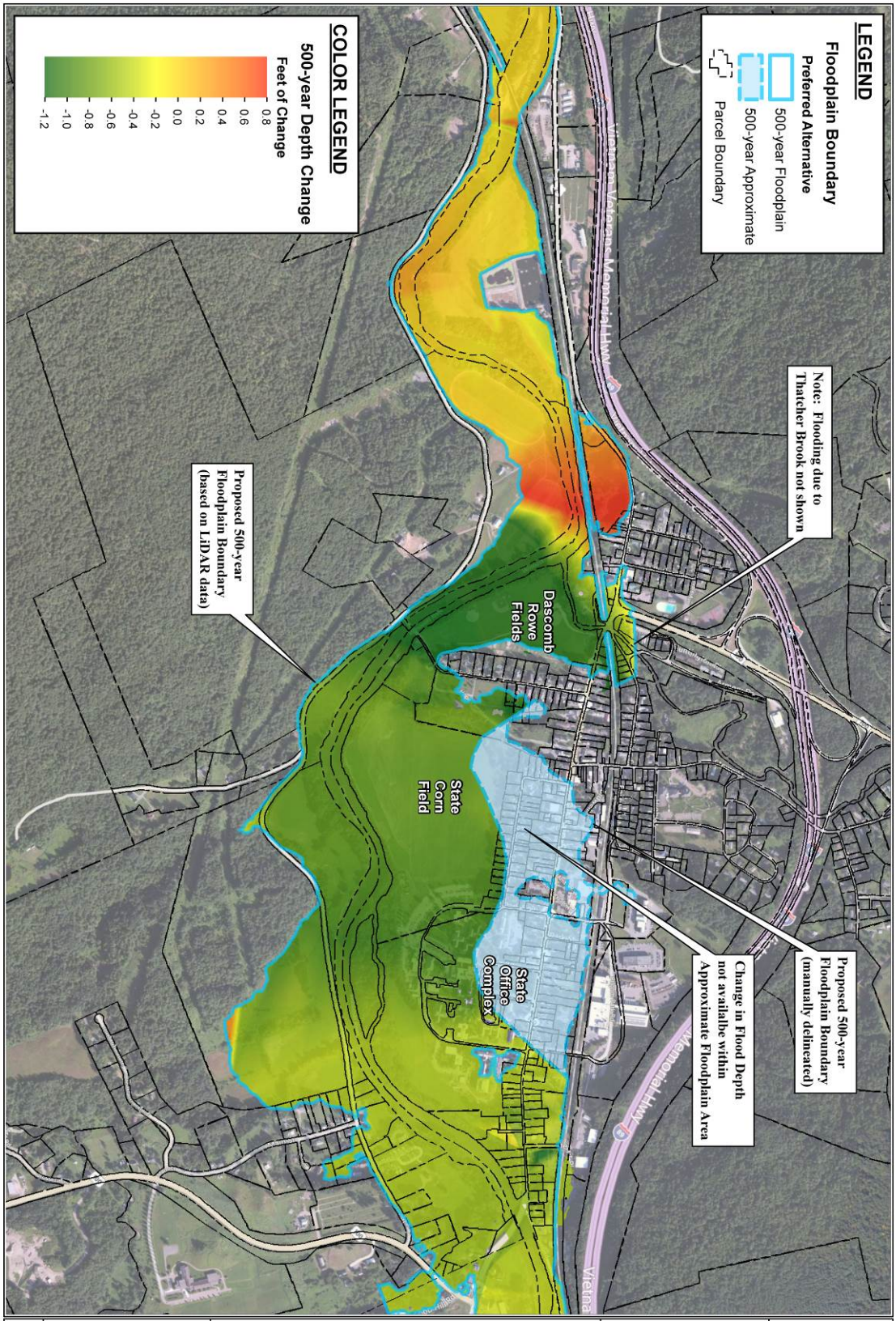

Figure 5	**Map By:** BMC **MMI#:** 4942-01-3 **MXD:** WaterburyStudy_Fig5.mdx **1st Version:** December 6, 2013 **Revision:** --- **Scale:** 1" = 800'	**FLOOD DEPTH CHANGE MAP - PREFERRED ALTERNATE** **WATERBURY FLOOD STUDY** **WATERBURY, VERMONT**	**SOURCE(S):** Vermont River Management Program Vermont Center for Geographic Information Bing Maps Aerial 0 200 400 800 Feet

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