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Lewis Creek Flood Mitigation Study

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Jessica Louisos, PE

August 1, 2024

SLR

Project Tasks and Schedule

Task	Task Description	2023							2024								
		6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
1.0	**Data Collection and Project Initiation**																
1.1	Project Kickoff Meeting																
1.2	Data Review																
1.3	GIS basemap																
1.4	Site Visit, Geomorphic Assessment																
1.5	Field Survey																
2.0	**Hydraulic Modeling**																
2.1	Hydraulic Model with LIDAR and Survey																
2.2	Model Validation																
2.3	Existing Conditions and Hydraulics Memo																
3.0	**Alternatives Analysis**																
3.1	Explore Flood Mitigation Alternatives																
3.2	Flood Inundation Mapping																
3.3	Mapping of Alternatives																
3.4	Ballpark Cost Estimates																
4.0	**Reporting and Presentations**																
4.1	Draft Memo																
4.2	Project Team Meeting																
4.3	Final Memo																
4.4	Public Presentation																

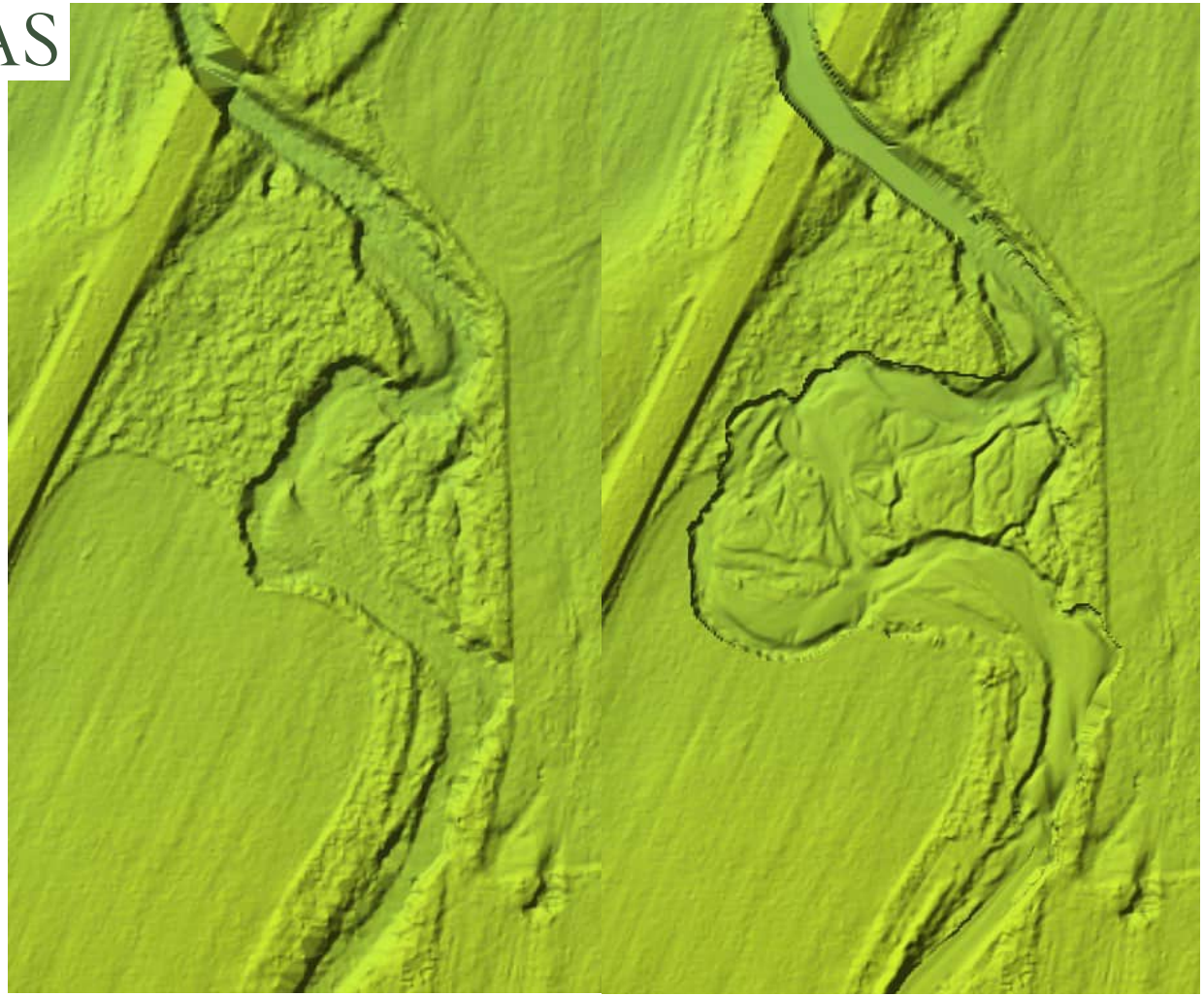
Complete by November 1, 2024

Data Collection

Figure 1 (left): Field GPS data collection
Figure 2 (right): Bridge data collection

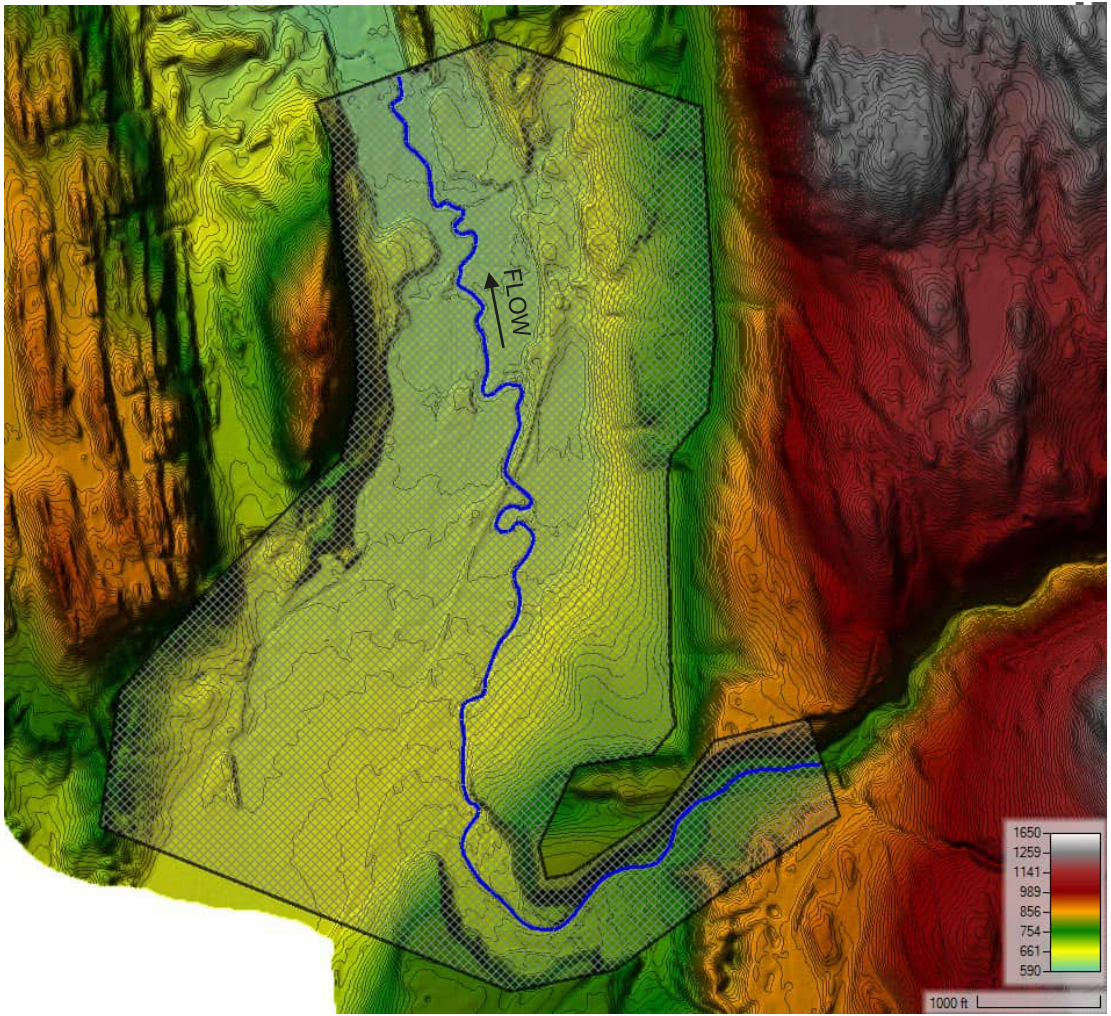
Data Collection - UAS

- Photogrammetric UAS survey
- Point Cloud
- Digital Terrain Model



Hydraulic Model Setup

- Computer model to represent flooding
- Used to test potential solutions
- Maple Ridge Auto on Ireland Road to downstream of Meadowlark Road Crossing
- 2.3 miles of Lewis Creek, 574 acres
- Watershed size = 8.1 square miles
- Geomorphic Assessment M22 and M23



Hydrology

- USGS gage analysis performed
- Flows used in model calculated with regression equation (Jacobs, 2010*)

Recurrence Interval	Lewis Creek	Meehan Road Tributary	Gravel Pit Tributary
2-year	423	22	26
5-year	682	35	42
10-year	917	47	56
25-year	1,234	63	75
50-year	1,478	75	90
100-year	1,740	88	106
500-year	2,579	130	156

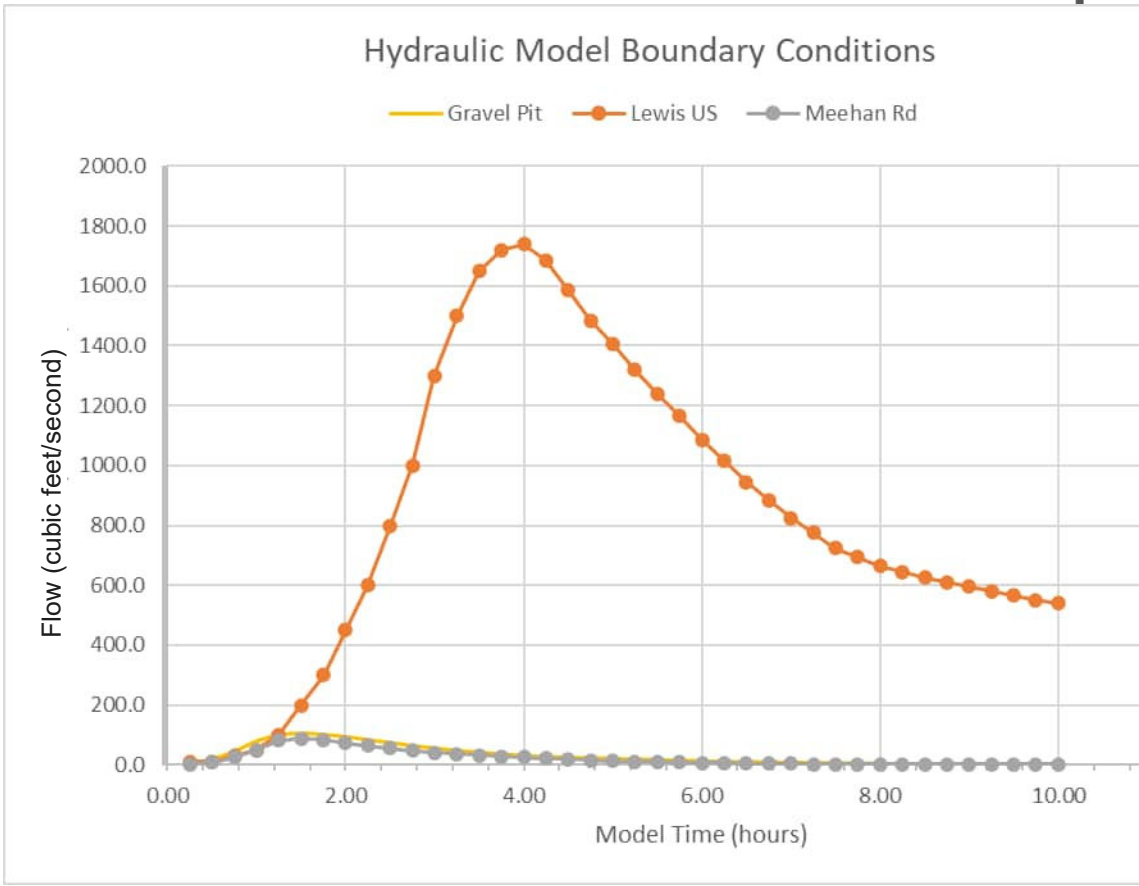


Figure 1: 100-Year Flood Hydrographs

*Jacobs, 2010. Estimating the Magnitude of Peak Flows for Steep Gradient Streams in New England. Prepared for The New England Transportation Consortium.

Model Setup

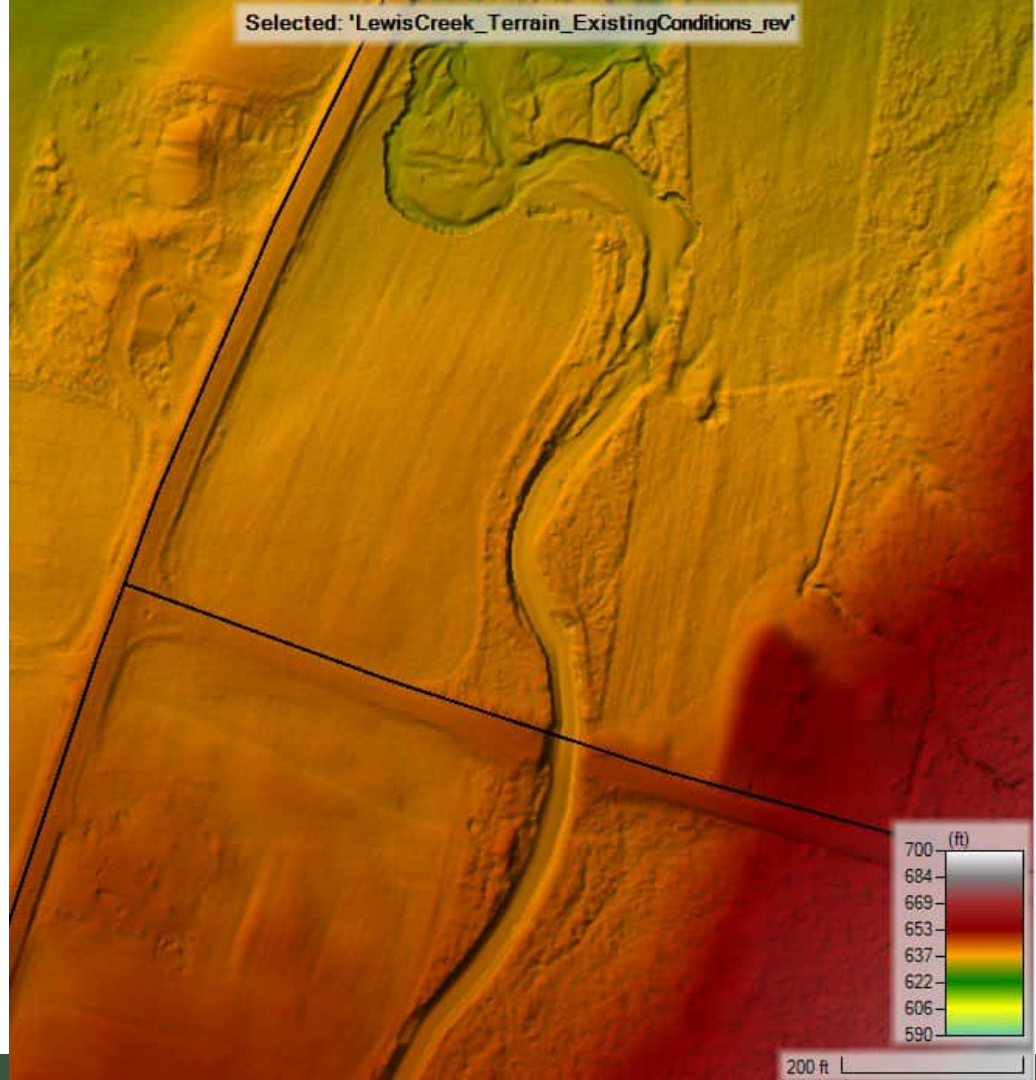
- Lewis Creek flowing north
- Crossing Hillsboro Road in this example view

Model Setup

- Landuse entered as roughness values
- Digitized by aerial and checked with field observations

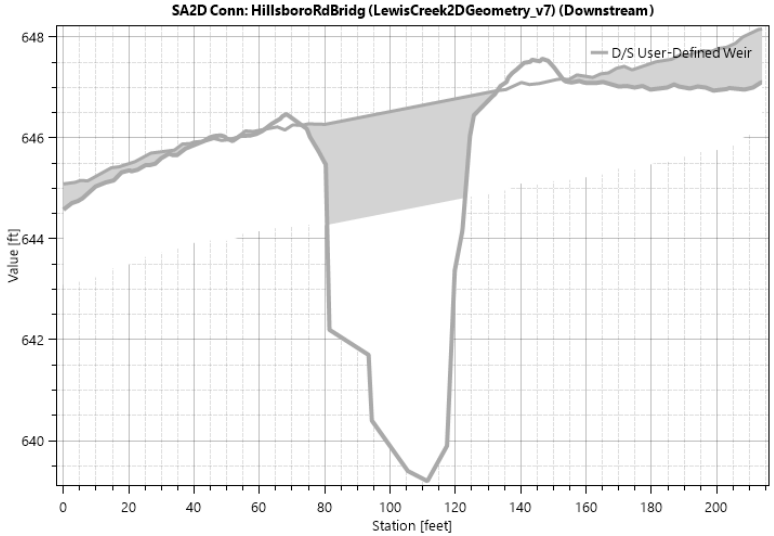
Model Setup

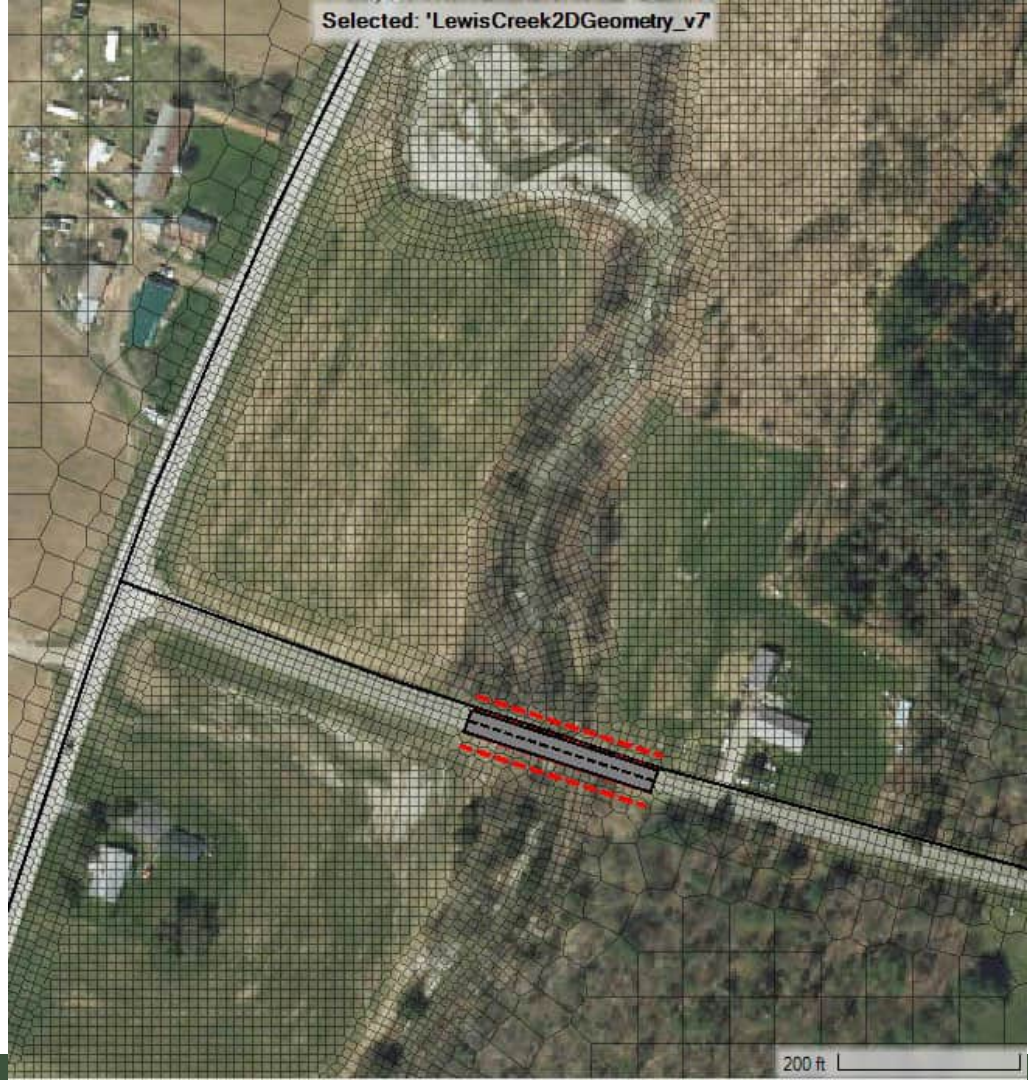
- High resolution LiDAR digital elevation model (2014)
- UAS photogrammetry of changes prior to 2024



Model Setup

- Model mesh refined to accurately show berms, road edges, channel
- Bridges and culverts inserted using historic plans, collected LiDAR, and high accuracy GPS data





Model Results

- 100-year dynamic model run
- Depth maximums
- 1.3 feet over Hillsboro Road

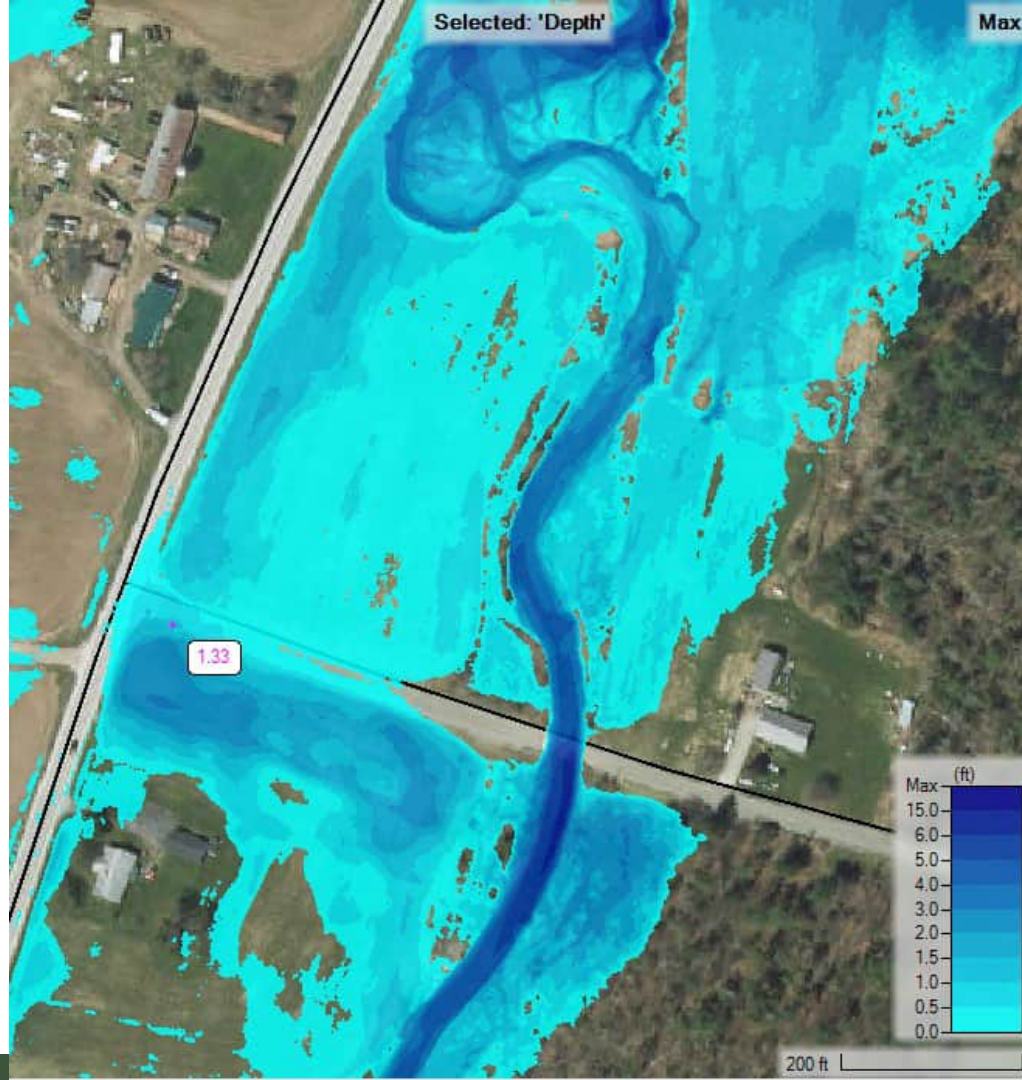
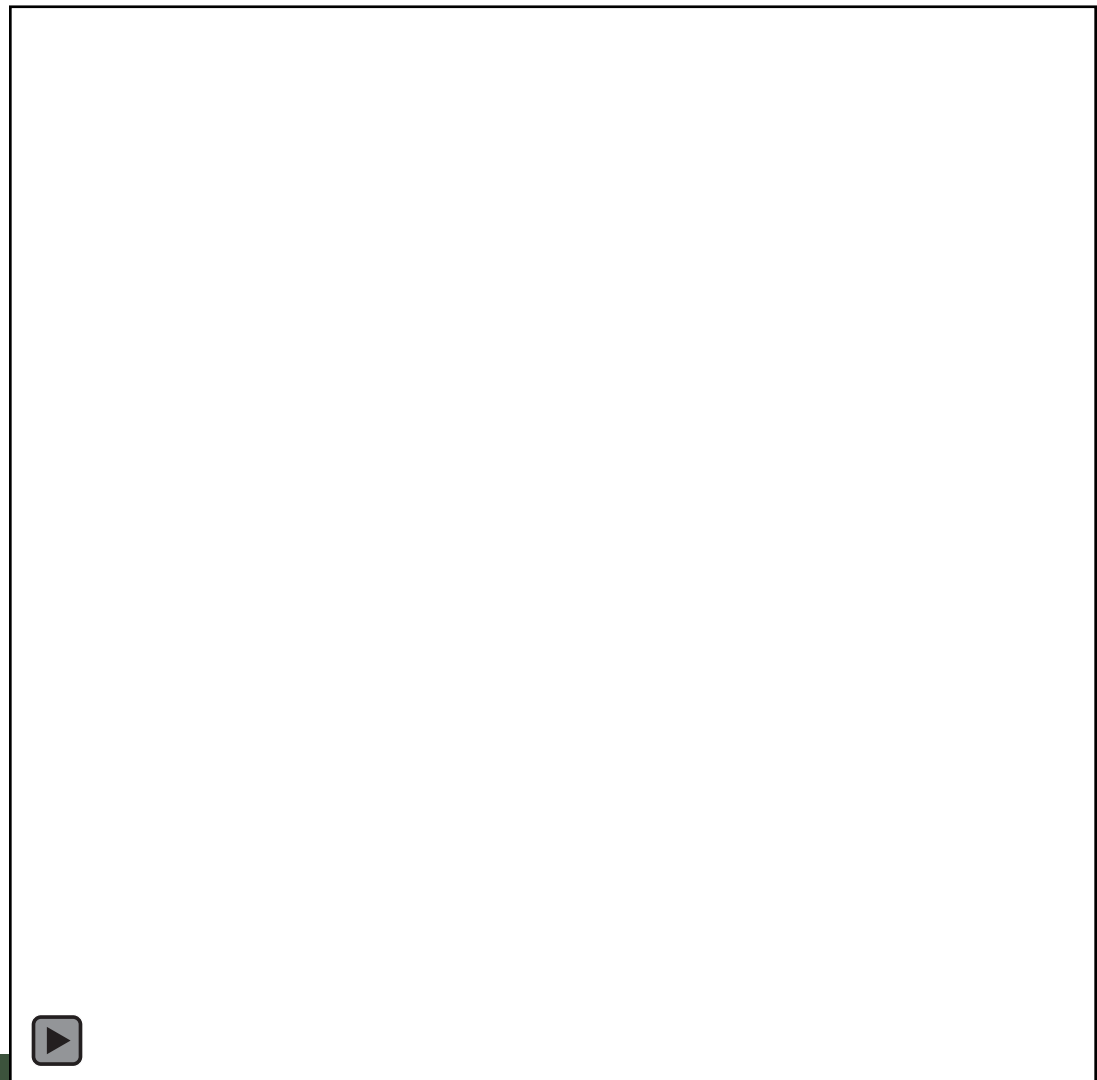


Photo courtesy of UVM Spatial Analysis Lab, July 16, 2024

Model Results

- 100-year dynamic model run
- Depth of water shown

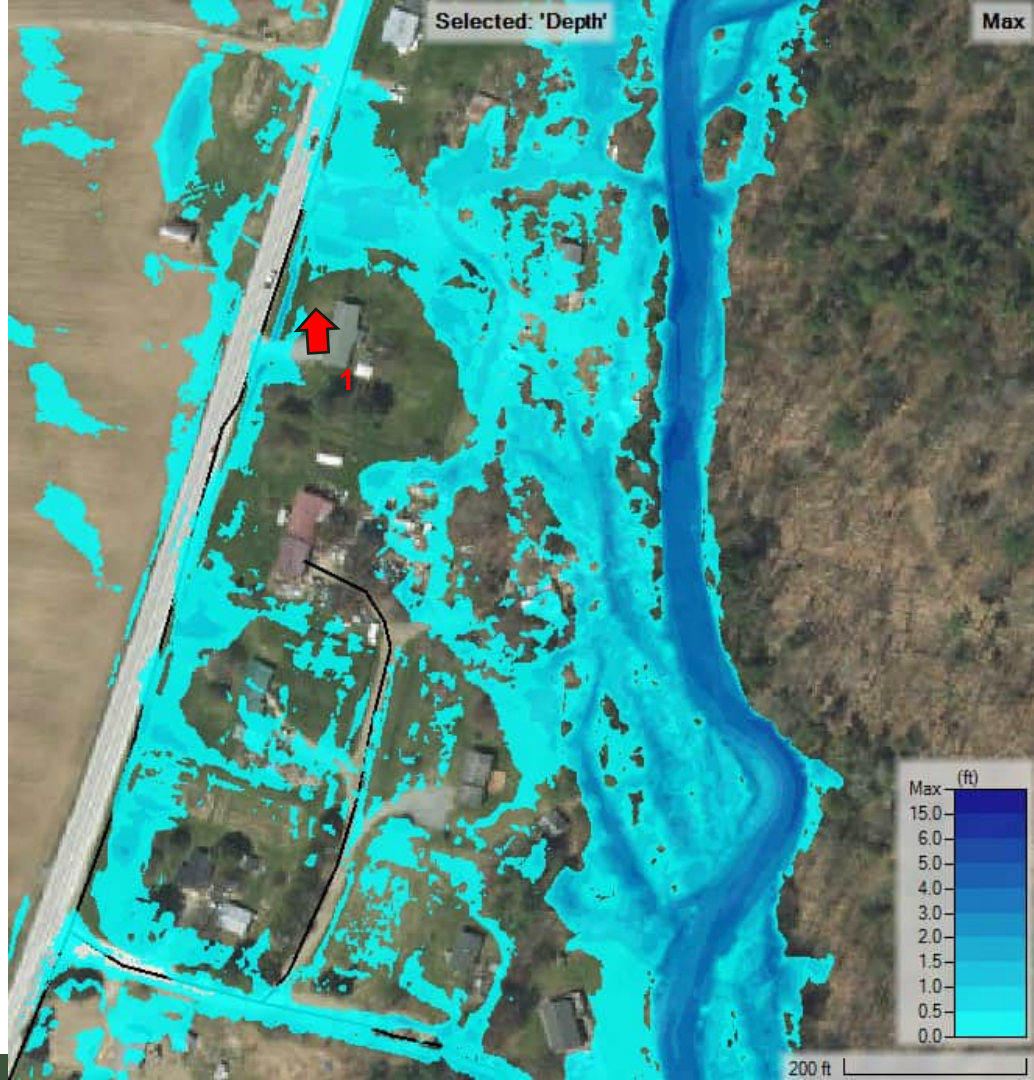


Model Results

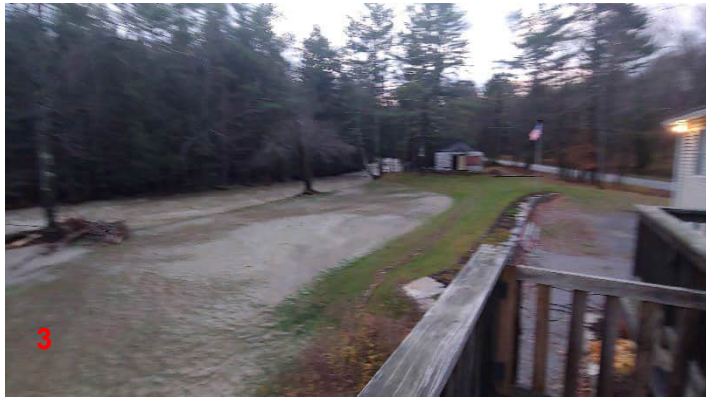
- 100-year dynamic model run
- Depth of water shown

Model Validation

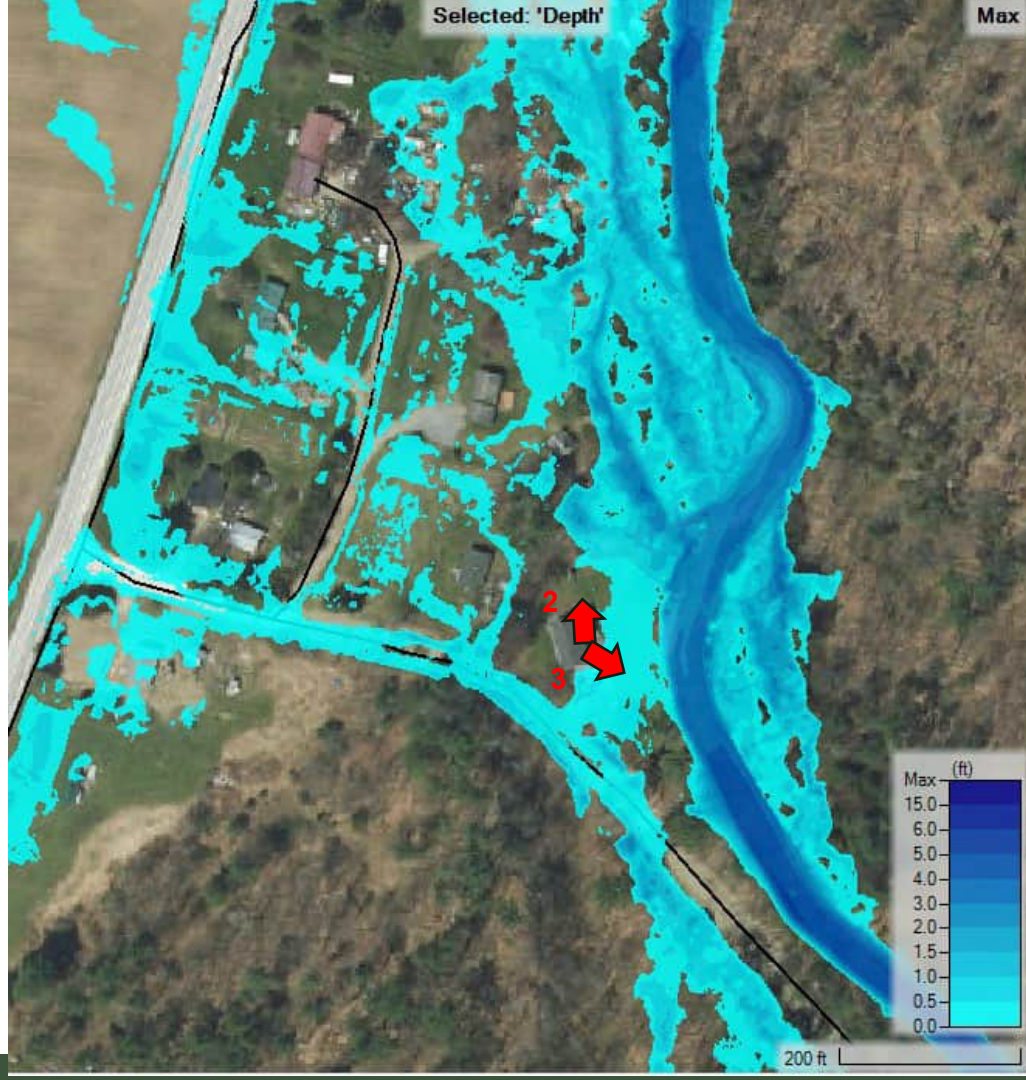
- Halloween 2019 – Along Route 116
- Modeled 100-year Depth =
  - 0.8 ft in around home
  - 0.2 feet on Route 116



Model Validation



- 0.2 feet on Route 116



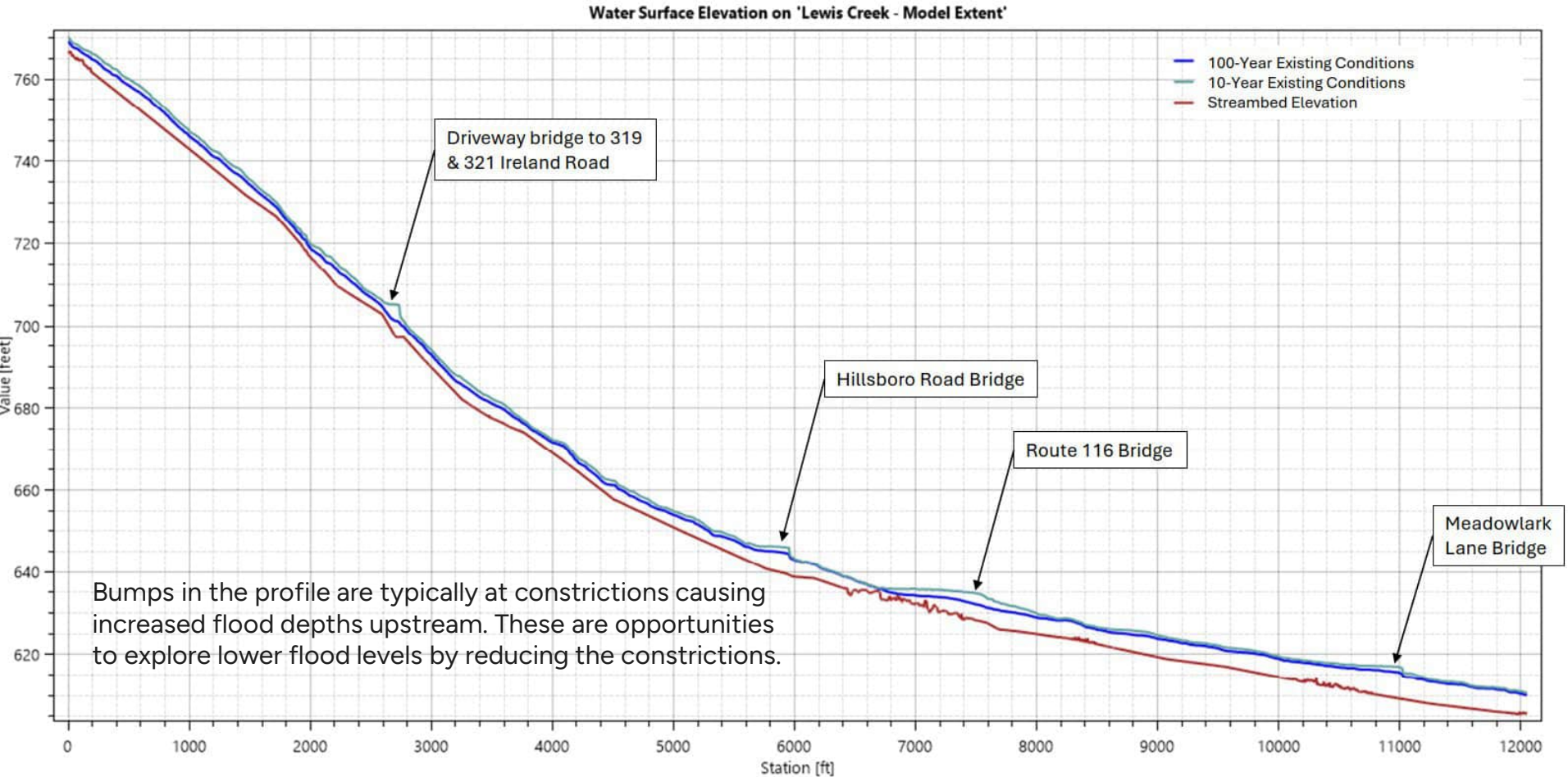
2024 Significant Damage

- Flooding at and around many homes
- Shamrock Drive erosion and sediment
- Driveway Bridge washed out
- Ireland Road Damage
- Hillsboro Road covered with water for days and clogged with sediment and debris

Geomorphic Setting

- Alluvial fan where the river changes from steep and narrow to flat and wide
- Natural deposition location
- No model will accurately predict where the next floodpath may be
- Very large sediment input that changes channel configurations and flow directions
- These are extremely risky settings

10-Year & 100-Year Flood Profiles



Bumps in the profile are typically at constrictions causing increased flood depths upstream. These are opportunities to explore lower flood levels by reducing the constrictions.

Dog River Floodplain Restoration – Northfield

Removing buildings & people & infrastructure from most vulnerable locations

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

Melrose Terrace, Brattleboro – Floodplain

Removing buildings & people & infrastructure from most vulnerable locations

- Remove 11 buildings
- Relocate road
- Relocate sewer main / utilities

Increase floodplain storage capacity

- Remove 28,000 CY fill in floodplain & lower land average 5 feet
- Plant restored 4.4-acre floodplain with native vegetation

2011 Flooding around Buildings

12-23-2022

Melrose Terrace, Brattleboro – Overflow culvert at bridge

10/28/2020

Pre-construction

6/19/2023

Post-construction

Greenway Trail Bridge Replacement– Jeffersonville

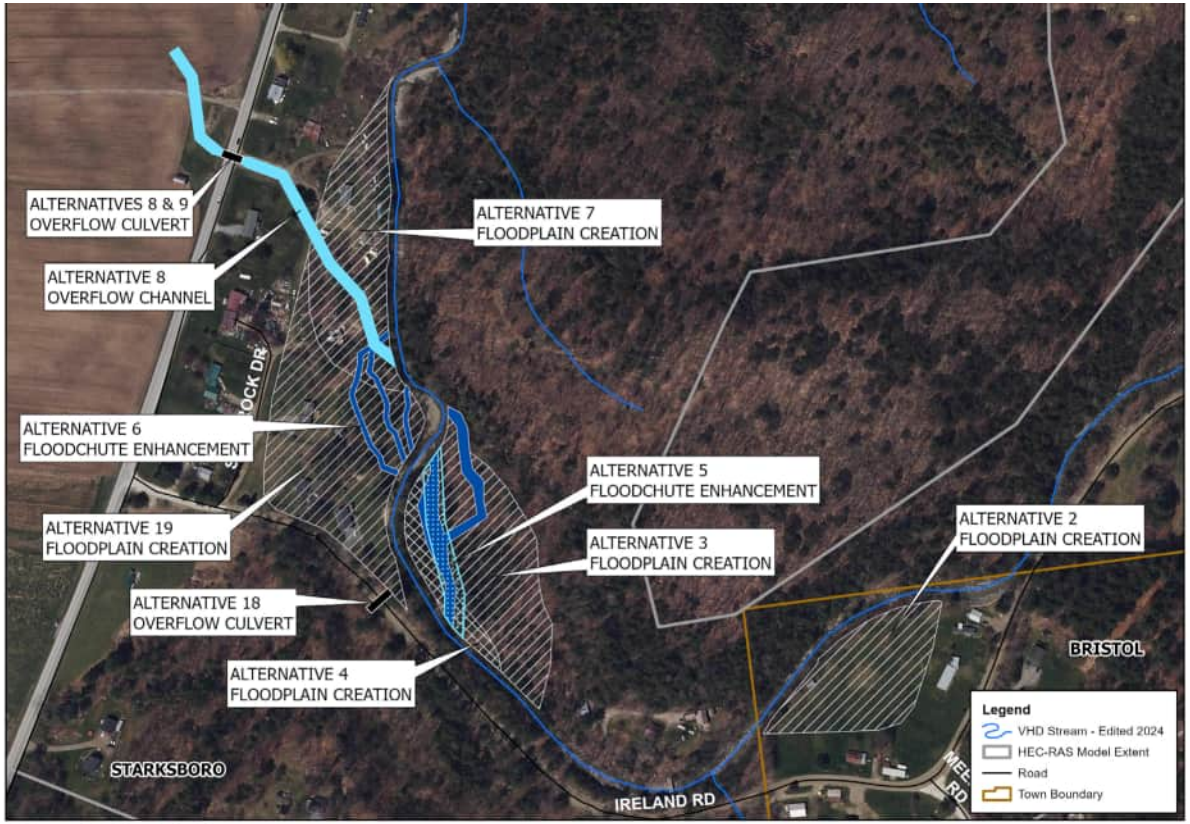
before

Removed constriction

- An undersized bridge and unused abutments were removed
- Larger bridge installed
- Opened up floodplain under bridge

after

Alternatives



ALTERNATIVES

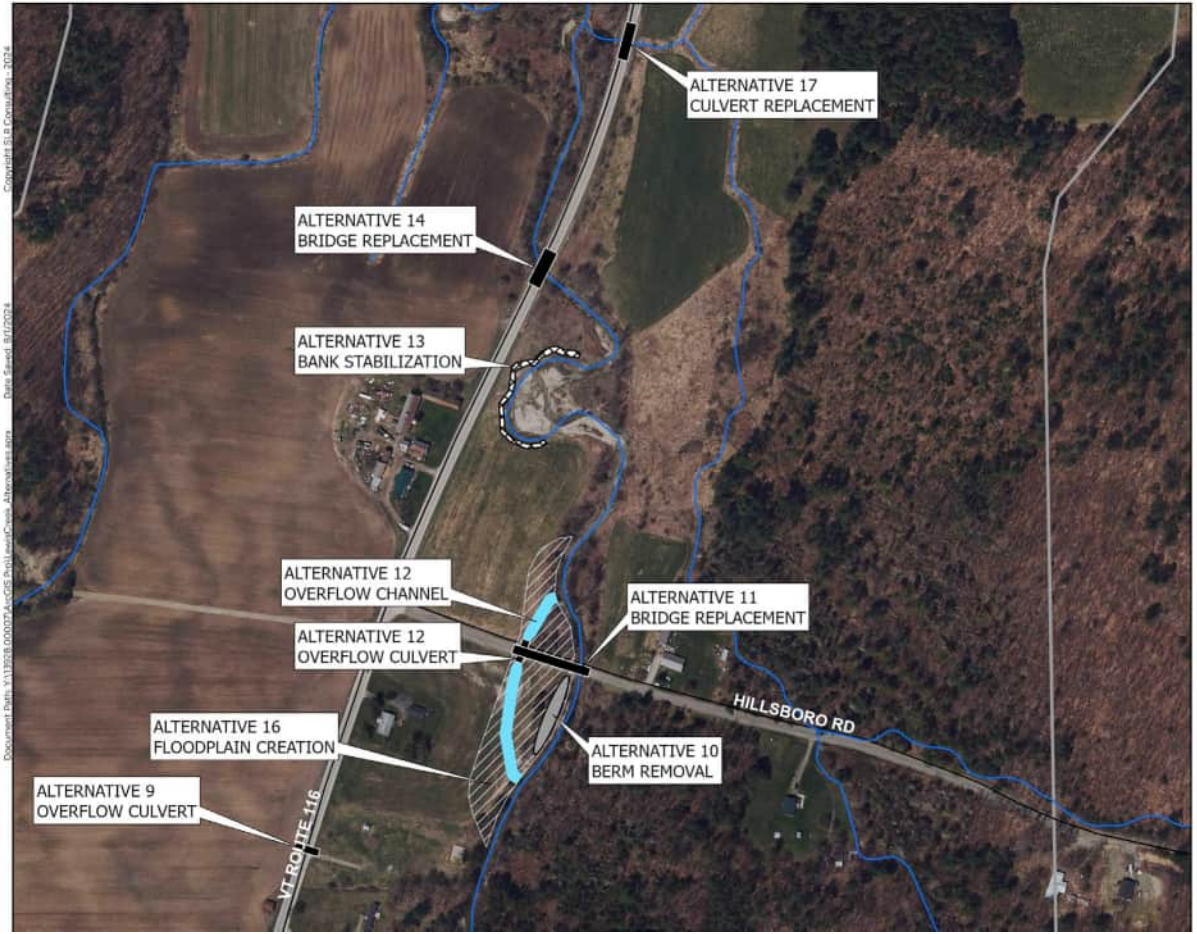
LEWIS CREEK FLOOD HAZARD MITIGATION STUDY
STARKSBORO AND BRISTOL, VERMONT
ADDISON COUNTY REGIONAL PLANNING COMMISSION

0 300 600
Feet
1:3,600

N

SLR
1 SOUTH MAIN STREET
2ND FLOOR
WATERBURY, VT 05676
802.882.8335

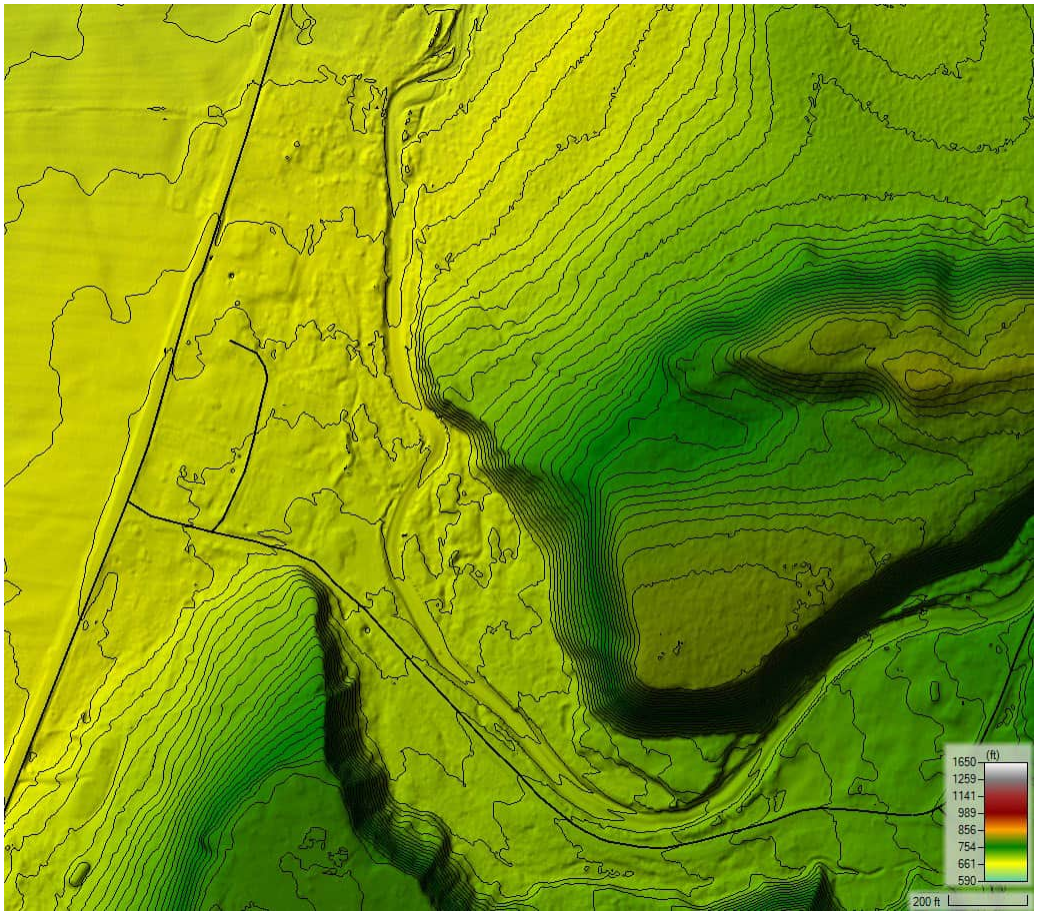
Alternatives



Alternatives Matrix

Alternative		Objectives								
ID	Description	Improve water quality	Improve floodplain connectivity	Improve habitat or aquatic organism passage	Reduce flood and erosion risk	Reduce comparative implementation cost	Reduce comparative maintenance cost	Avoid constraints	Recommended	Notes
1	Do nothing	NO	NO	NO	NO	BEST	NO	NO	NO	Lewis Creek causes flooding of properties, homes, and roads in the vicinity of Ireland Road, Hillsboro Road, and Route 116. The river transitions from a steep, narrow-valley setting to a flat, broad valley in this location. The river forms an alluvial fan, where extensive sediment deposition and channel adjustment are expected. Historic channel management and development patterns are not compatible with this natural condition.
2	Floodplain creation behind 340, 415, and 455 Ireland Road	BEST	BEST	NO	Better	Maybe	Better	Better	NO	A large swath of open space exists adjacent to Lewis Creek along Ireland Road, which is currently managed as lawn. The creek is disconnected from this land due to historic incision. Lower the land behind these three homes to provide floodplain access at the 10-year flood and higher. Size of floodplain is 2.0 acres.
3	Floodplain creation across from 103 Ireland Road (large)	Better	BEST	NO	Better	Maybe	Better	Better	NO	Undeveloped land exists on the eastern side of the creek, across from several homes built close to the river, where floodwaters first exit the main channel and flood properties. Lower the entire undeveloped area to provide floodplain access at the 2-year flood and higher. This area is currently forested with areas of wetland and historic floodchutes. Size of floodplain is 3.5 acres.
4	Floodplain creation across from 103 Ireland Road (small)	Better	BEST	NO	Better	Better	Better	Better	YES	Undeveloped land exists on the eastern side of the creek, across from several homes built close to the river, where floodwaters first exit the main channel and flood properties. Lower a portion of the undeveloped area closest to the creek to provide floodplain access at the 2-year flood and higher. This area is currently forested. Size of floodplain is 0.6 acres. Modeling shows flood mitigation benefits are similar to alternative 3 with less impact from clearing forested land.

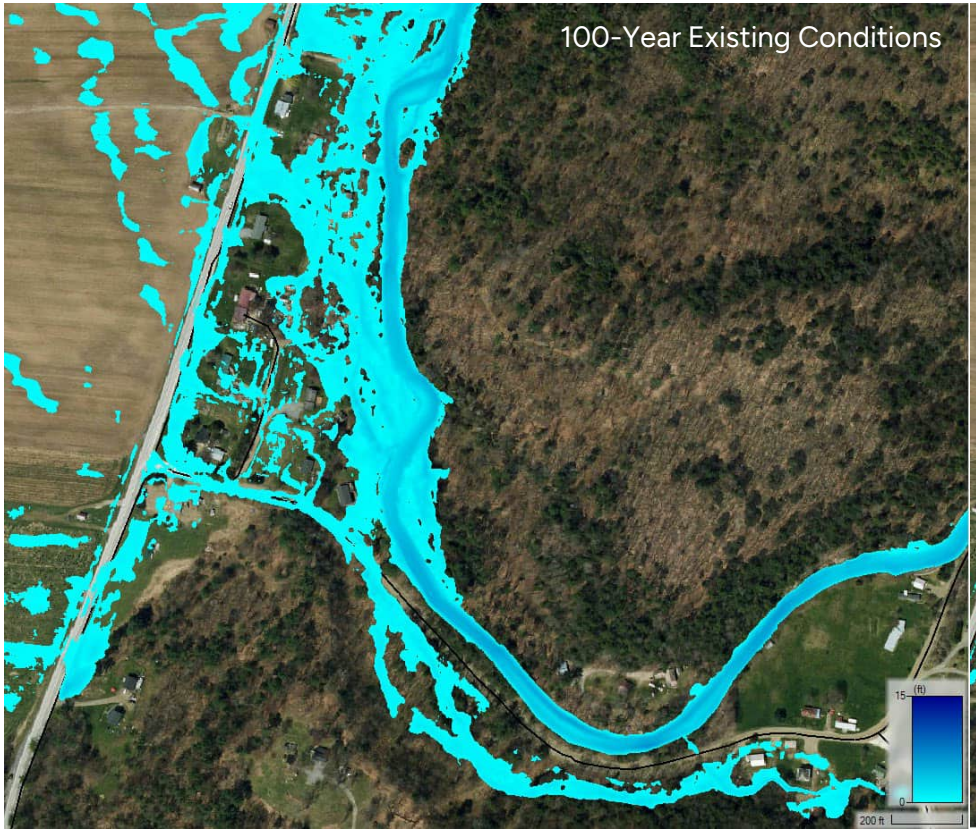
Lower Ireland Road & Shamrock Drive Area

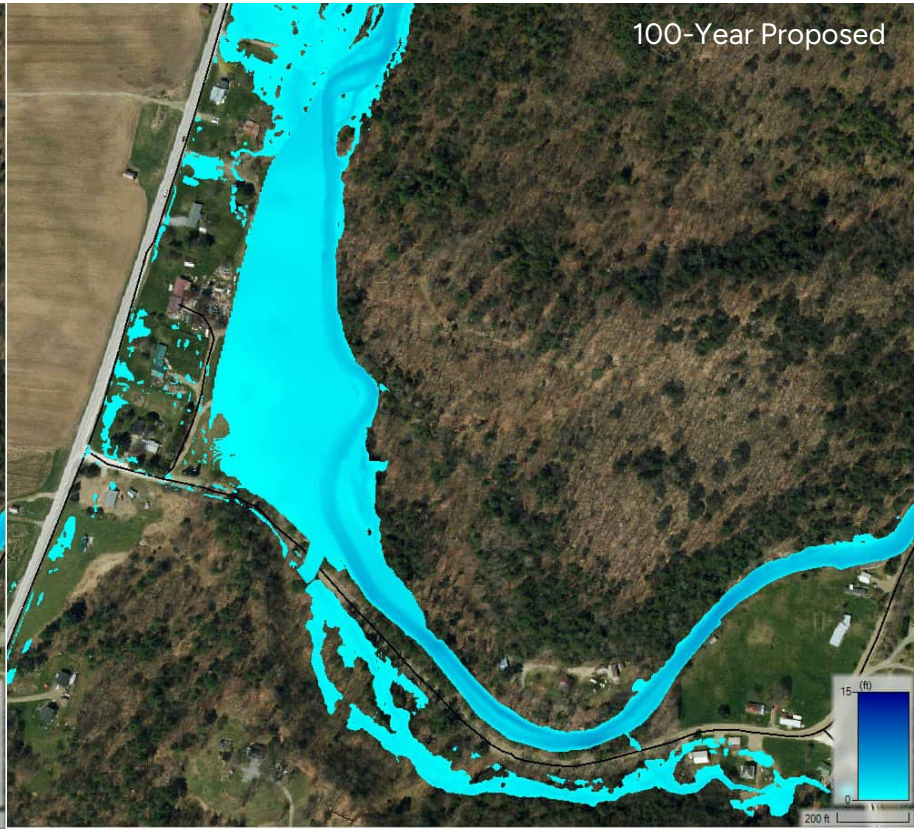


Alternatives 4, 18, 19

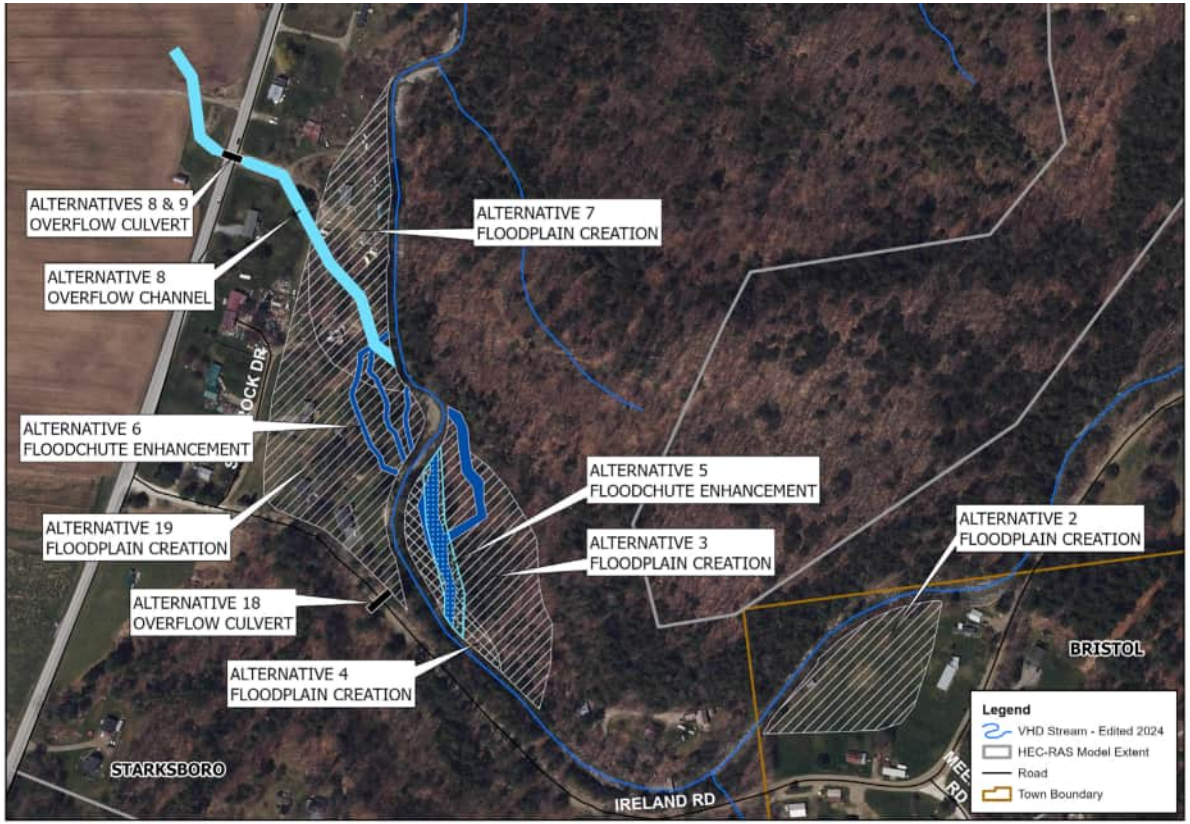
- Combined approach including:
  - buyout of at-risk homes
  - floodplain lowering
  - drainage improvements (addition of overflow culvert)

Alternatives 4, 18, 19





Alternatives



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0 300 600
Feet
1:3,600

N

SLR
1 SOUTH MAIN STREET
2ND FLOOR
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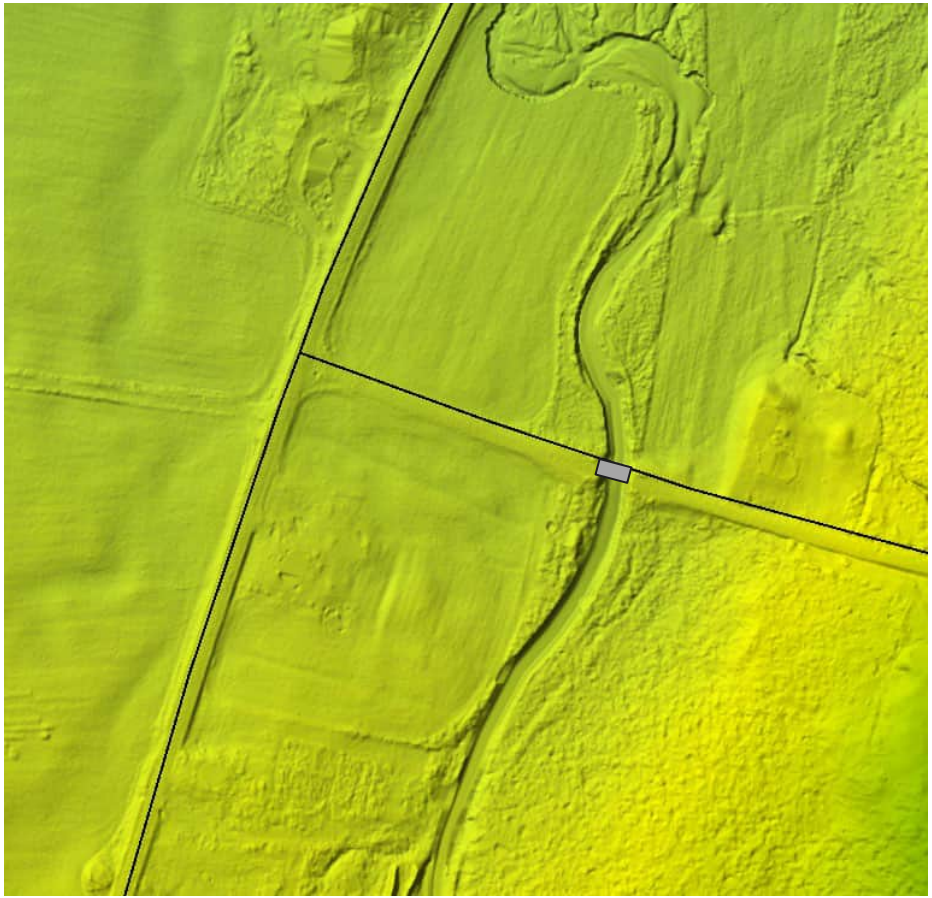
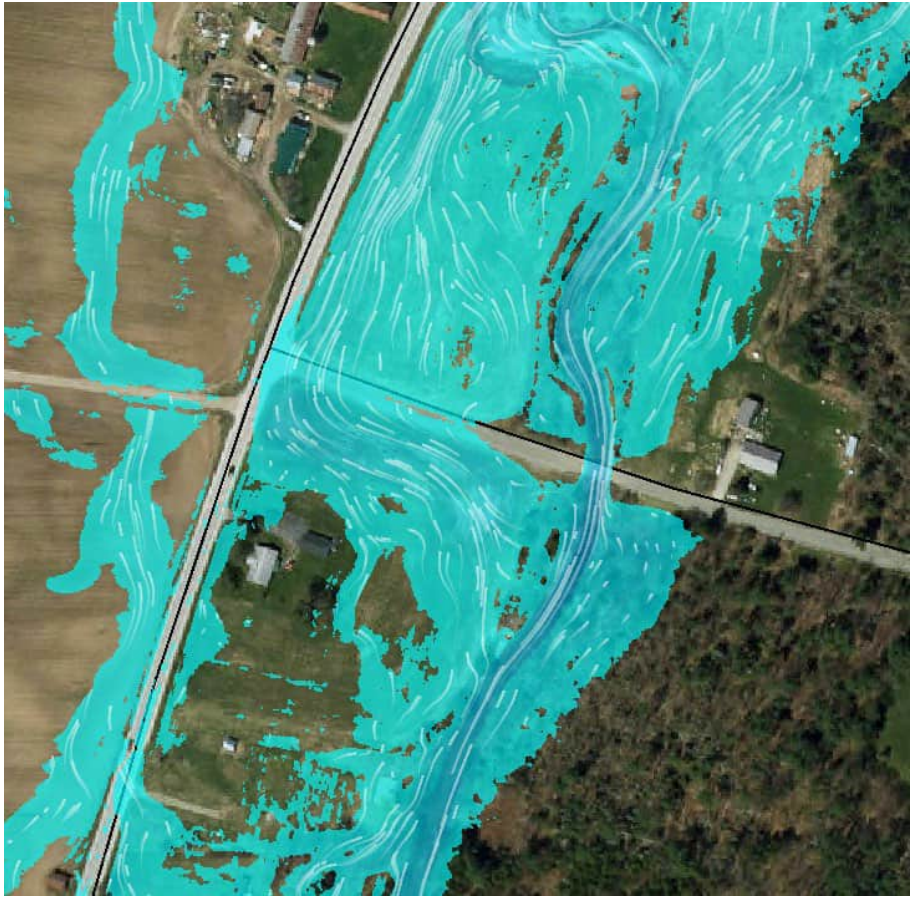
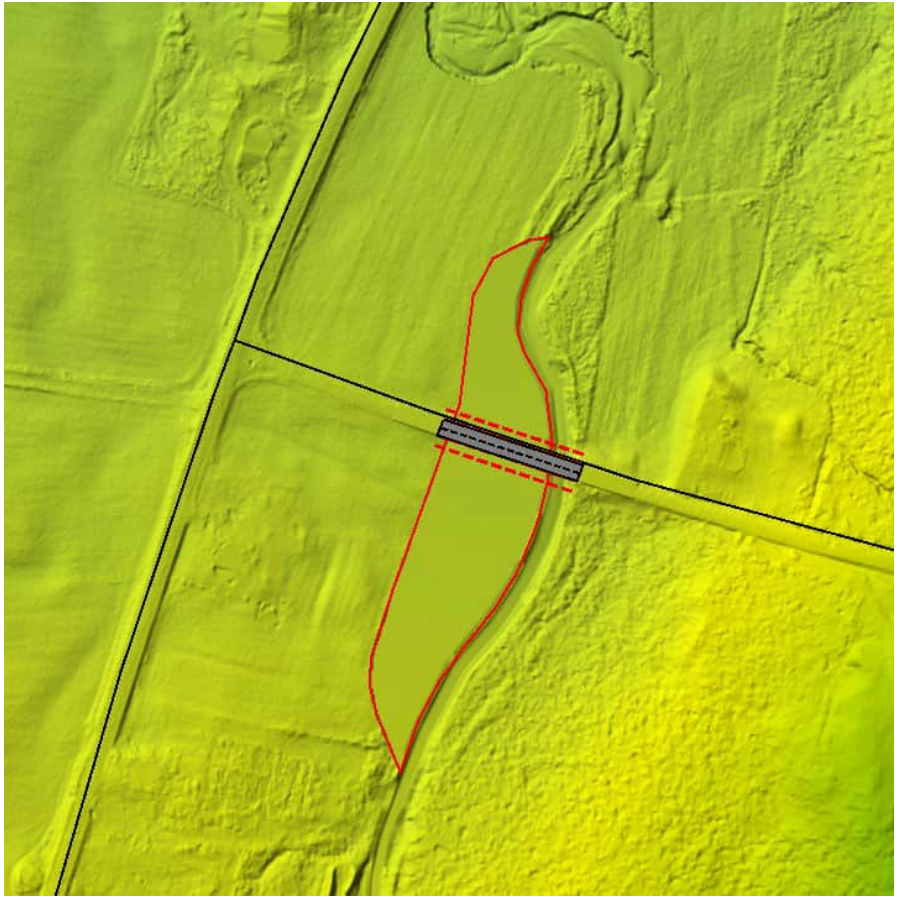
Hillsboro Road - Existing





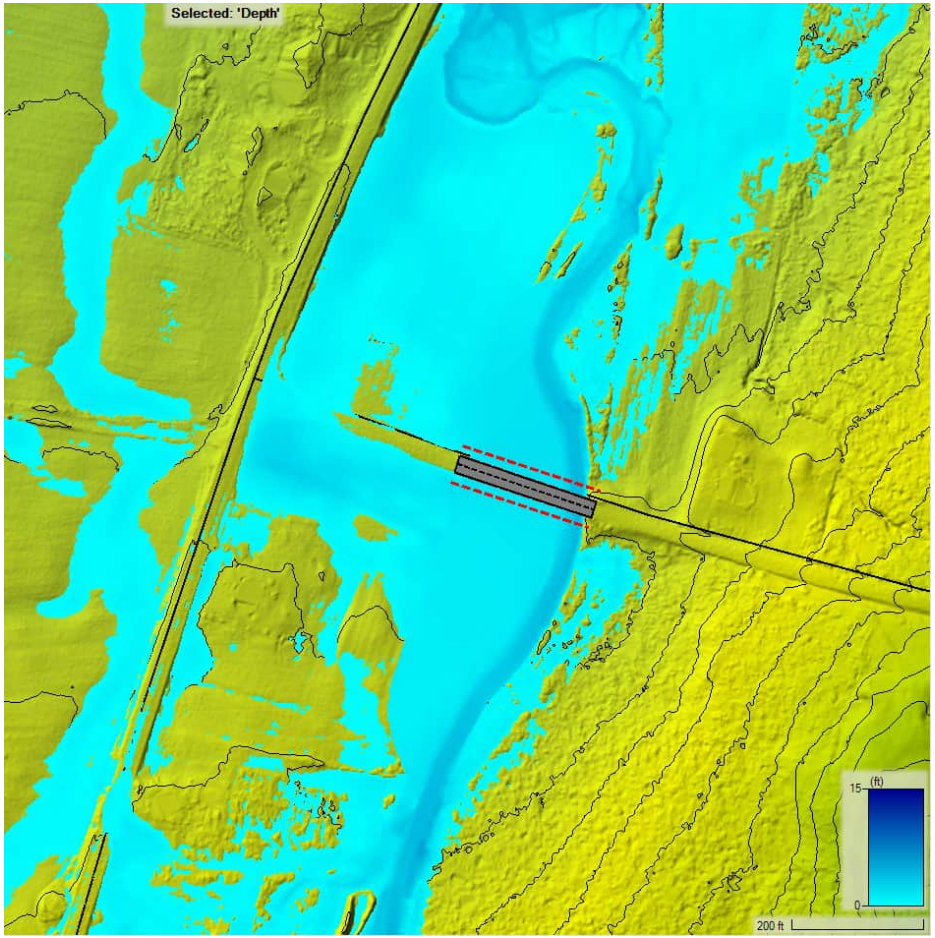
Hillsboro Road - Alternatives 11 & 16

- 200-foot bridge
- Floodplain lowering and berm removal - 150 feet by 860 feet long

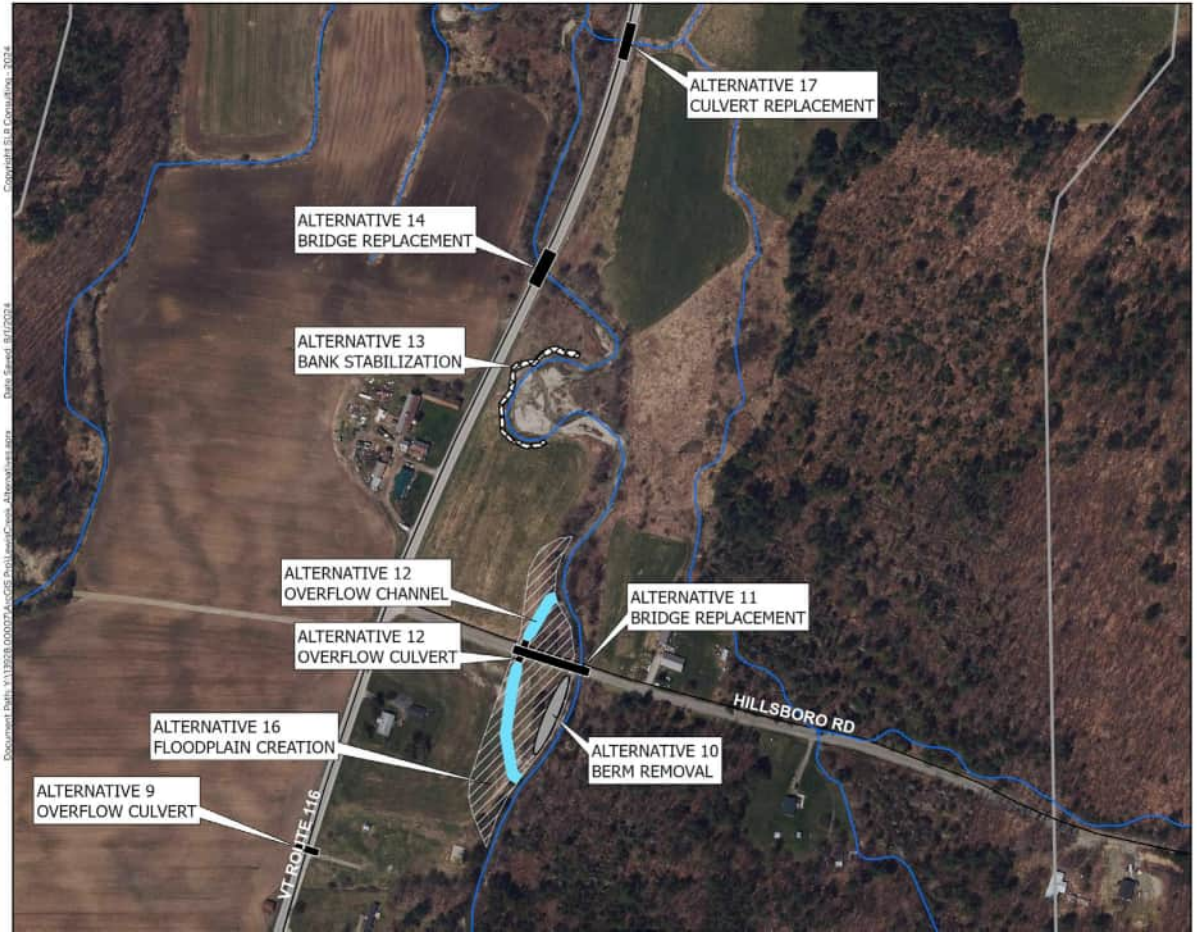


Hillsboro Road - Alternatives 11 & 16

- Substantial reduction in length of roadway overtopping for 100-year event
- Depth of water over road less than 6 inches
- Less potential for clogging with wood and ice



Alternatives



Buyout of At-risk Homes

- Removing people and infrastructure from harm's way
- Pair with floodplain restoration for additional flood mitigation benefit

Figure courtesy of UVM Spatial Analysis Lab, imagery collected on July 16, 2024

Route 116 Bank Stabilization – Alternative 14

- Proactive road stabilization
- Could include habitat improvement

Construction
Placing ballast between logs.
12/23/2020

Naturalized Root fans.
9/15/2021

Next Steps

- Town, neighbors, and partners to consider information gathered
- SLR to finalize the project report and circulate as a resource
- Consider moving projects forward to grant applications or other next steps
- FEMA funding HMGP pre-application for selected project due August 30
  - https://vem.vermont.gov/funding/mitigation

Do you have any questions?