

Granite Street Historic District Flood Resiliency Plan

Hardwick, Vermont

June 10, 2026

SLRCONSULTING.COM

SLR

Agenda

- River Model Setup & Results
- Flood Mitigation Strategies
- Lamoille River Alternative Modeling Recap
- Cooper Brook Alternative Modeling
- Post Flood Drainage

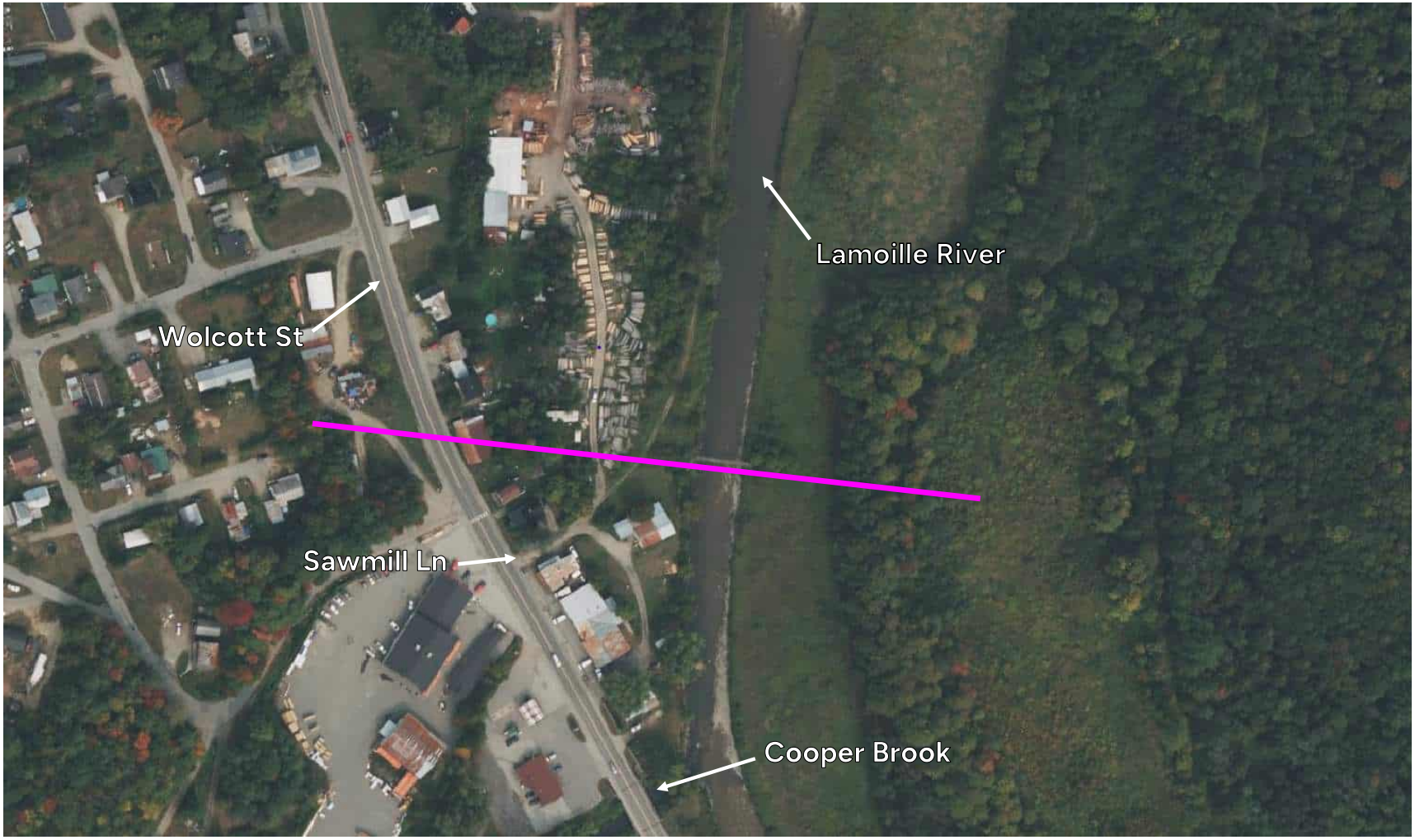


Granite Street Historic District

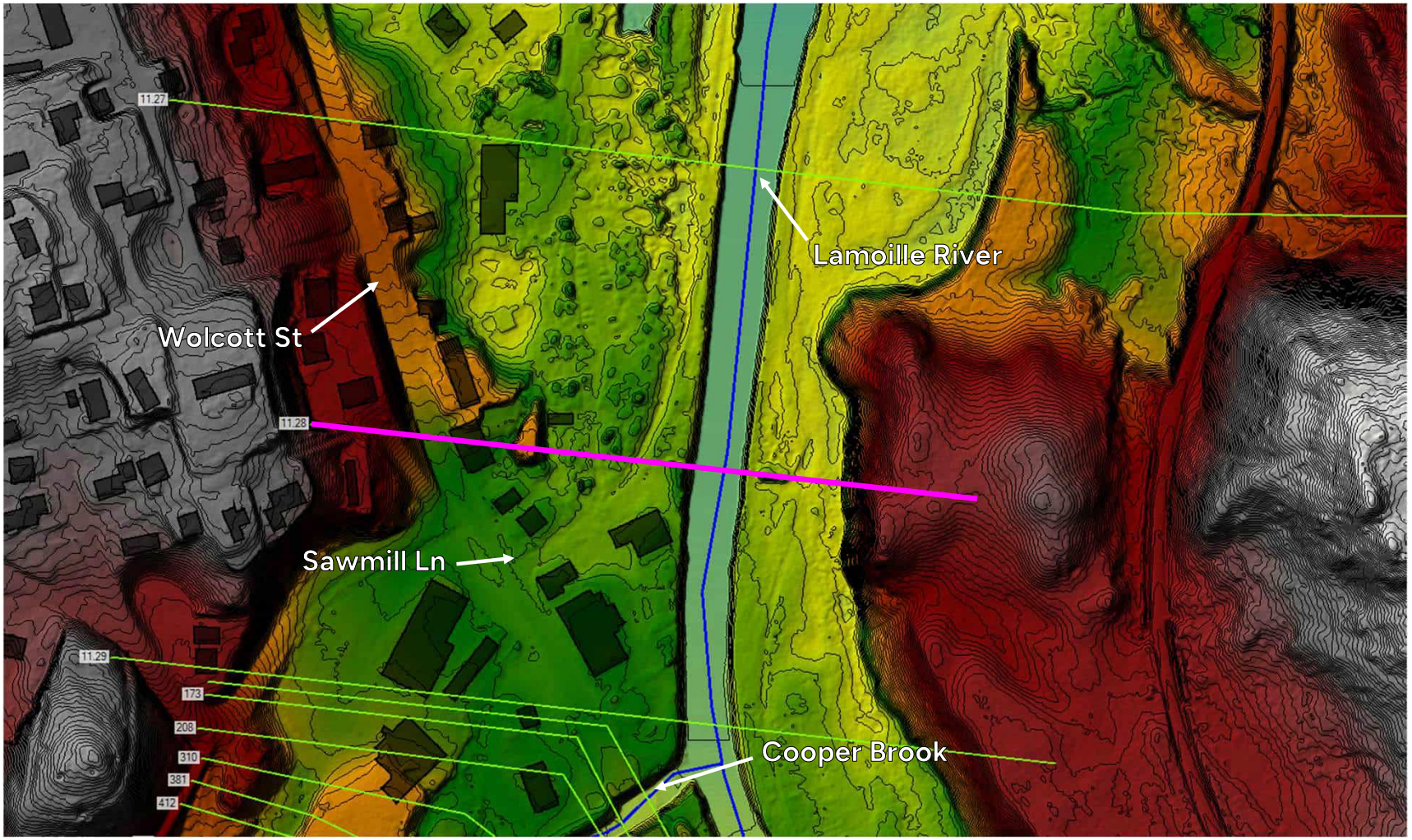


Photo by: Orleans County NRCD

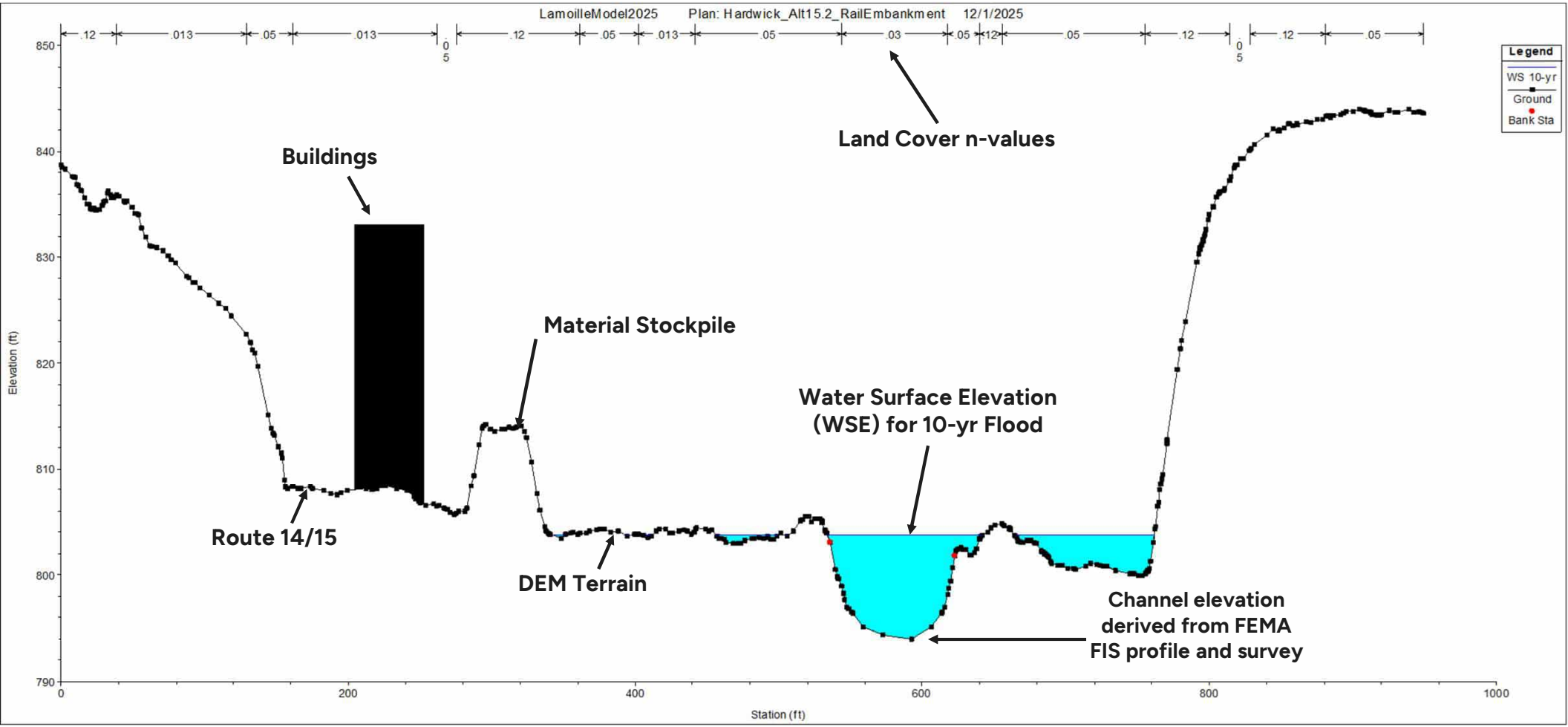
Map View



Model Terrain

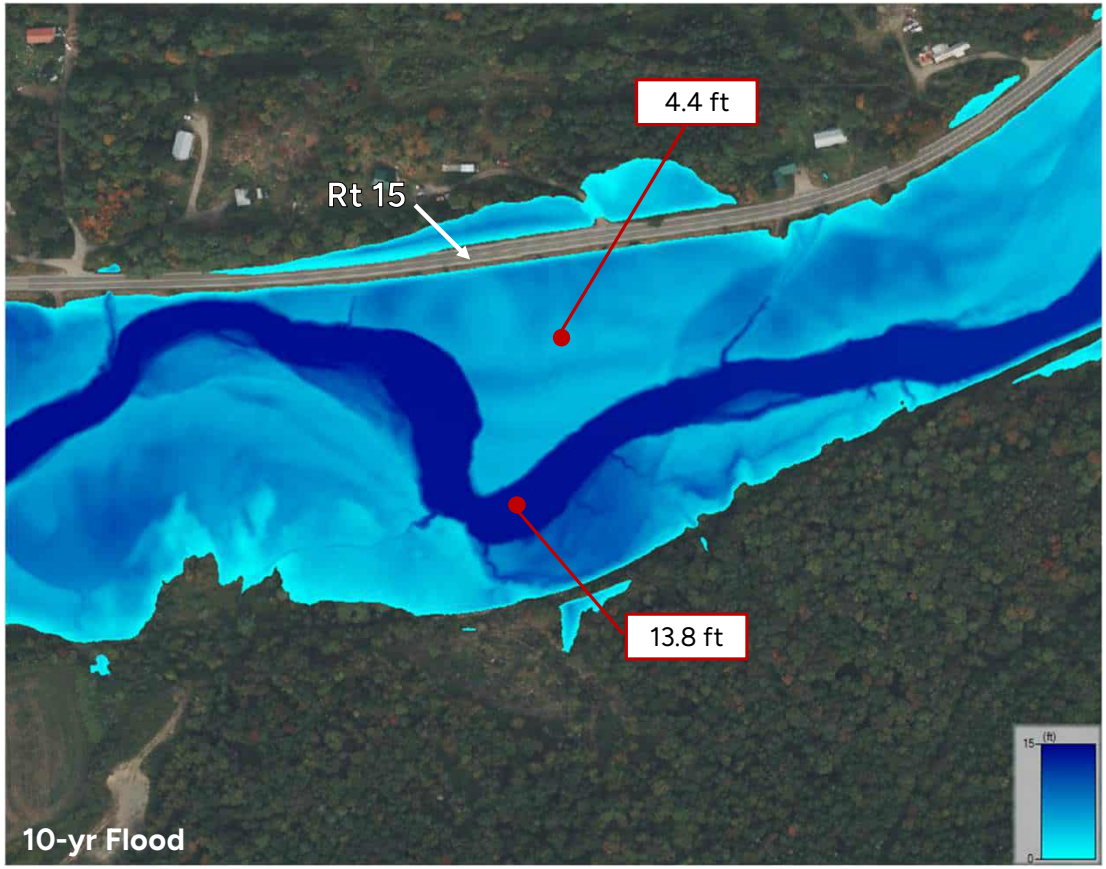


Cross Section View



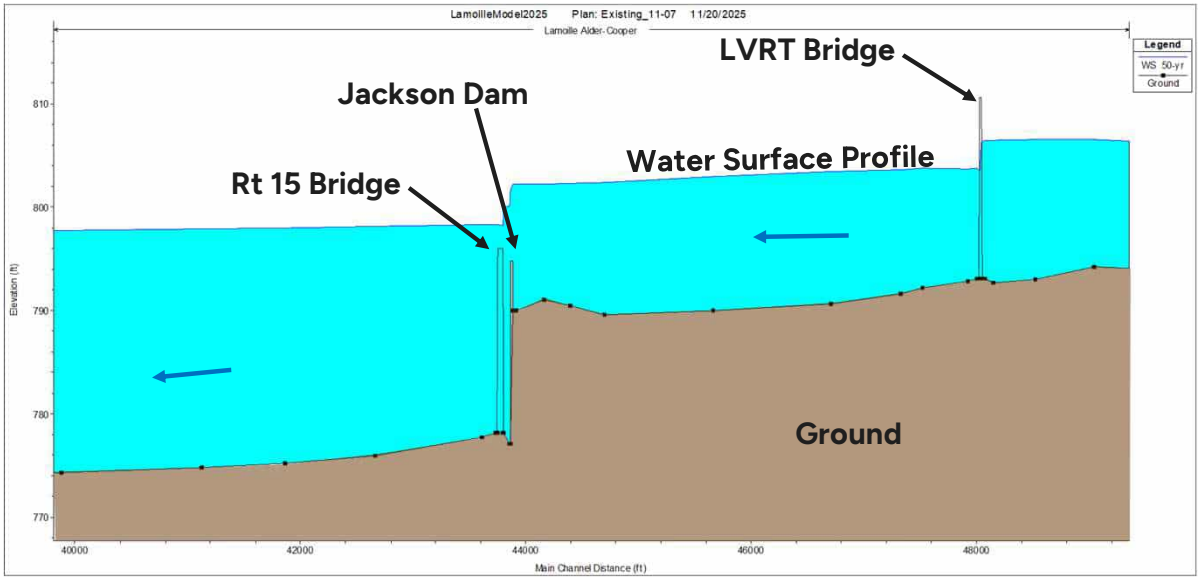
What can the model tell us?

- Water Surface Elevation
- Floodplain Mapping
- **Flow Characteristics**
  - Velocity
  - **Depth**
- Channel and Water profiles
- Dam, Bridge, and Culvert Impacts
  - Backwatering
  - Overtopping
  - Scour

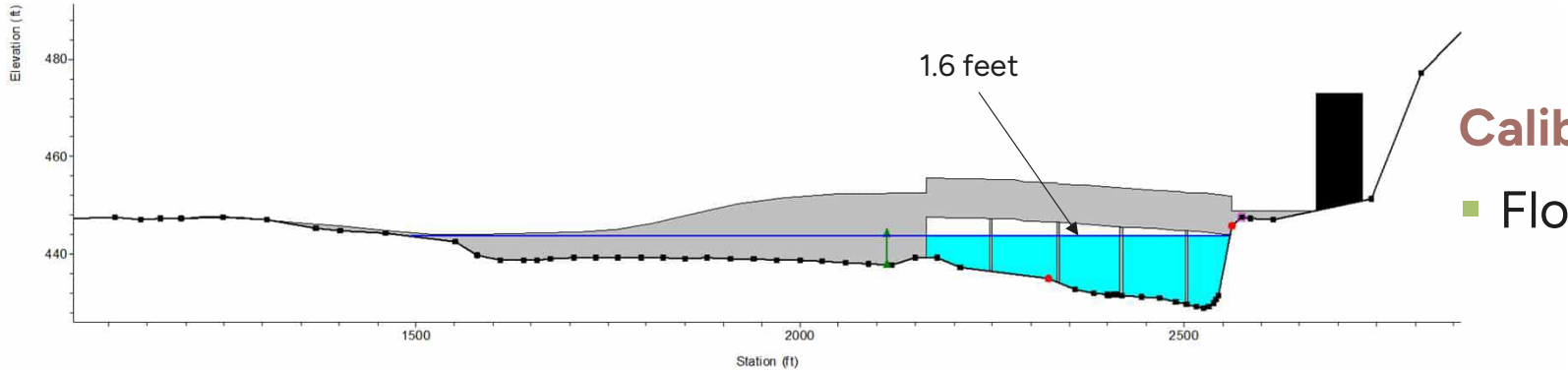


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How Accurate is it?



Calibration / Validation:

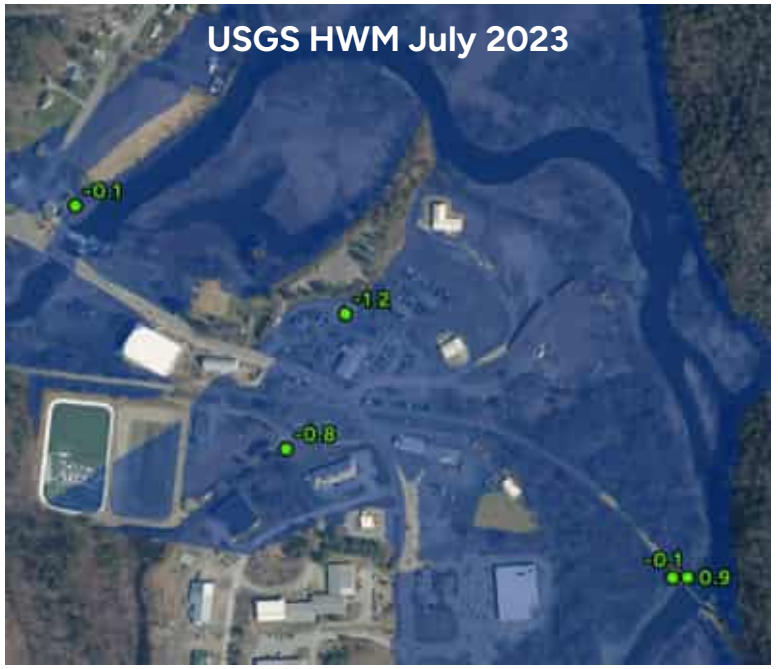
- Flooding Photos



Wrong Way Bridge
Lamoille River at ~2-year flood level
Jessica Louisos, May 24, 2013

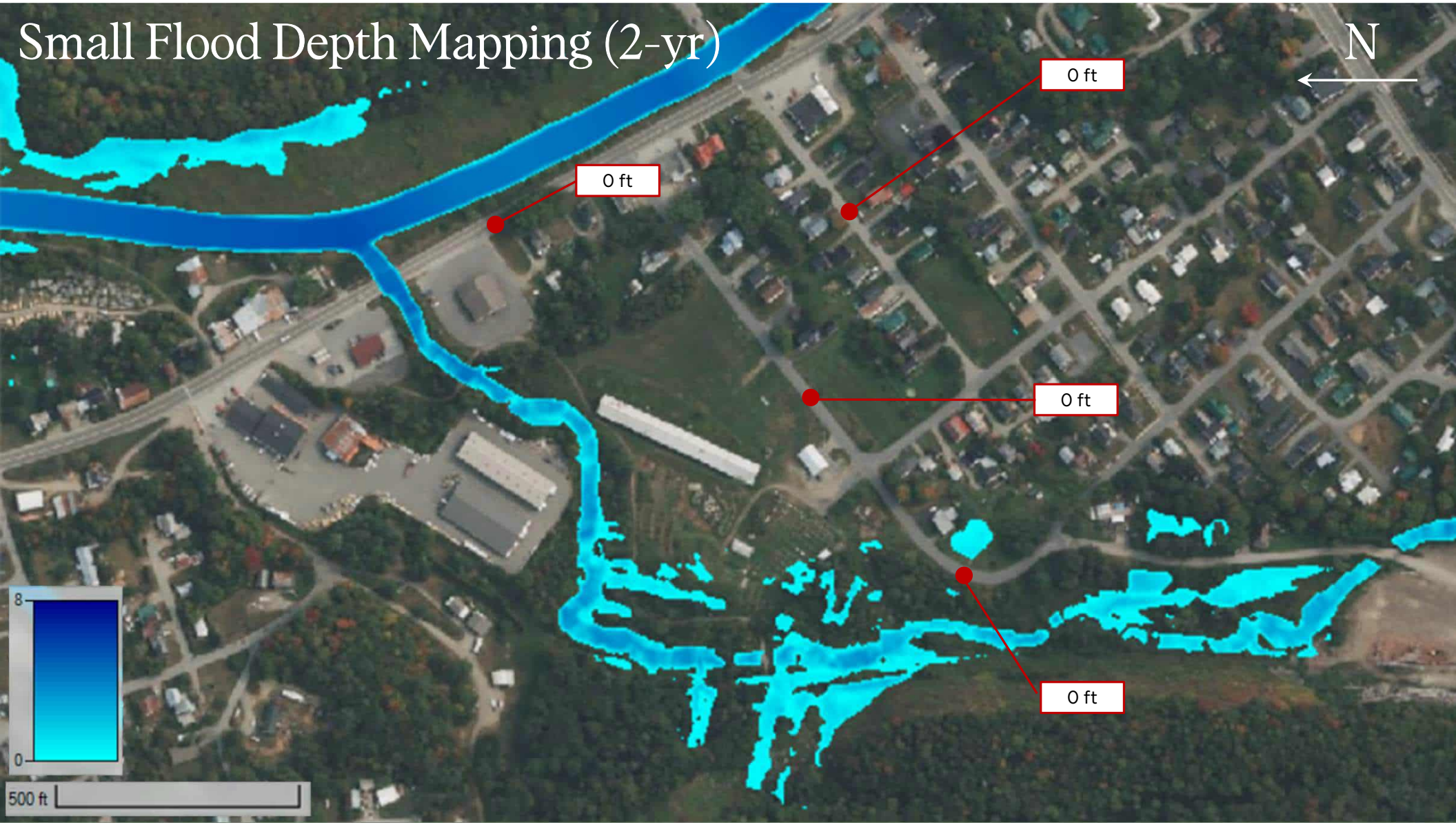
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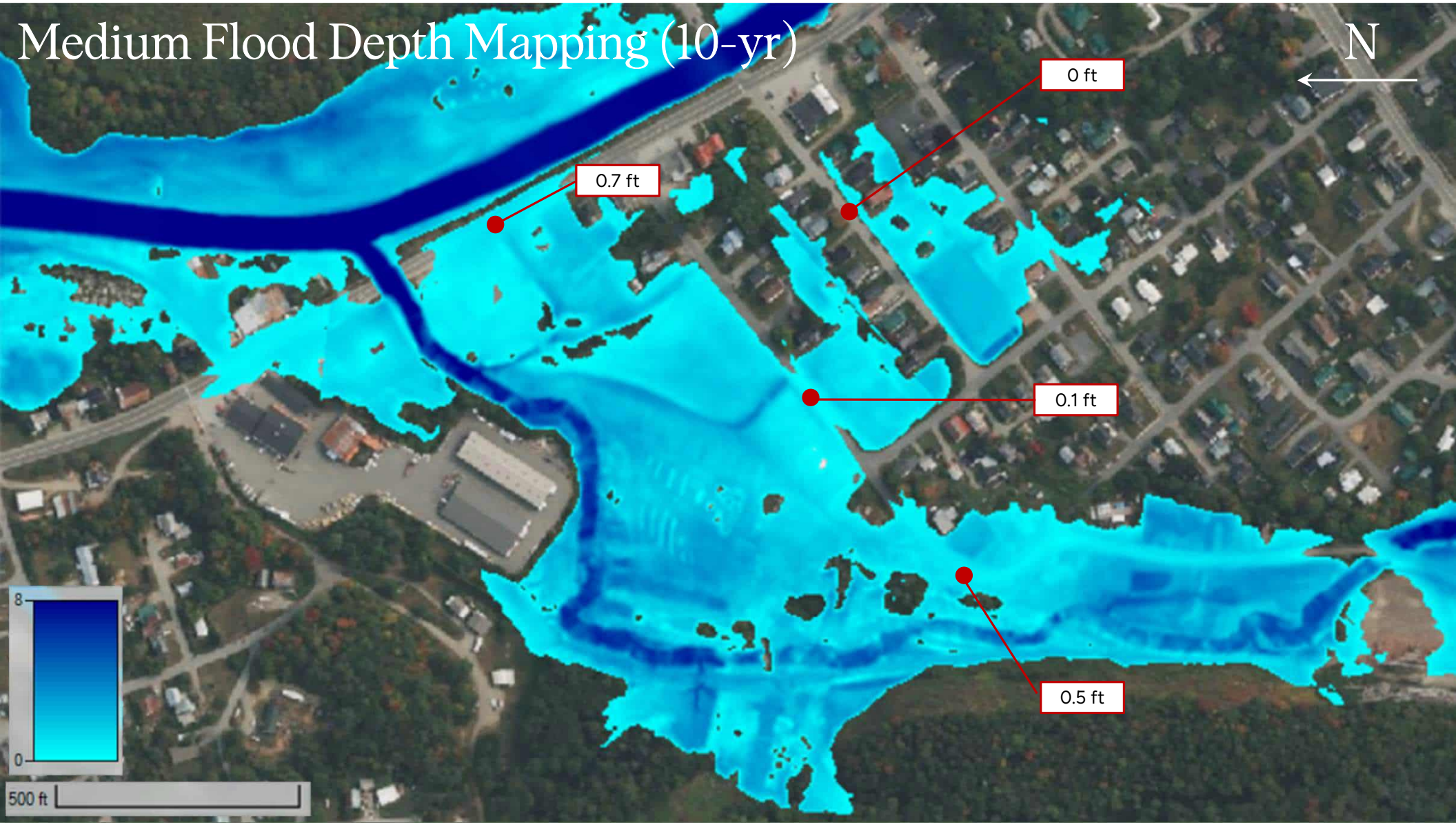


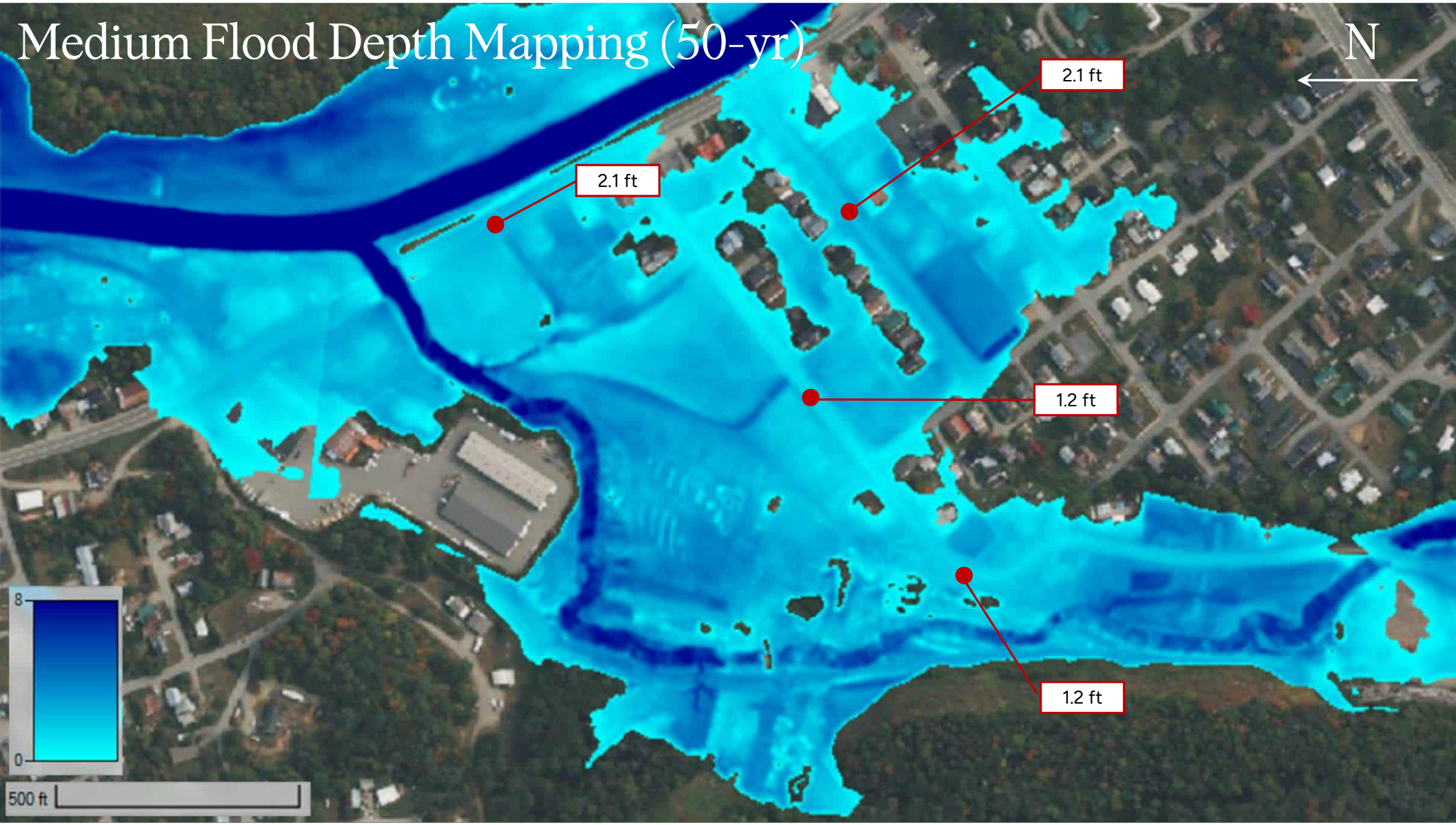


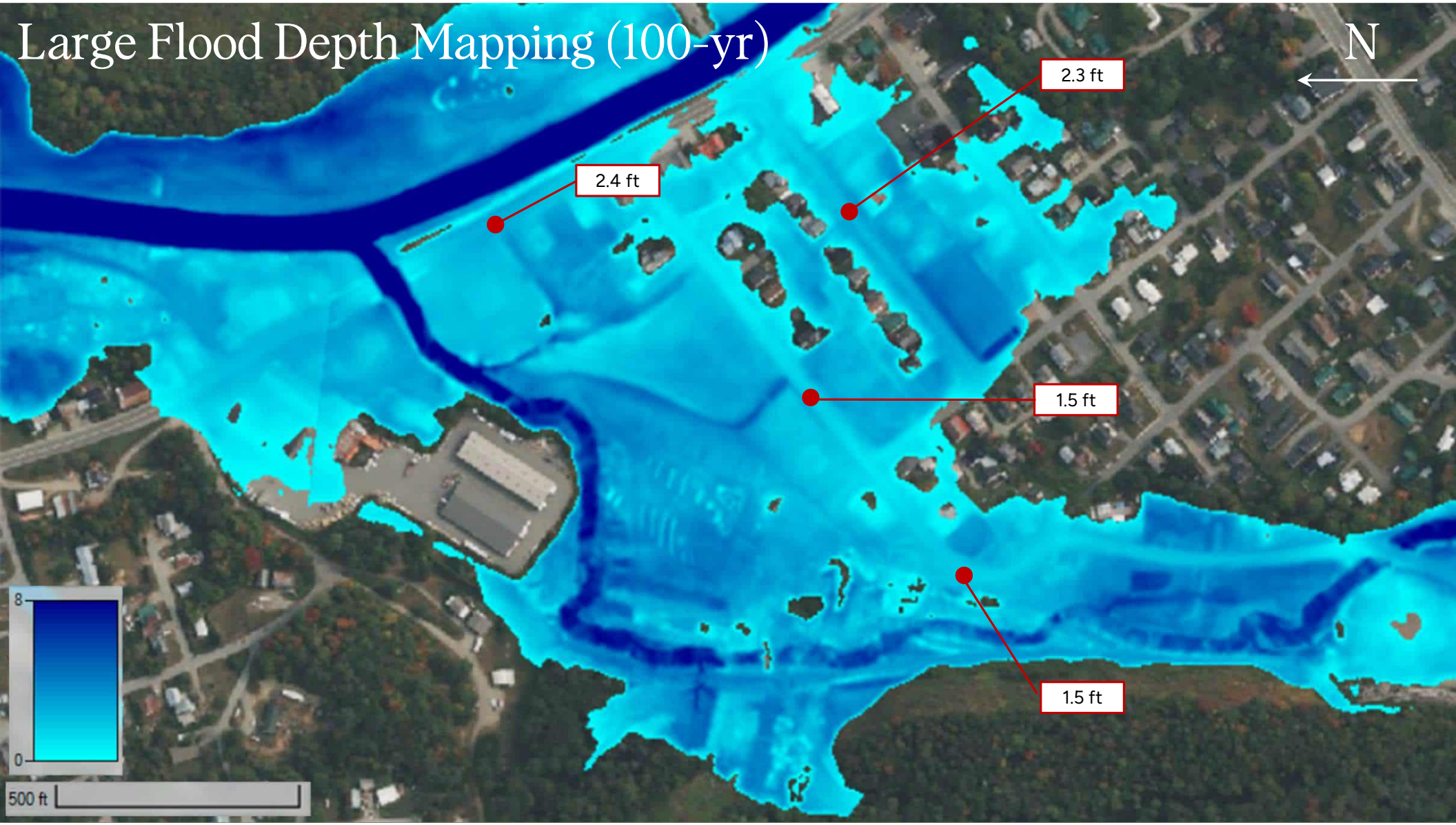
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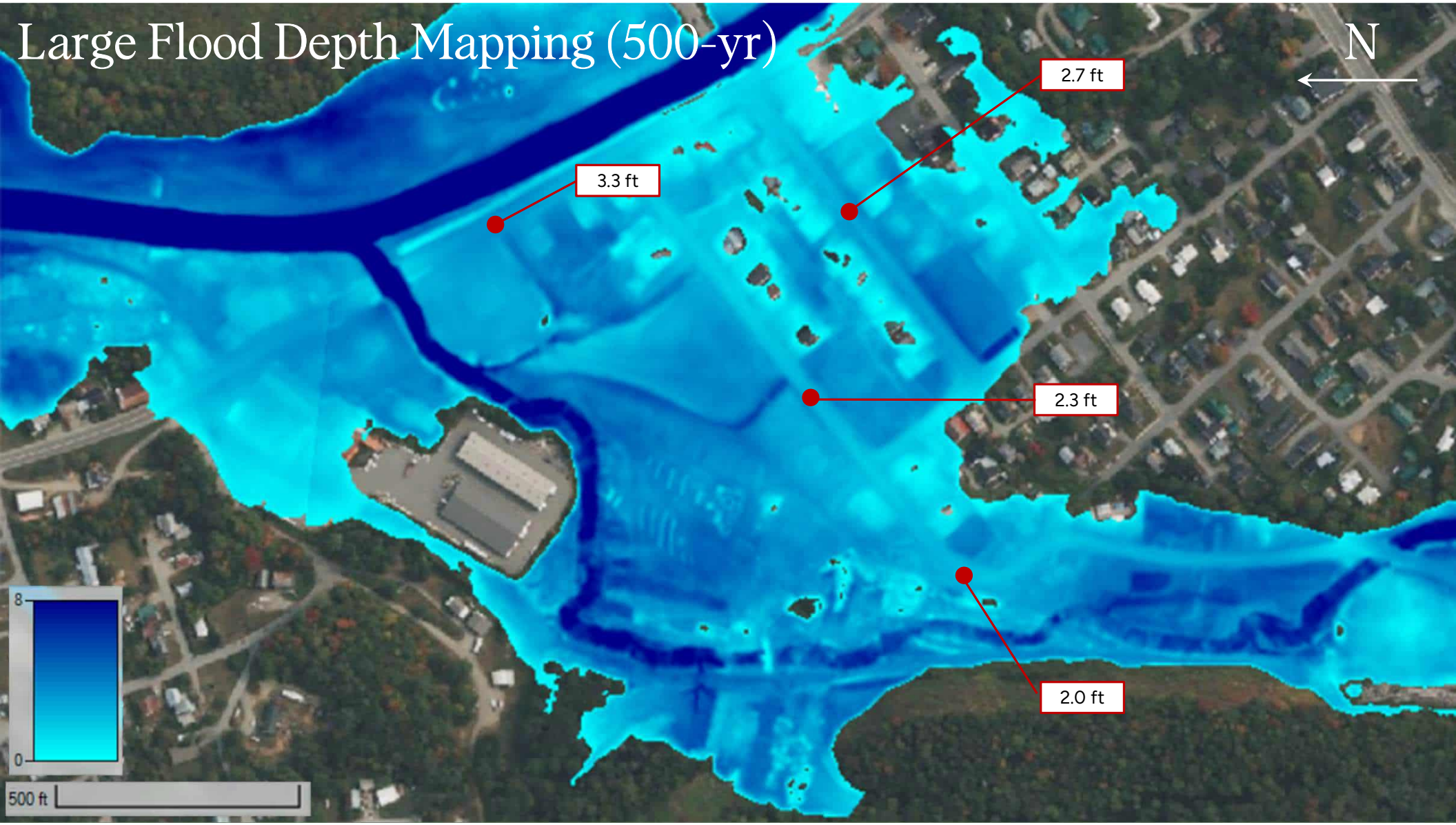
- High Water Marks (HWMs)
- Accuracy is within 1 ft
- Good for comparing alternatives


Small Flood Depth Mapping (2-yr)
N
0 ft
0 ft
0 ft
0 ft
8
0
500 ft

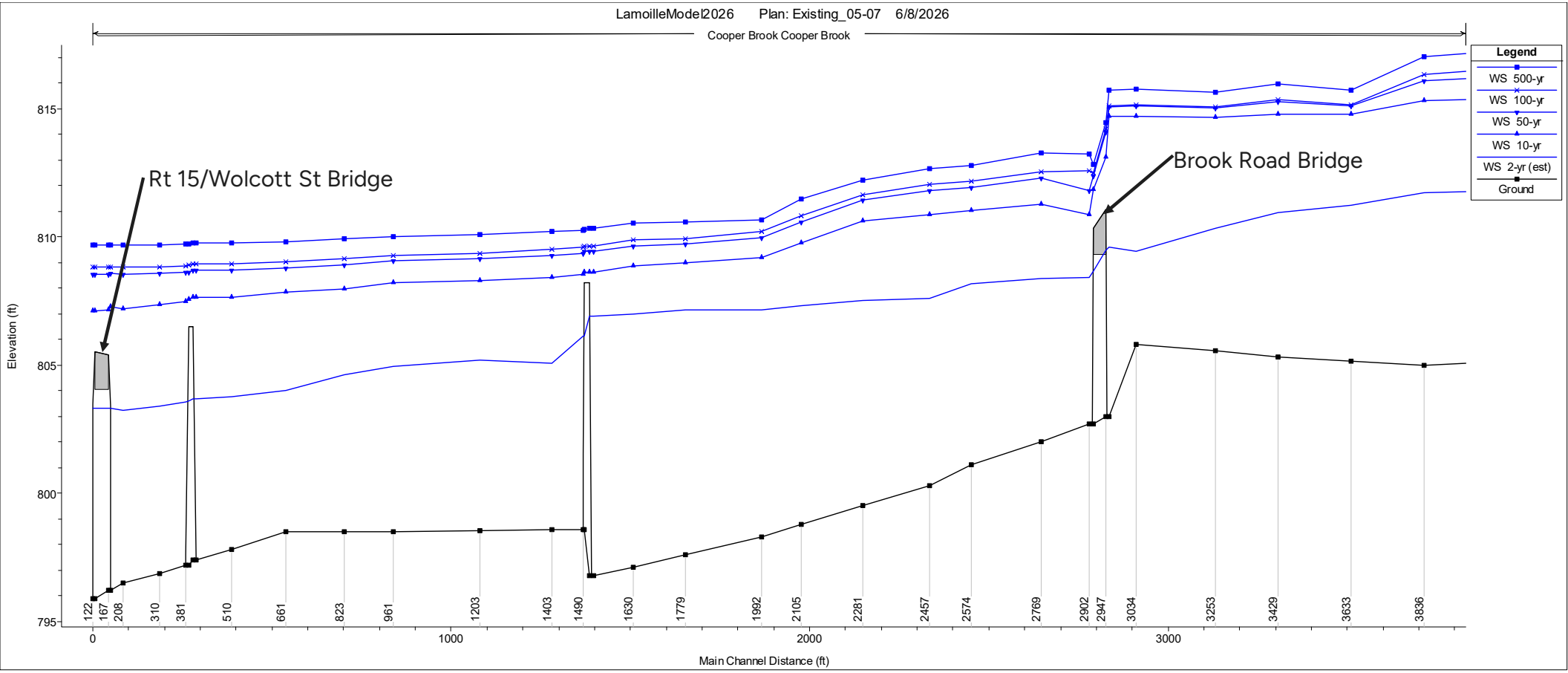

Medium Flood Depth Mapping (10-yr)
N
0 ft
0.7 ft
0.1 ft
0.5 ft
8
0
500 ft


Medium Flood Depth Mapping (50-yr)
N
2.1 ft
2.1 ft
1.2 ft
1.2 ft
8
0
500 ft

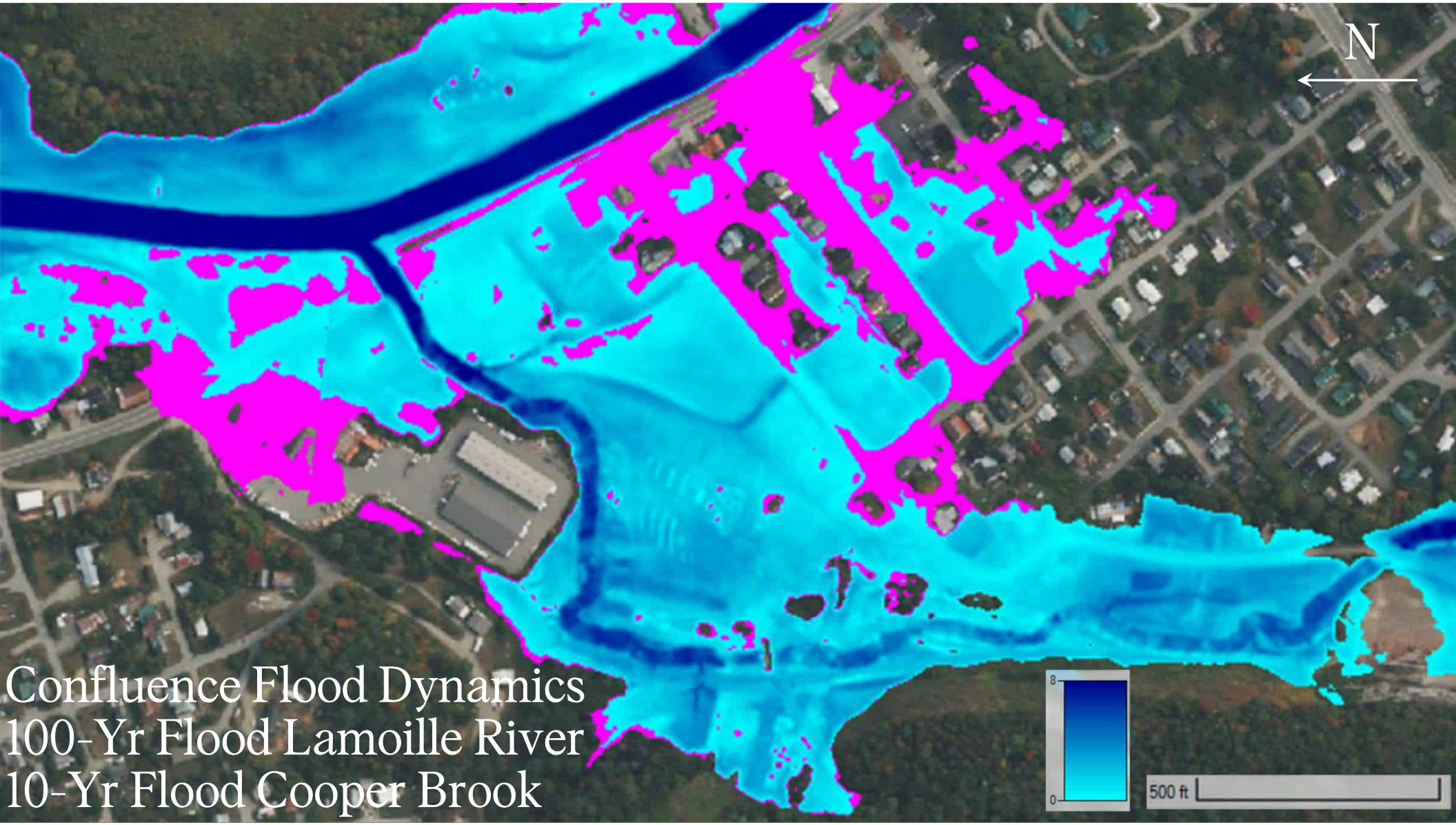

Large Flood Depth Mapping (100-yr)
N
2.3 ft
2.4 ft
1.5 ft
1.5 ft
8
0
500 ft

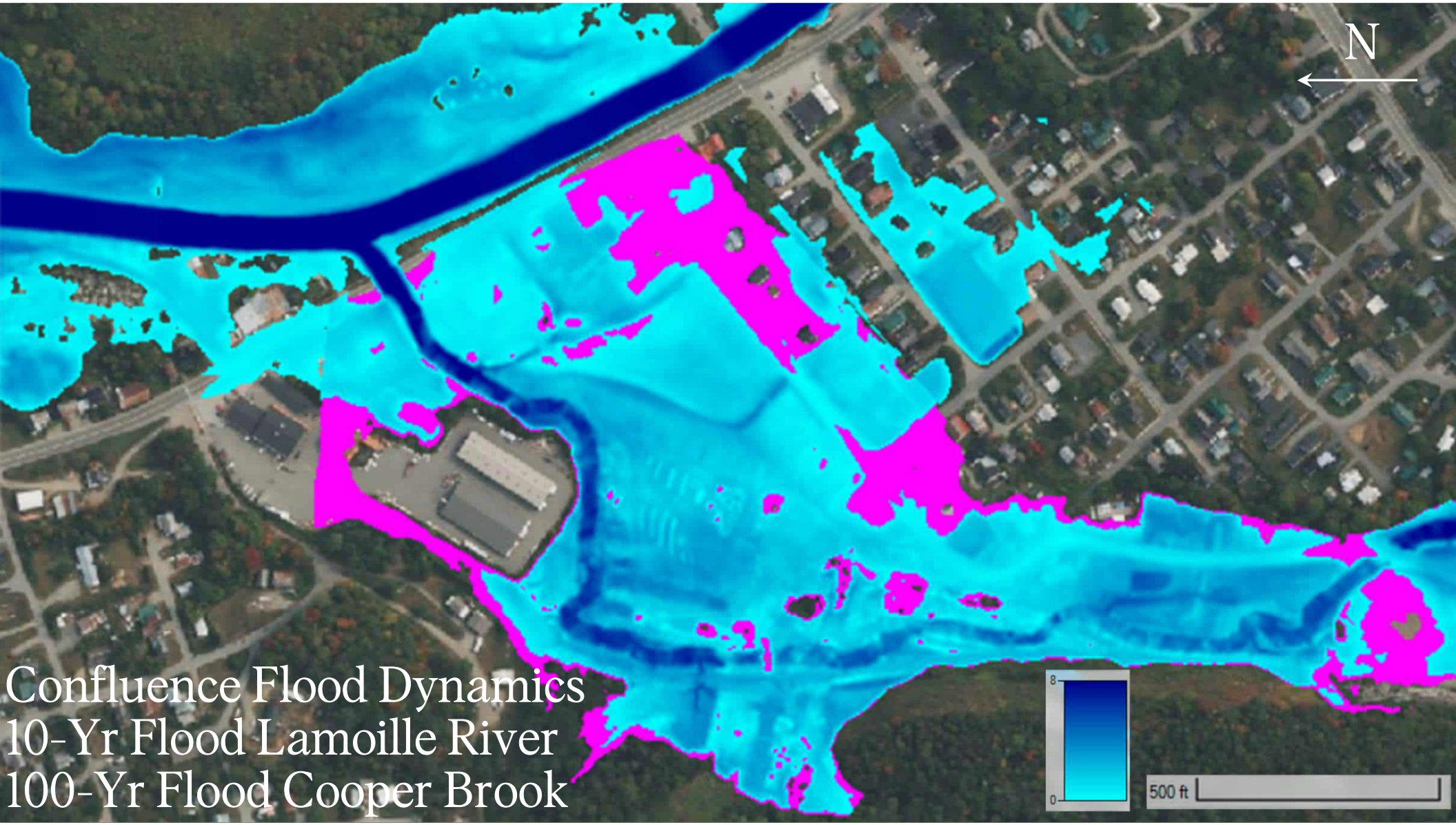

Large Flood Depth Mapping (500-yr)
N
2.7 ft
3.3 ft
2.3 ft
2.0 ft
8
0
500 ft

Existing Conditions – Cooper Brook Profile



3,800 ft (0.7 miles)


N
Confluence Flood Dynamics
100-Yr Flood Lamoille River
10-Yr Flood Cooper Brook
8
0
500 ft


N
Confluence Flood Dynamics
10-Yr Flood Lamoille River
100-Yr Flood Cooper Brook
8
0
500 ft

Types of Flood Mitigation Alternatives

Constriction Reduction

- Widen bridges, culverts, or other structures
- Remove fill or buildings

Floodplain Reconnection

- Lower floodplain
- Remove berm
- Elevate channel
- Buyouts

Infrastructure Protection

- WWTP and utilities
- Roads
- Buildings





Floodplain Restoration in Brattleboro

Removed Buildings, People, and Infrastructure from Most Vulnerable Locations

- Removed 11 buildings
- Relocated road
- Relocated sewer main / utilities

Increased Floodplain Storage Capacity

- Removed 28,000 CY of fill in floodplain and lowered land average of 5 feet
- Planted and restored 4.4 acres of floodplain with native vegetation



Floodplain Restoration in Brattleboro



Pre-construction

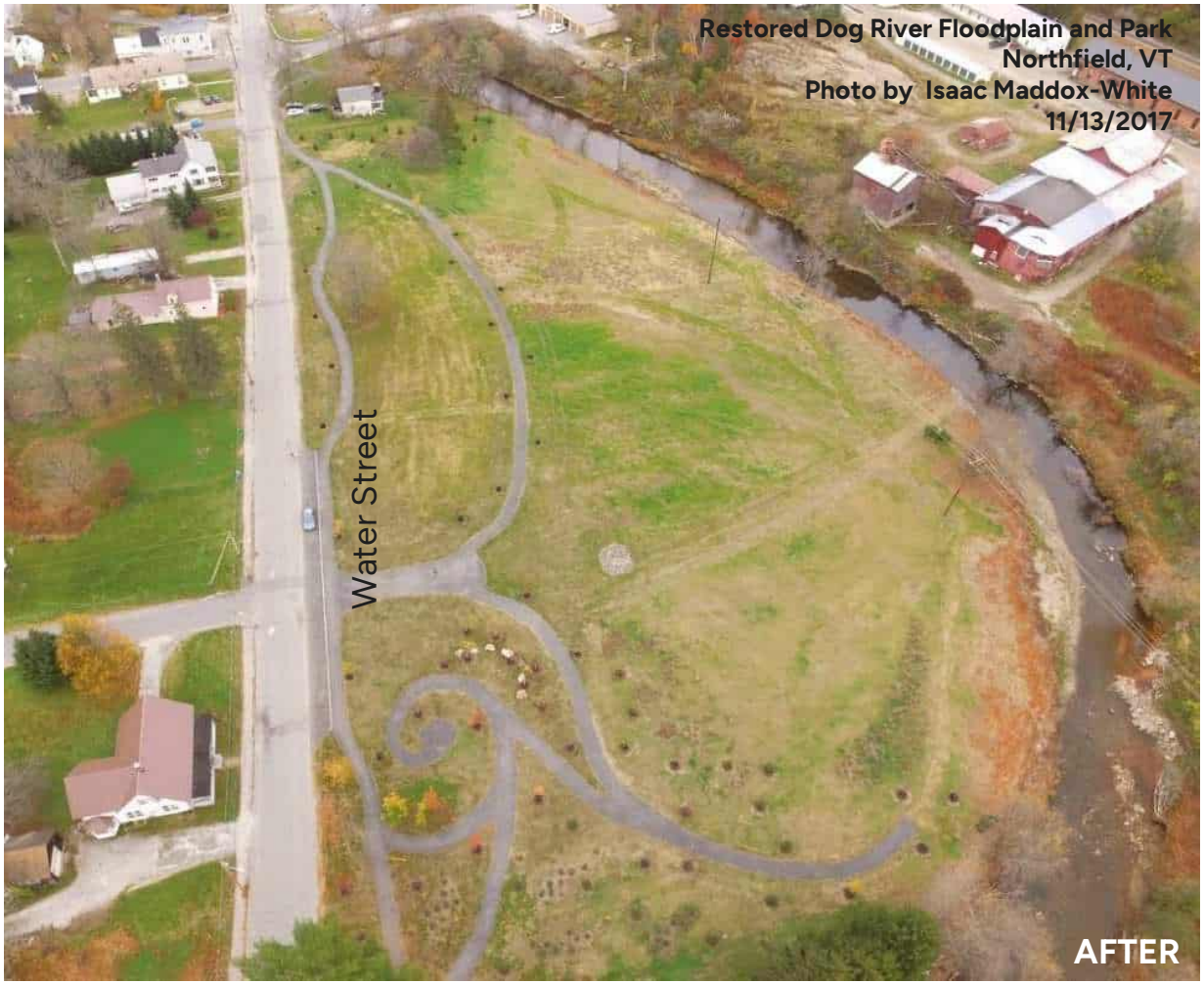


Post-construction

Dog River Park in Northfield



- 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



Dog River Park in Northfield



Dog Floodplain
Northfield, VT
Photo by M. Braun
10/30/2017



Dog Floodplain
Northfield, VT
Photo by R. Schiff
9/7/2018

Route 15 Bypass Culverts - Cambridge

Provide additional capacity under highway embankment

- Large culvert installed under road
- Floodwater trapped behind road embankment can flow out of village
- Road overtops less
- Buildings flooded less







Greenway Trail Bridge Replacement– Jeffersonville



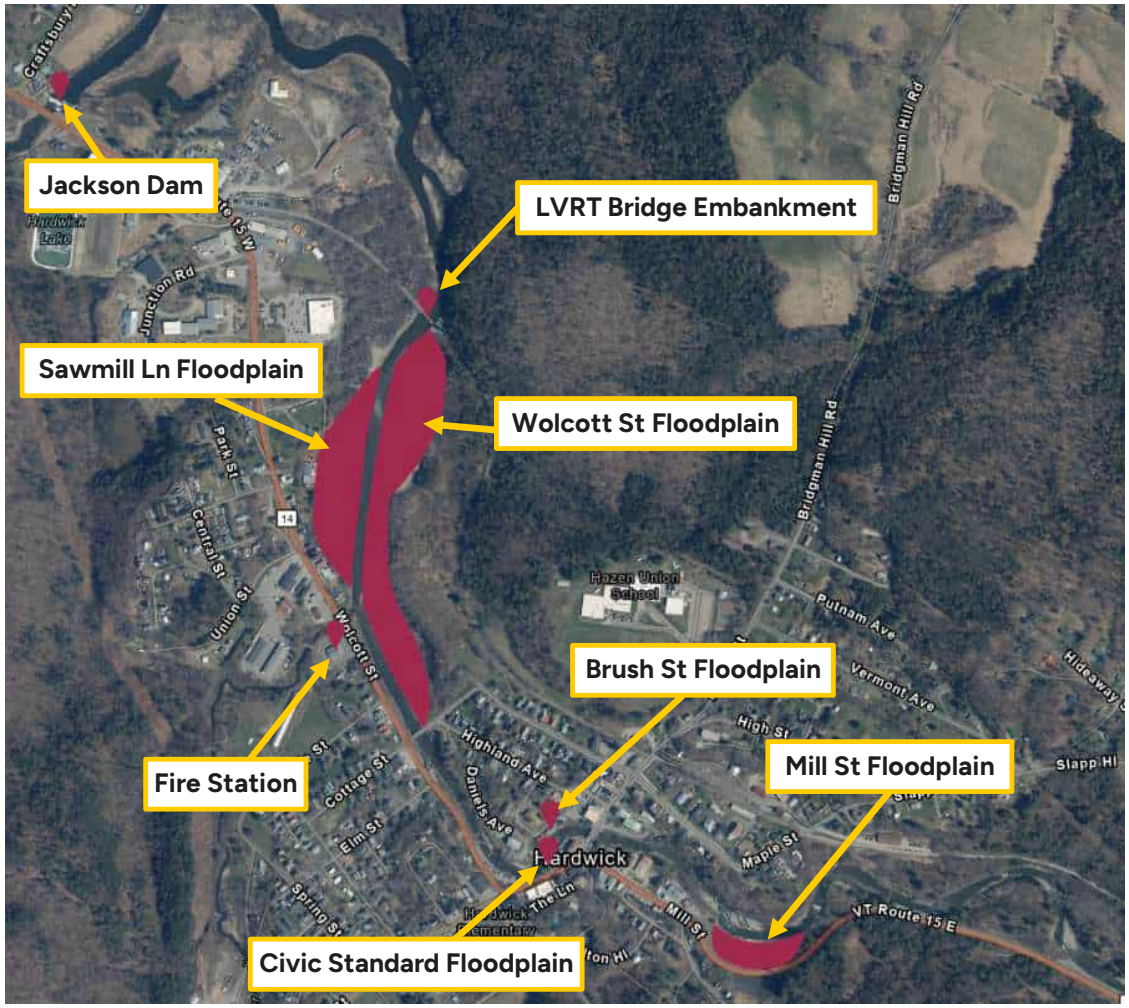
Removed constriction

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



Potential Flood Mitigation Alternatives in Hardwick

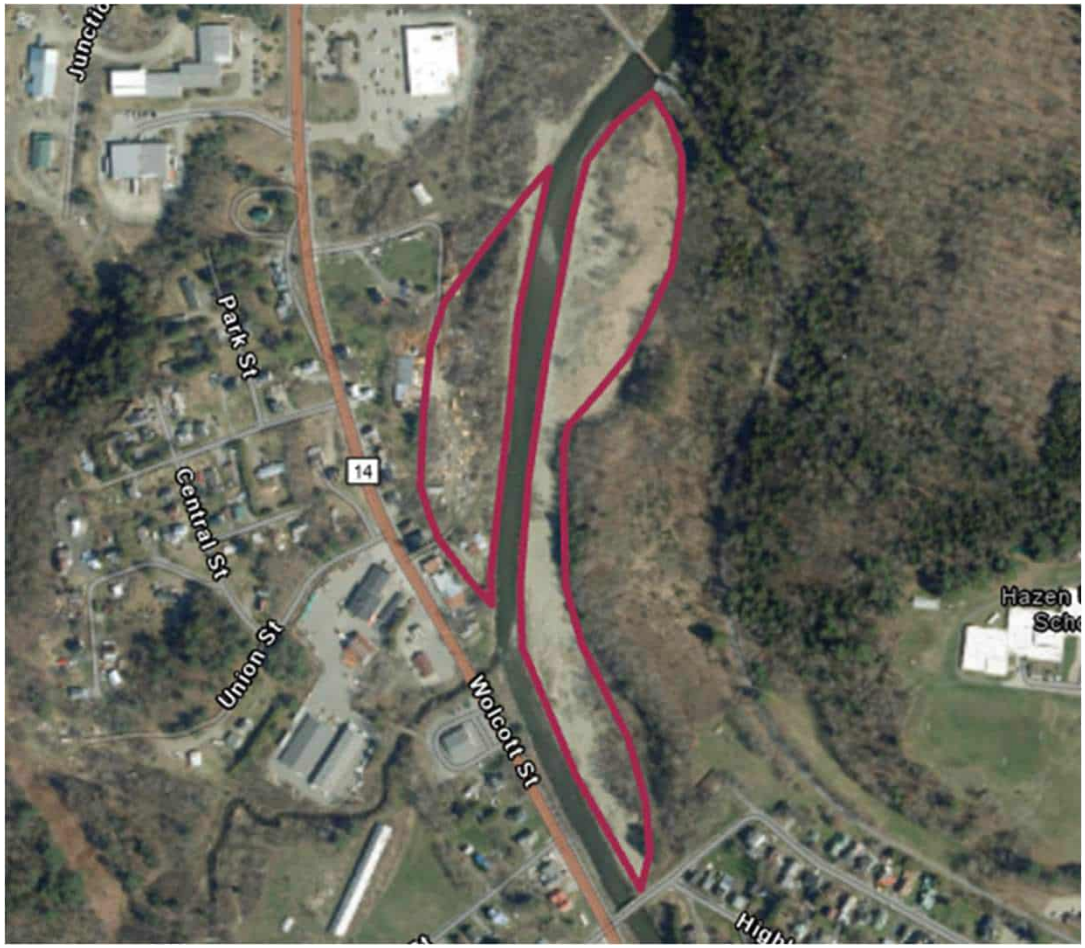






Wolcott Street and Sawmill Lane Floodplains





Problems

- Sediment deposition
- Inundation flooding
- Possible buyouts

Possible Solutions

- Floodplain restoration opportunity

LVRT Embankment

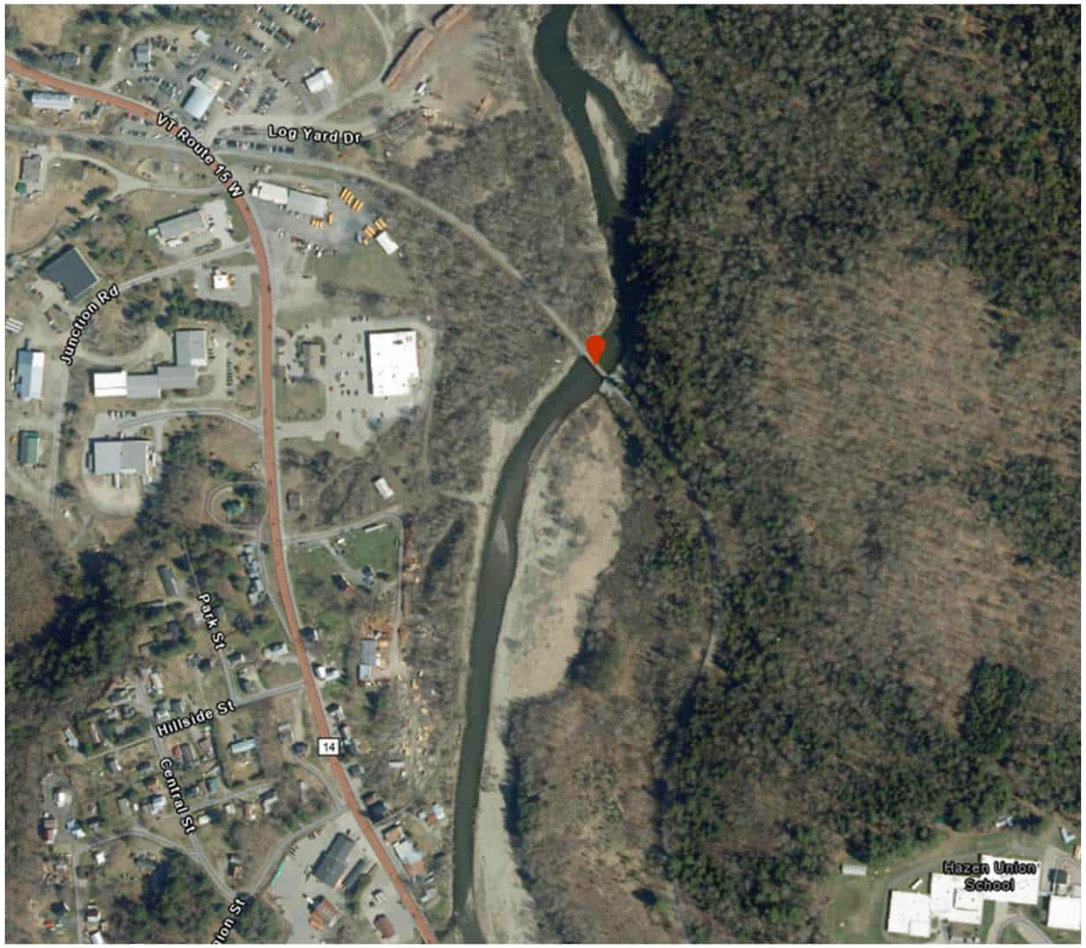


Problems

- LVRT Bridge is a constriction and backs up flow
- Embankment fully blocks floodplain

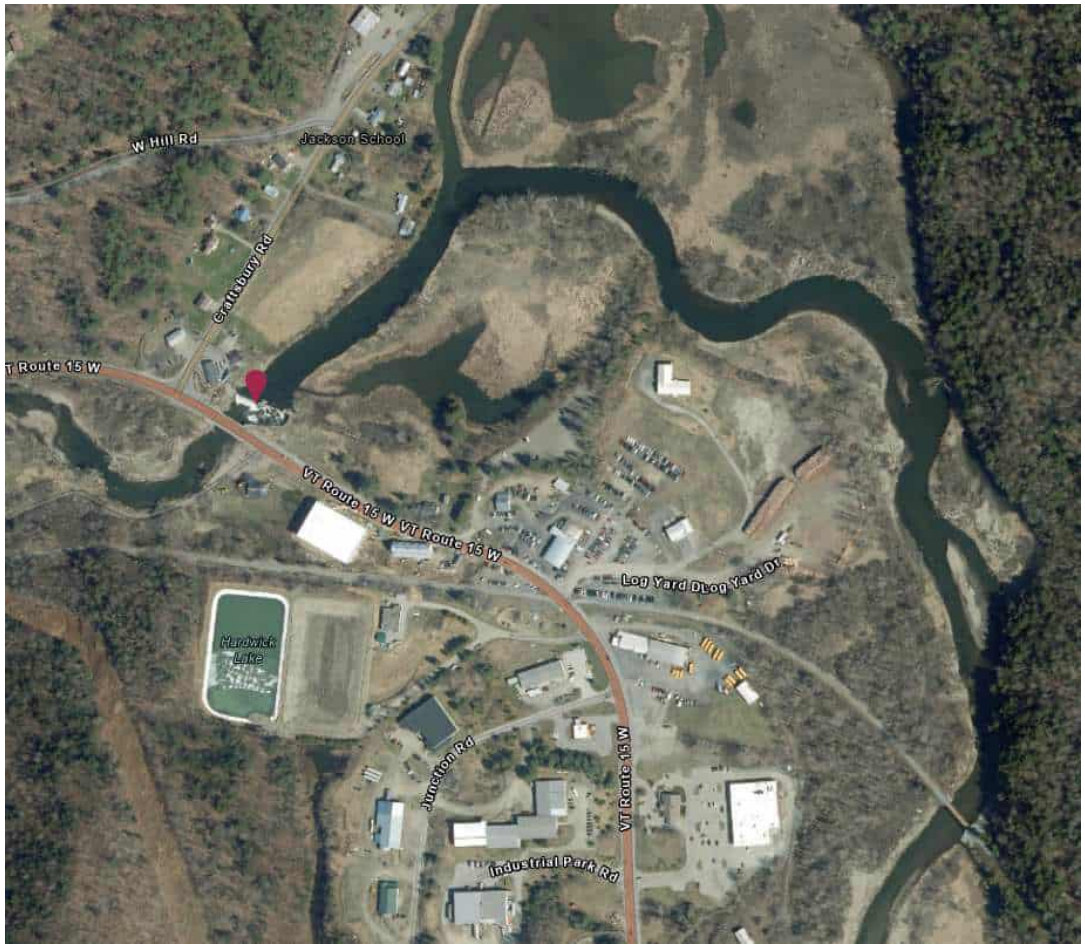
Possible Solutions

- Lower Embankment / Planned Overflow
- Widen Bridge



Jackson Dam





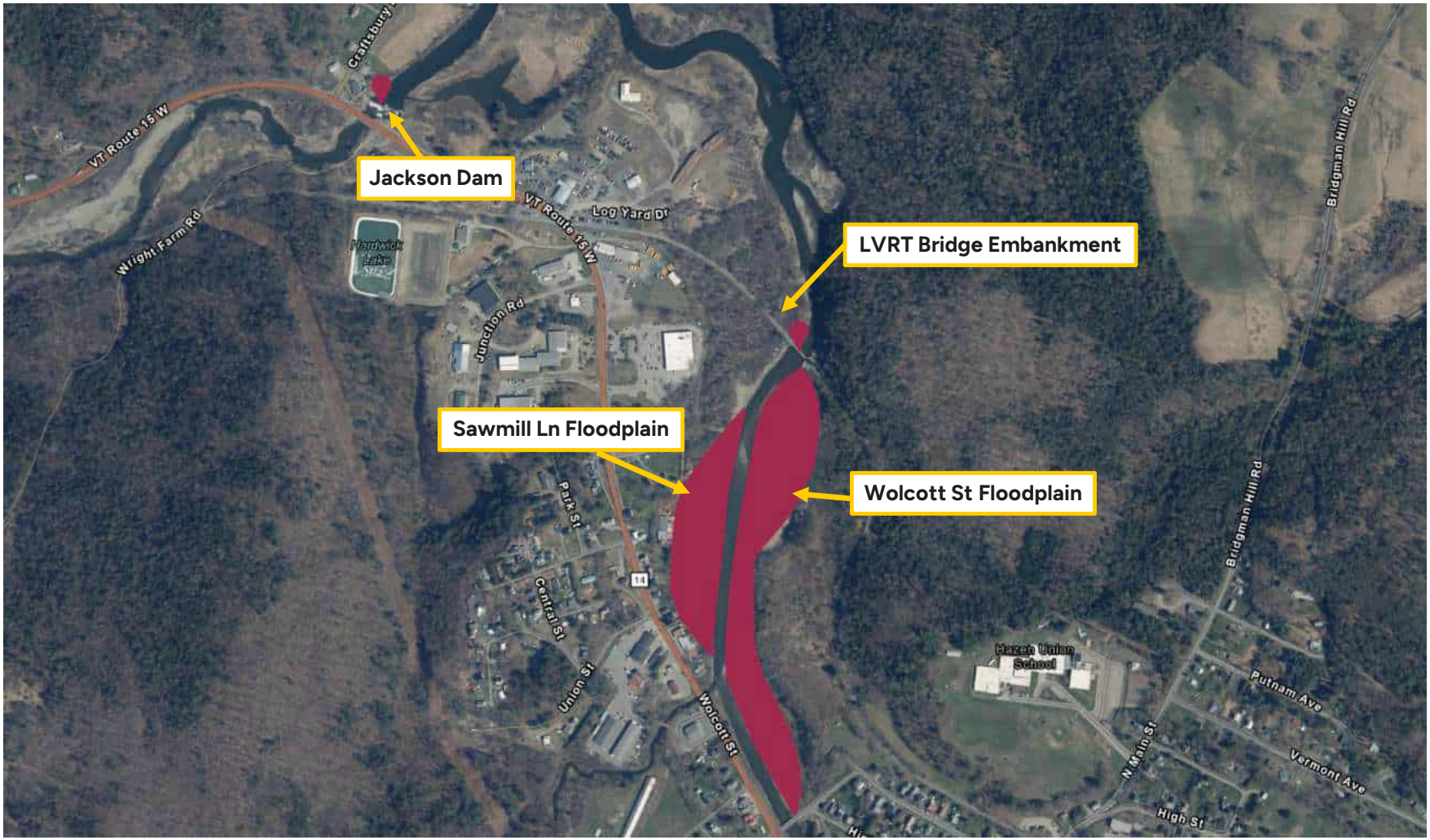
Problems

- Barrier in River

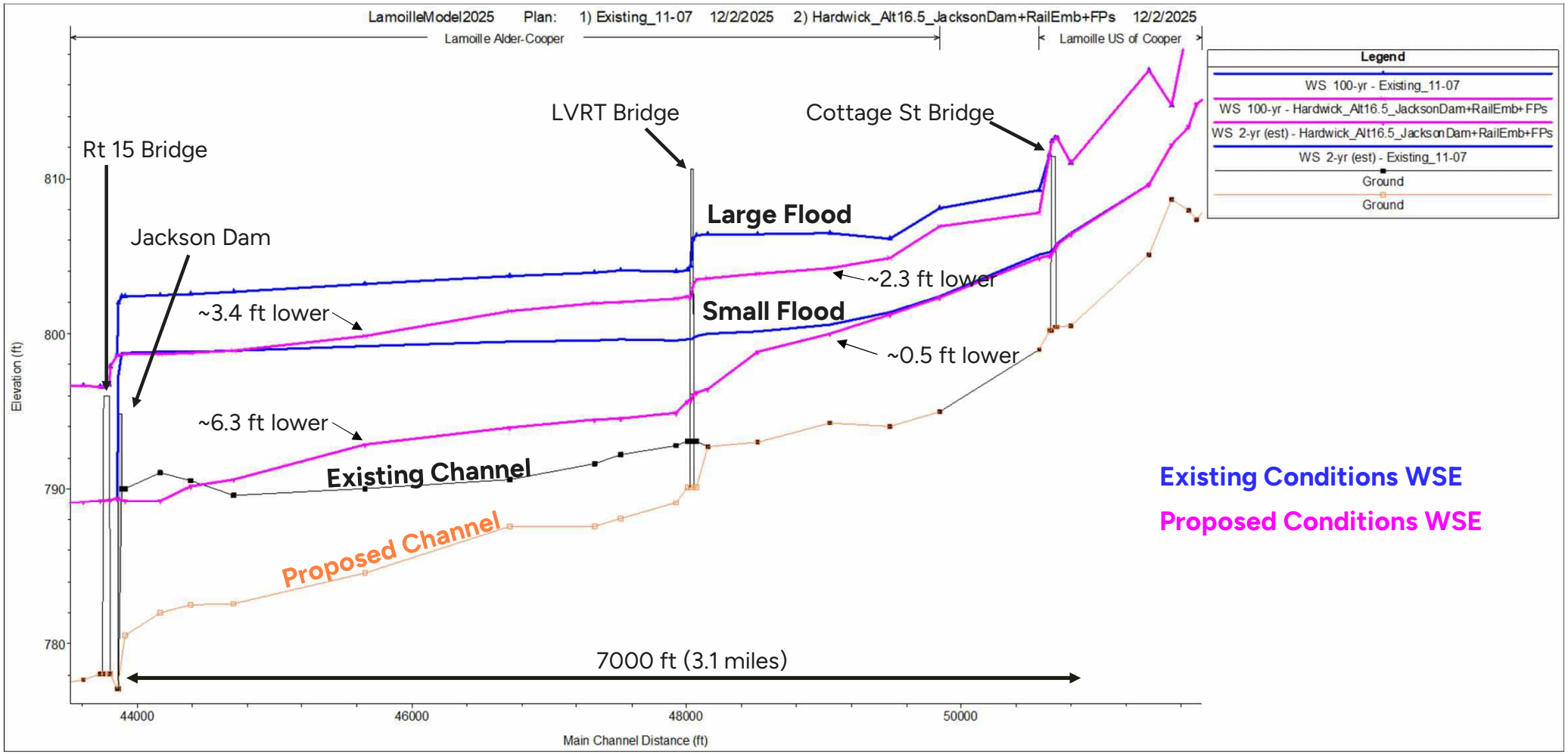
Possible Solutions

- Dam removal
- Permanent drawdown

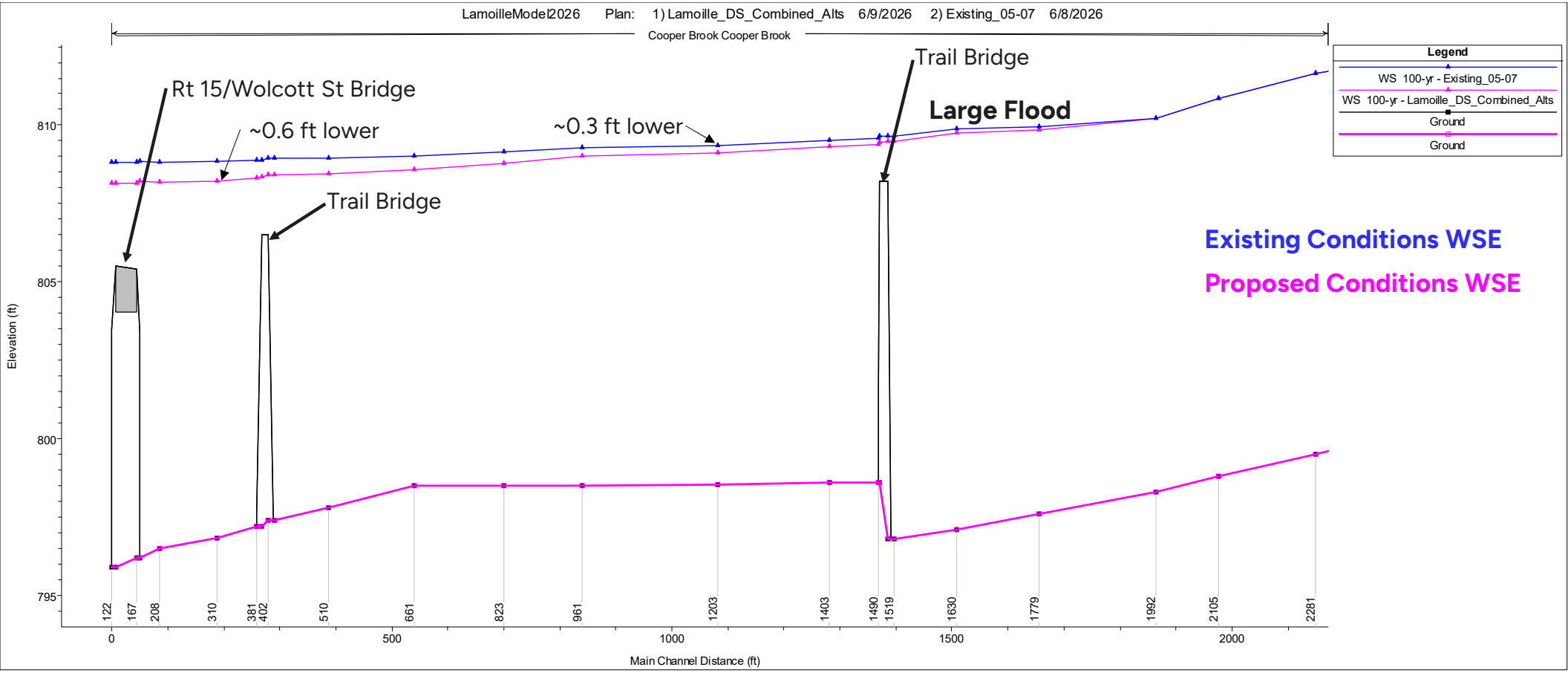
Combined Flood Mitigation Alternatives



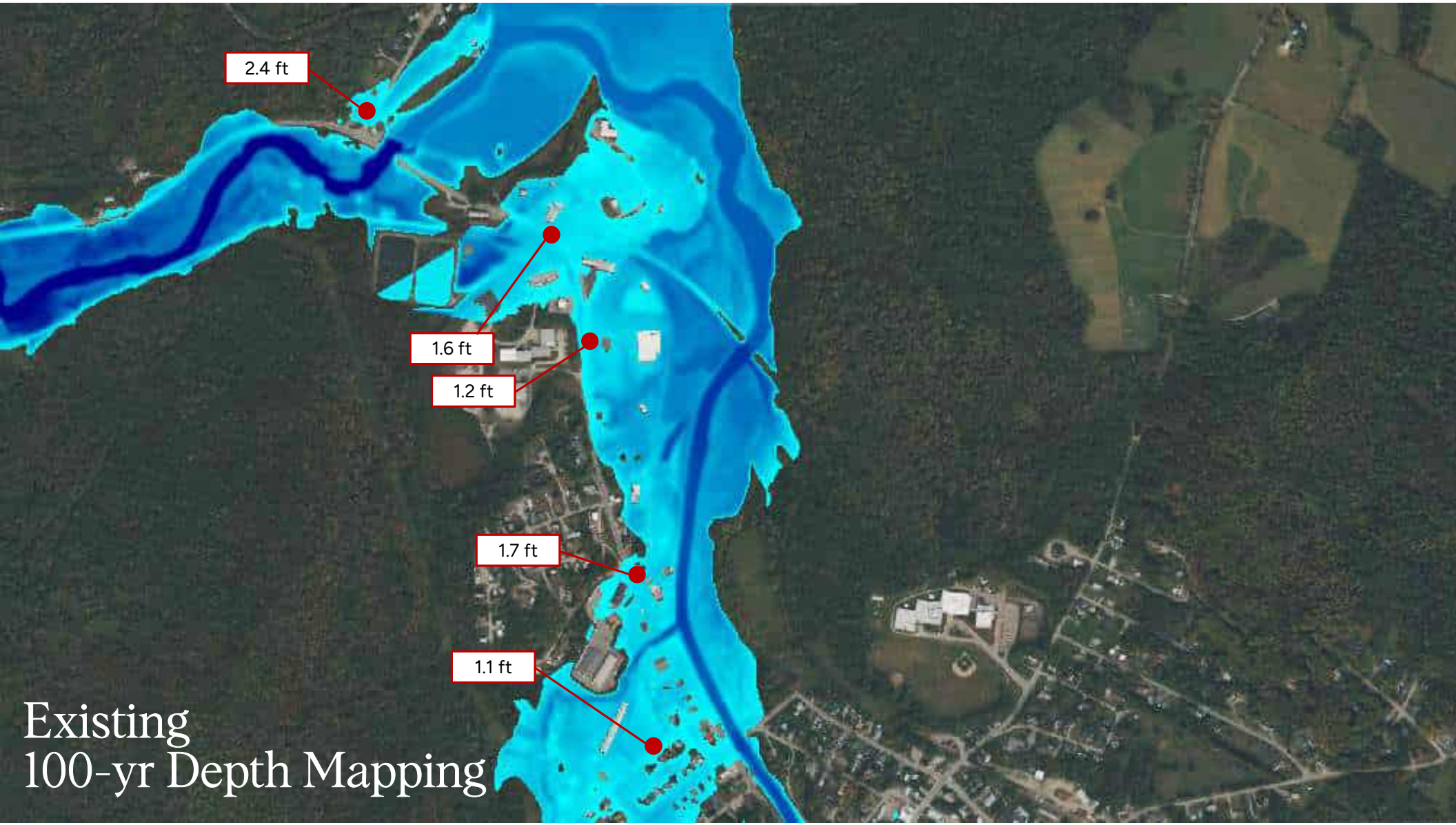
Results – Lamoille River Profile



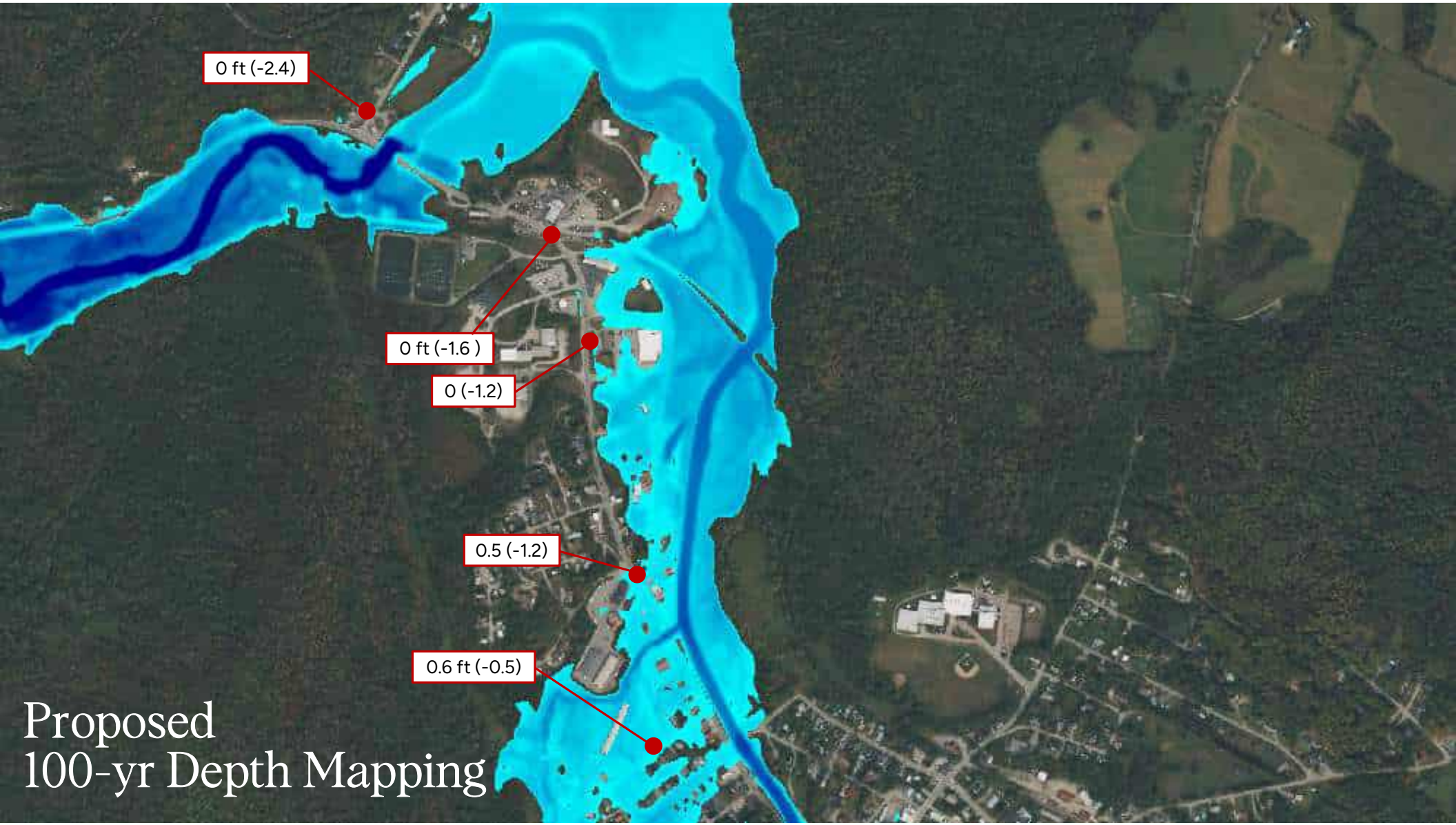
Results – Cooper Brook Profile



1,870 ft (0.4 miles)

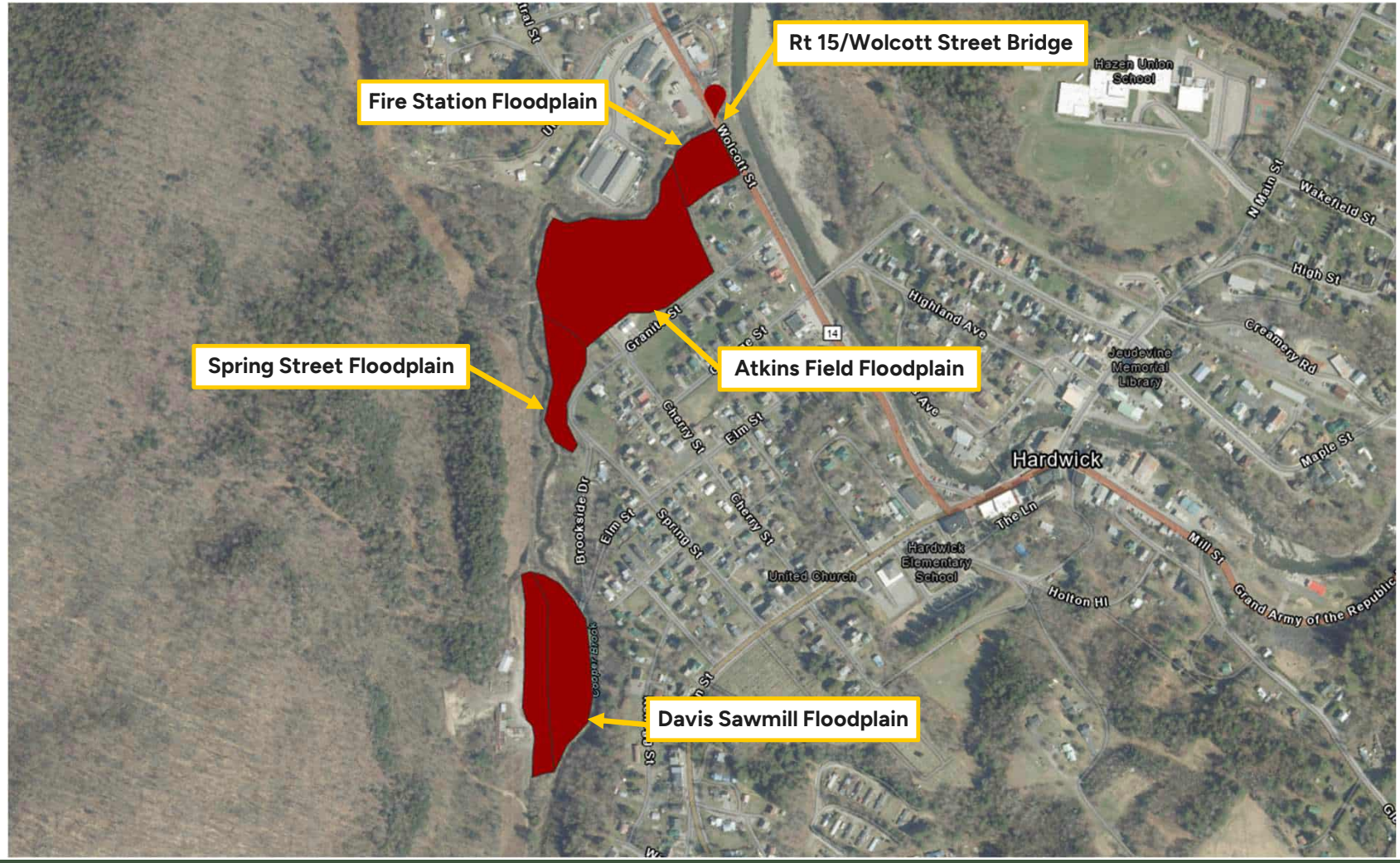


Existing
100-yr Depth Mapping



Proposed 100-yr Depth Mapping

Cooper Brook Flood Mitigation Alternatives



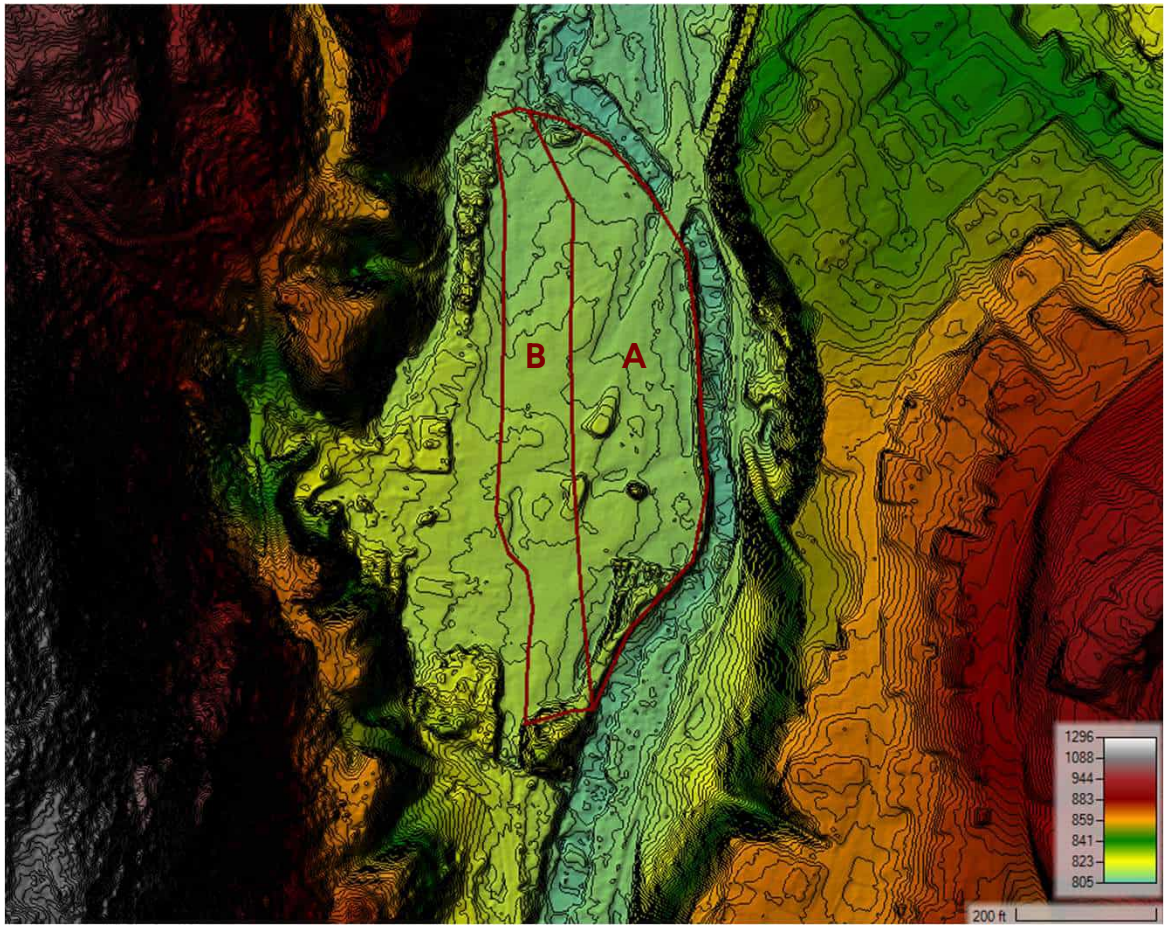
Davis Sawmill Floodplain

- Upstream of Granite Street neighborhood
- Potential area for flood benches or floodplain restoration
  - 2.5 – 4.5 acres
- The Brook Road bridge to access the sawmill is a constriction
- Existing modeling shows the area floods regularly (2 to 10-year flood)

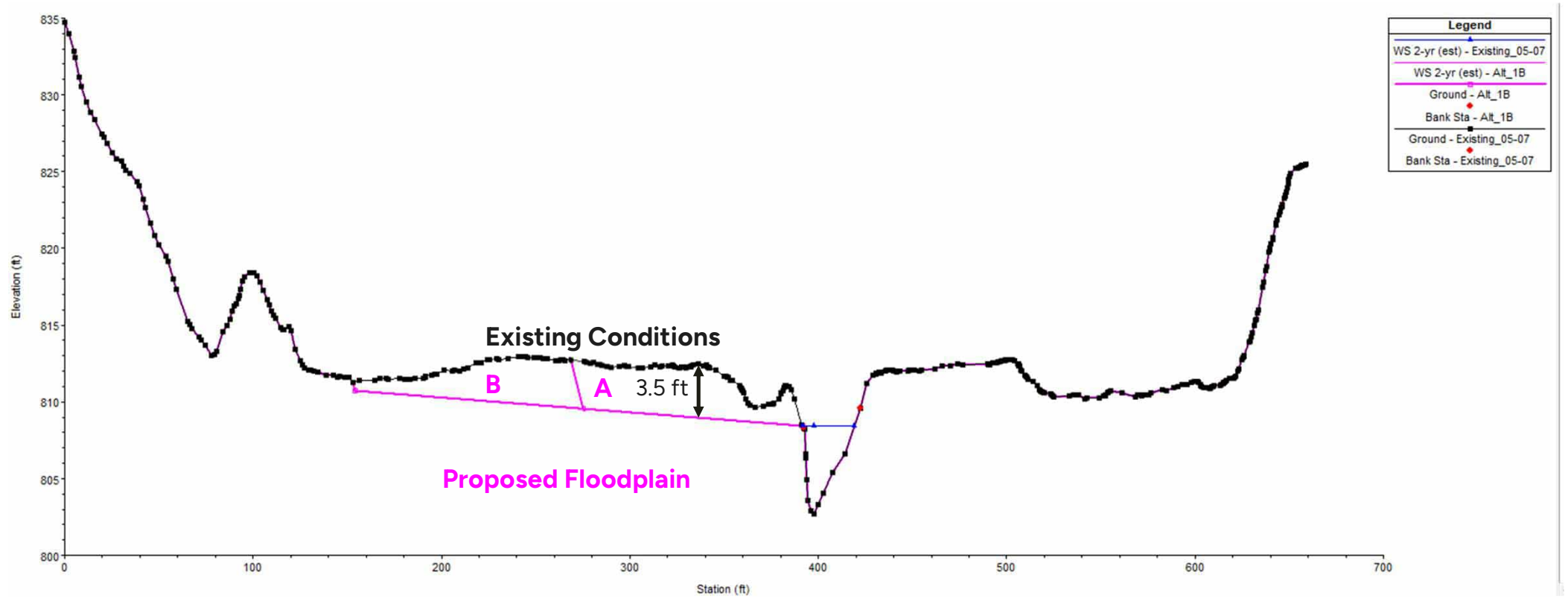


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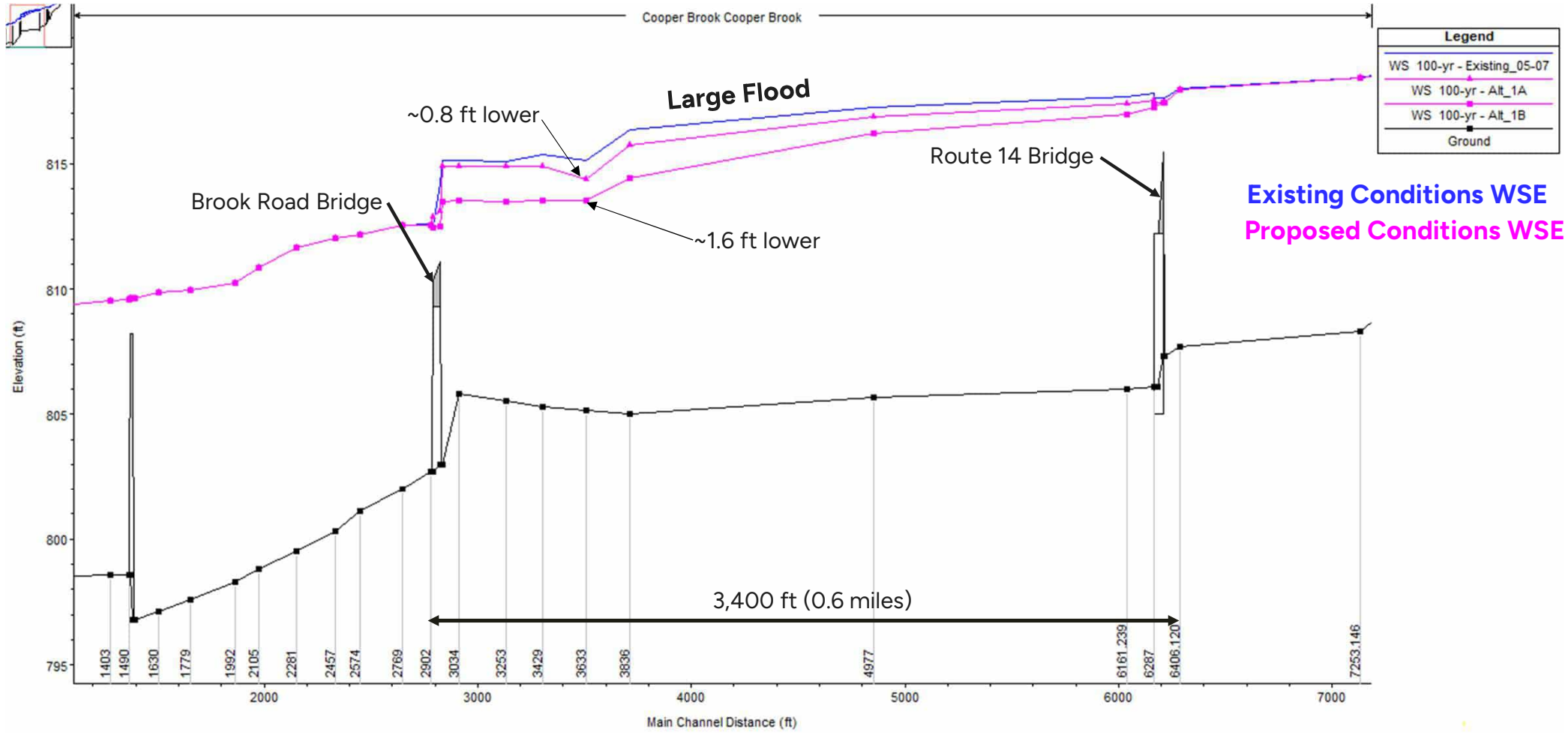
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Cross Section View – Existing and Proposed



Results – Cooper Brook Profile



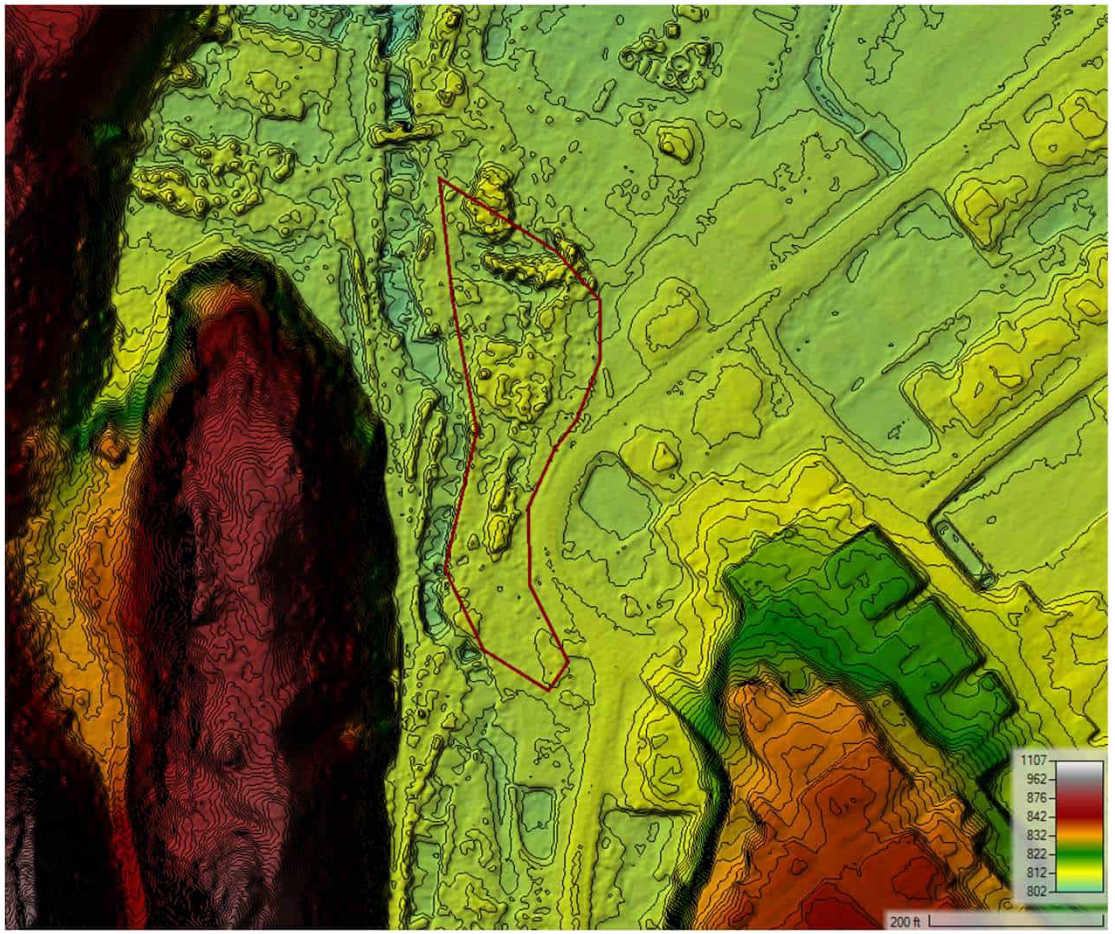
Spring Street Floodplain

- Narrow point in valley upstream of Atkins Field
- Potential area for floodplain restoration
  - 4.1 acres
  - Up to ~4 feet of cut
- Flood waters begin to enter the neighborhood
- Existing modeling shows the area floods regularly (2 to 10-year flood)

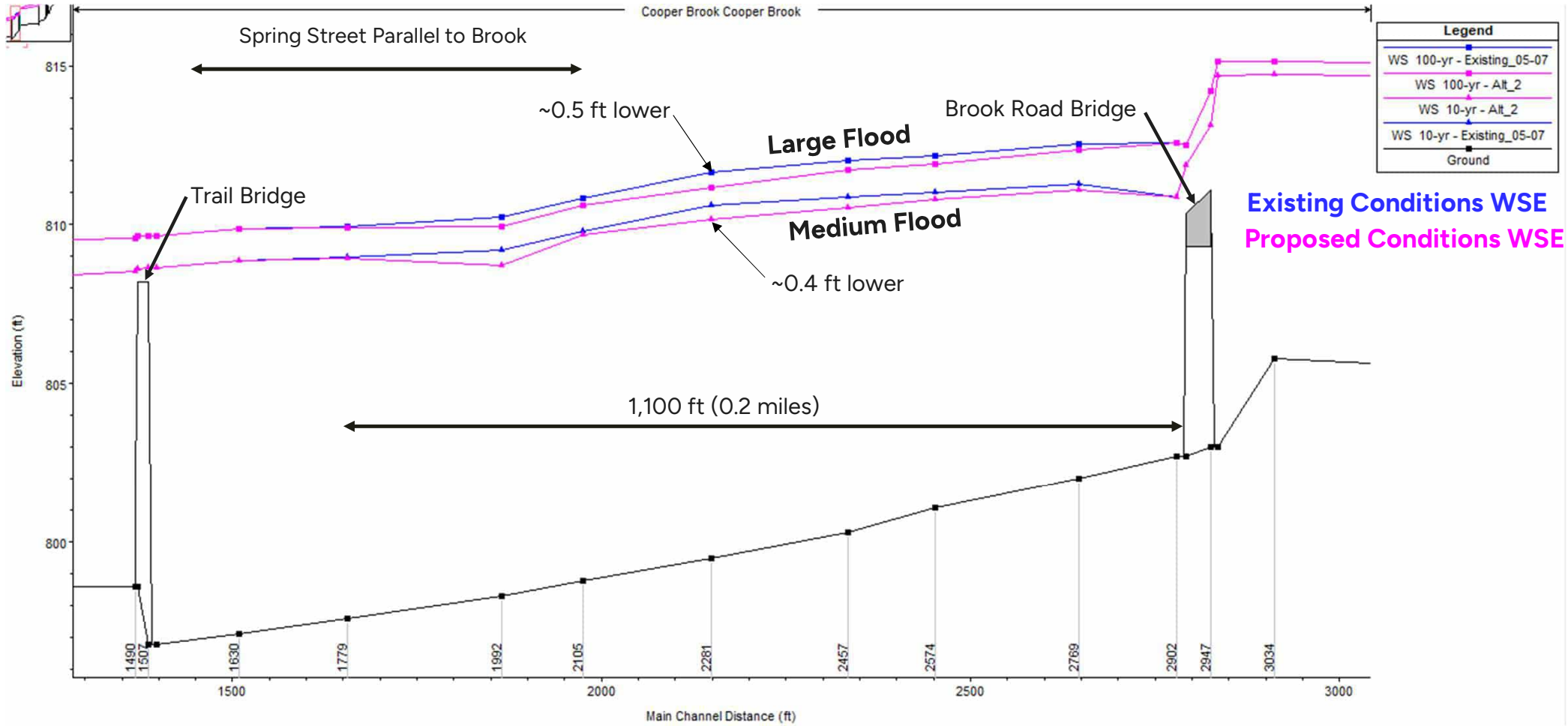


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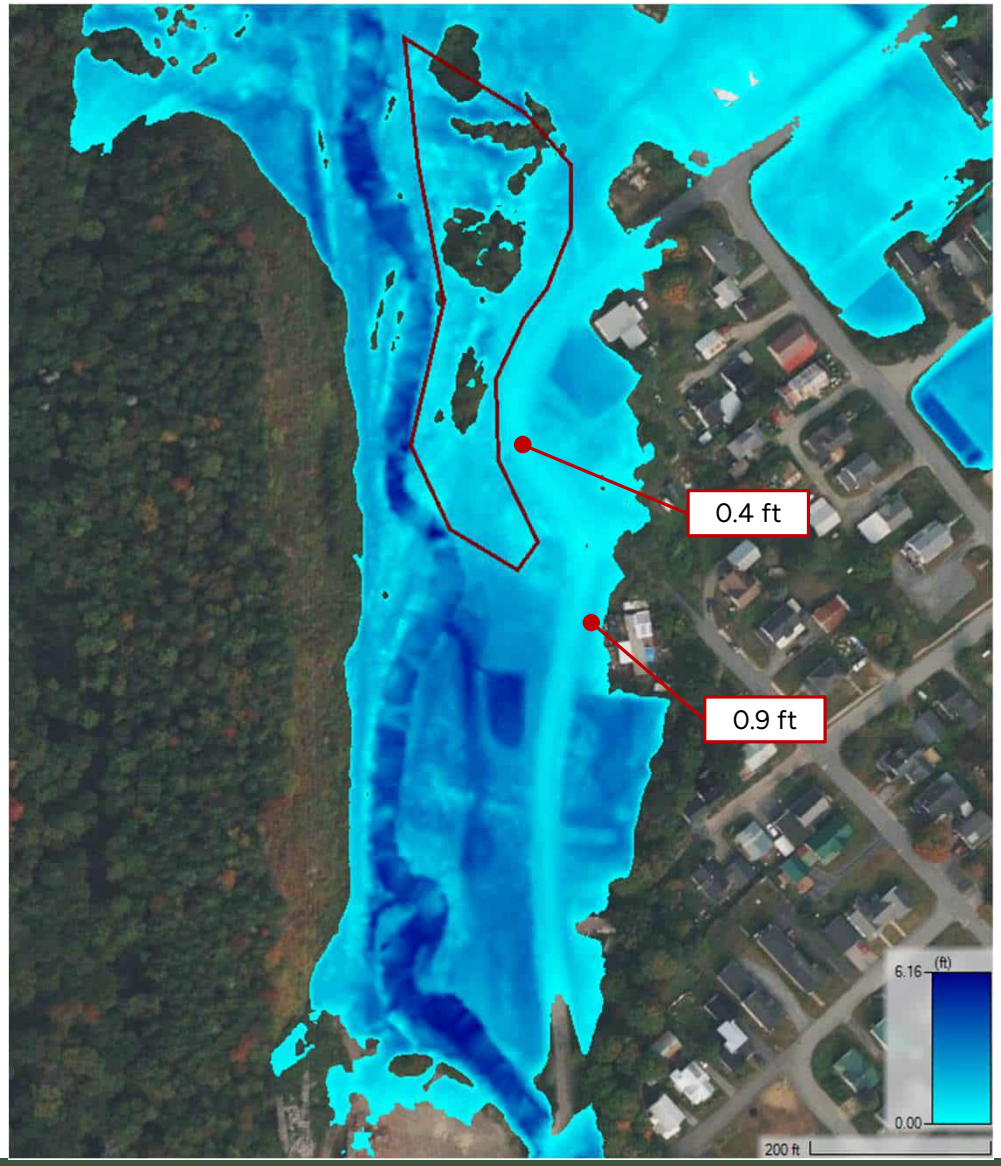
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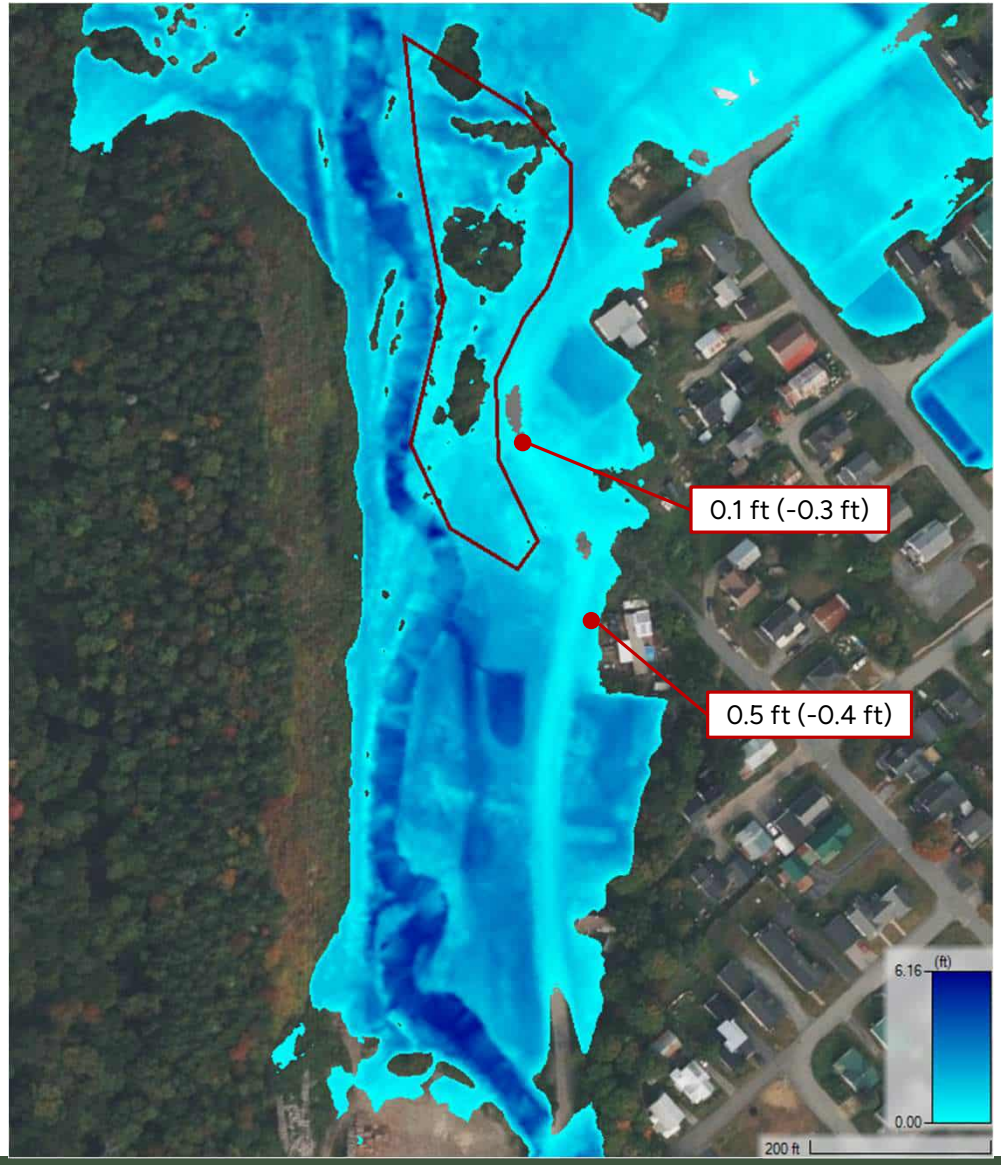
Results – Cooper Brook Profile



Existing
10-yr Depth Mapping

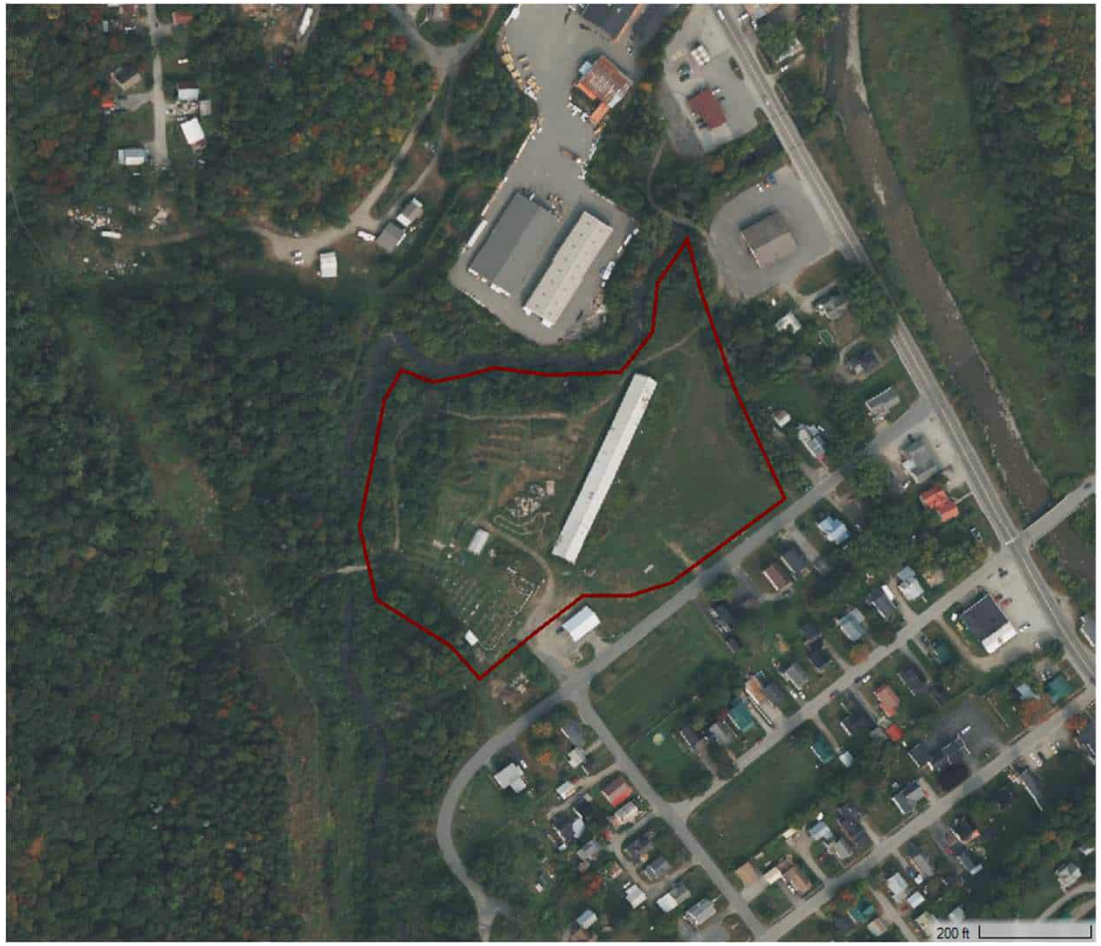


Proposed
10-yr Depth Mapping



Atkins Field Floodplain

- Potential area for floodplain restoration
  - 3.4 acres
  - Up to ~4.5 feet of cut
- Berm along river channel on upstream portion
- Existing modeling shows the area floods regularly (2 to 10-year flood)

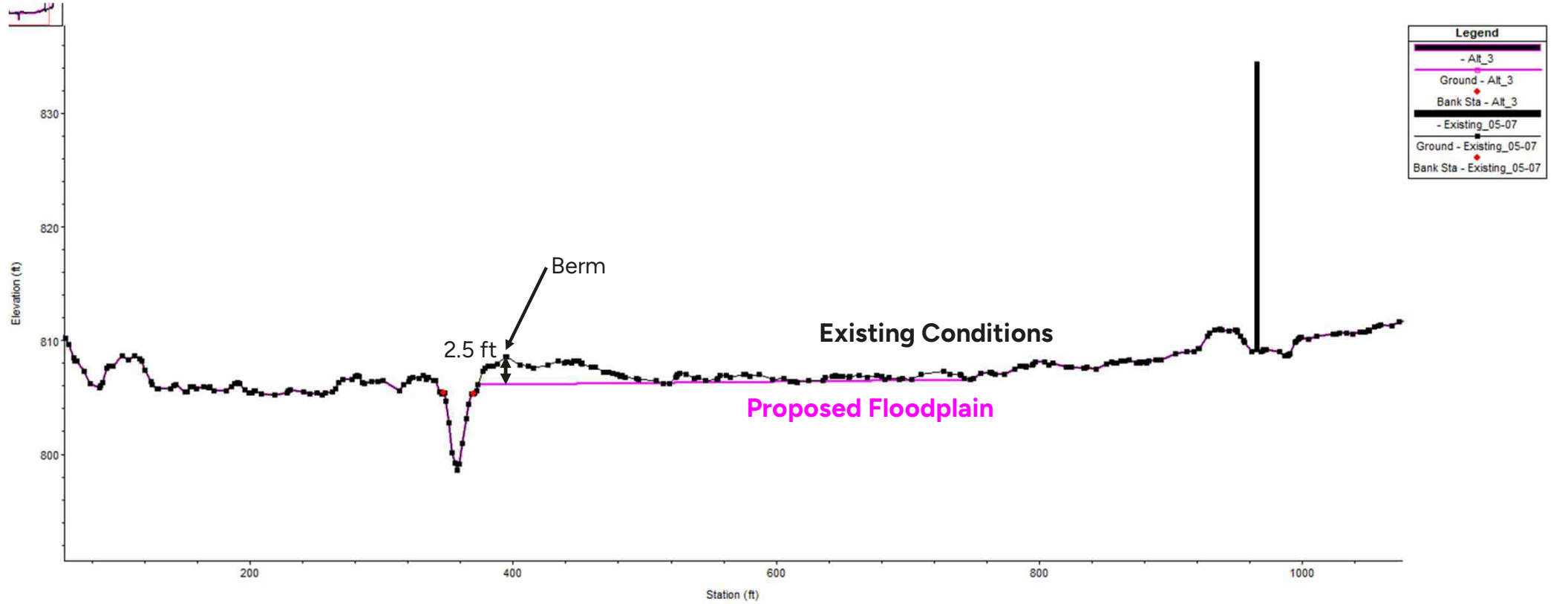


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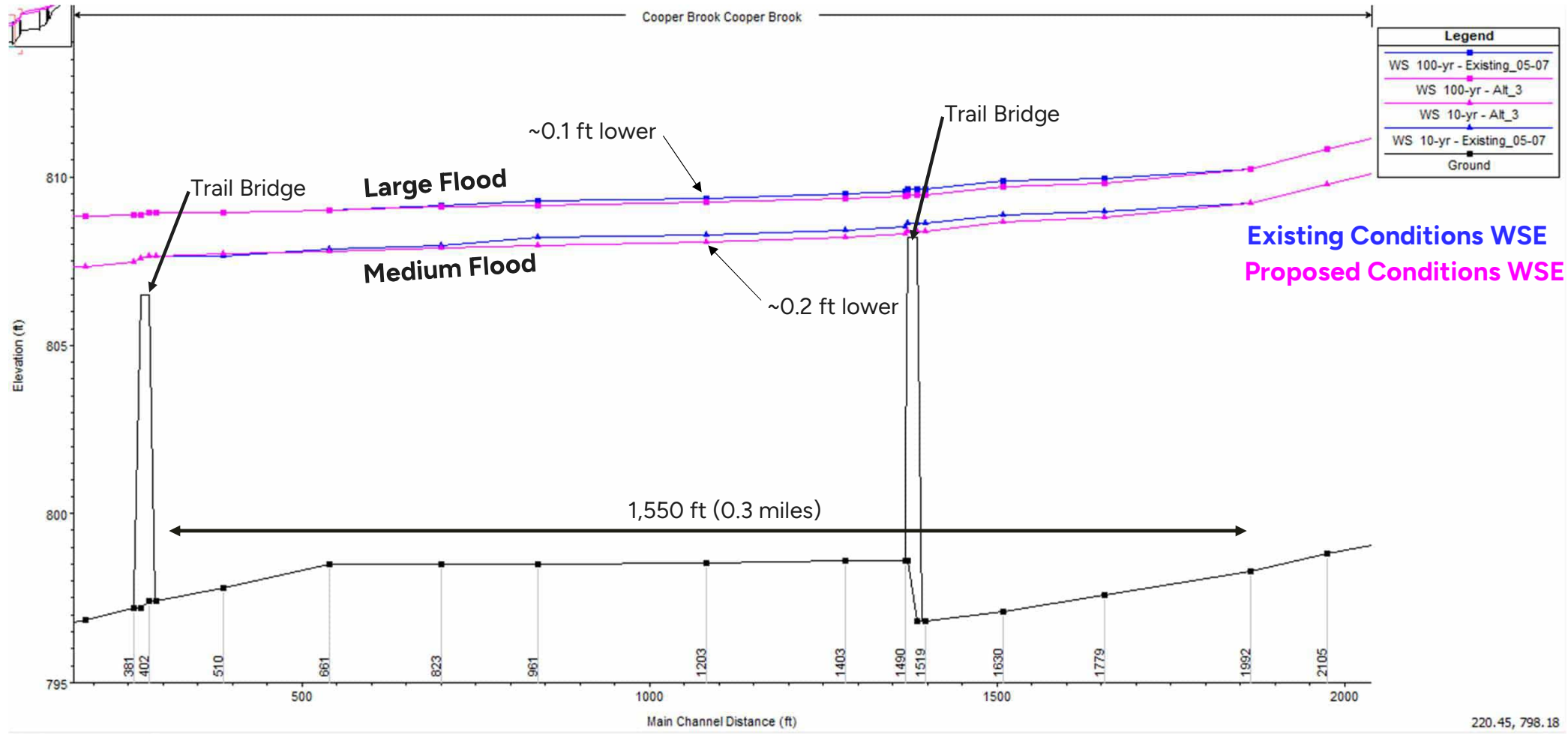
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Cross Section View – Existing and Proposed



Results – Cooper Brook Profile



Hardwick Fire Station



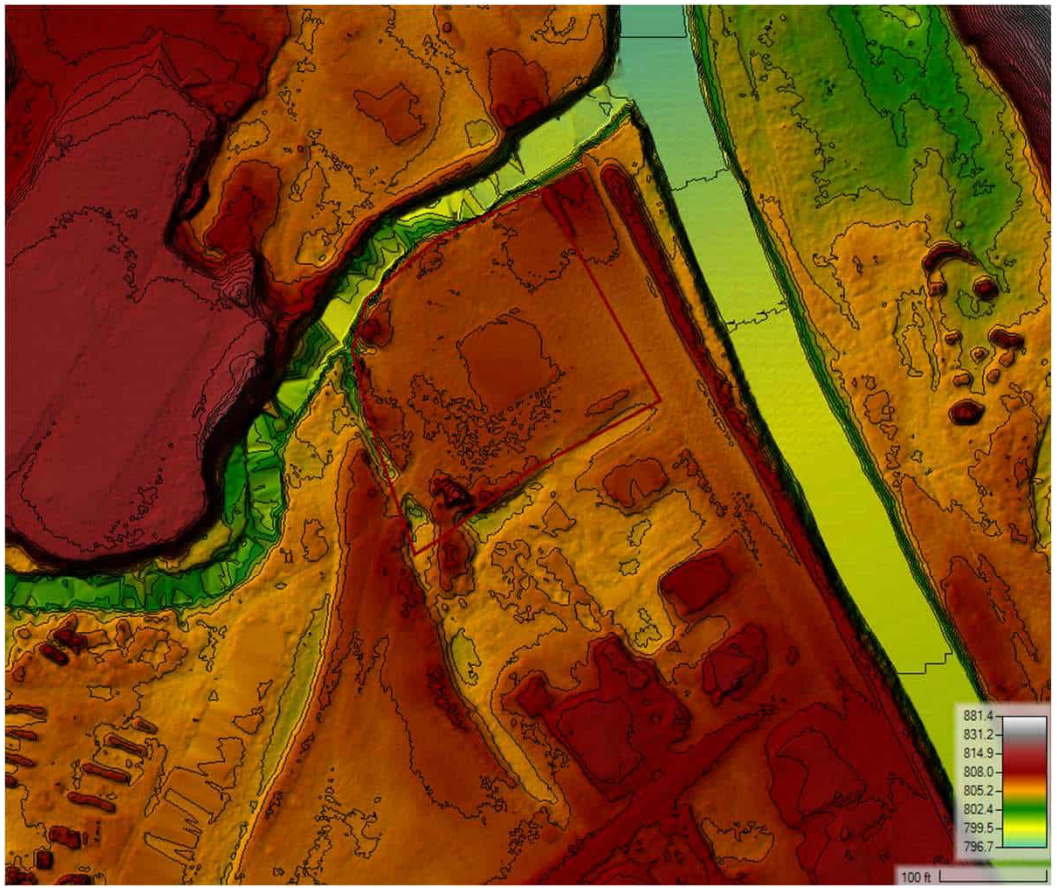
- Potential area for floodplain restoration if Fire Station is relocated
  - 1.2 acres
  - Up to ~4 feet of cut



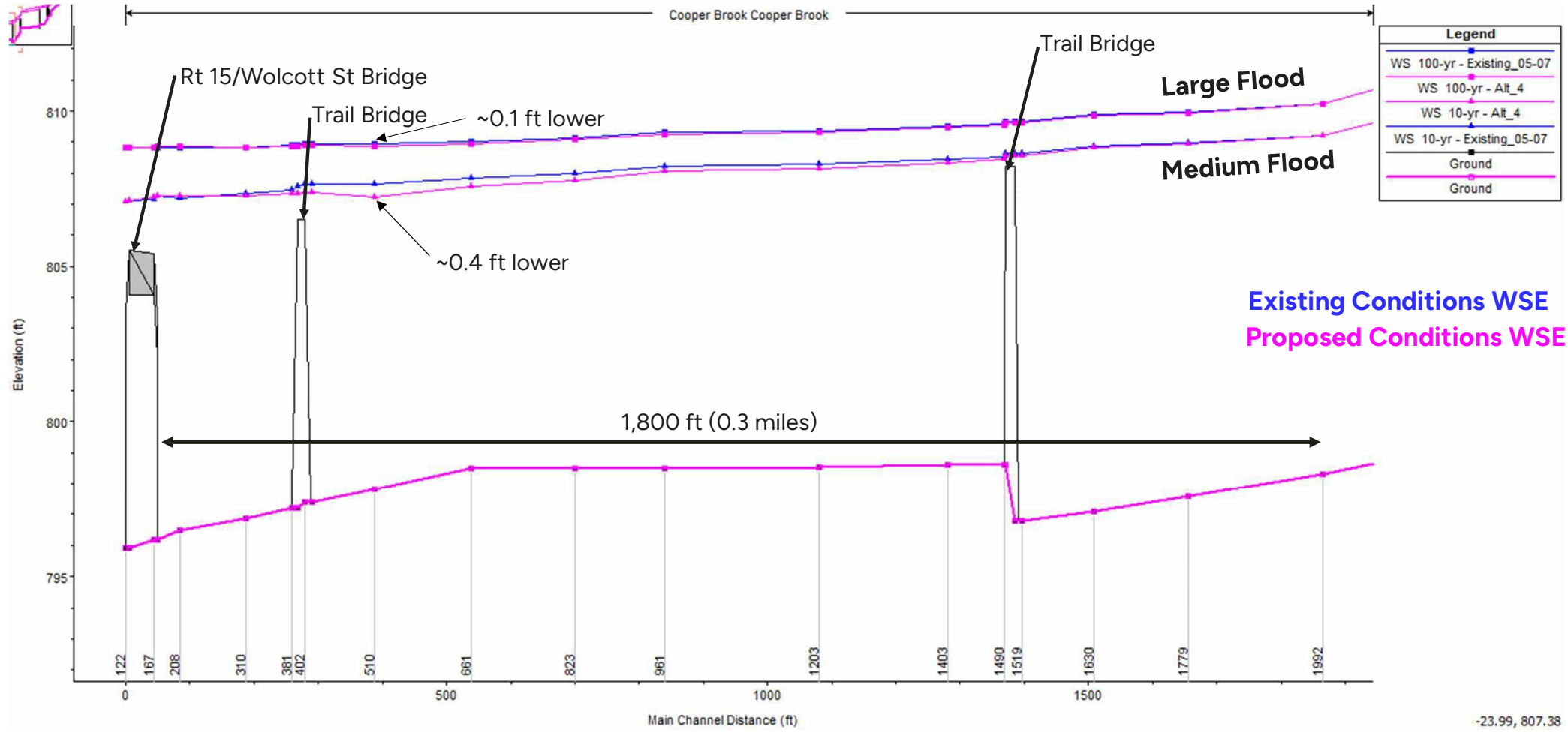
Hardwick Fire Station



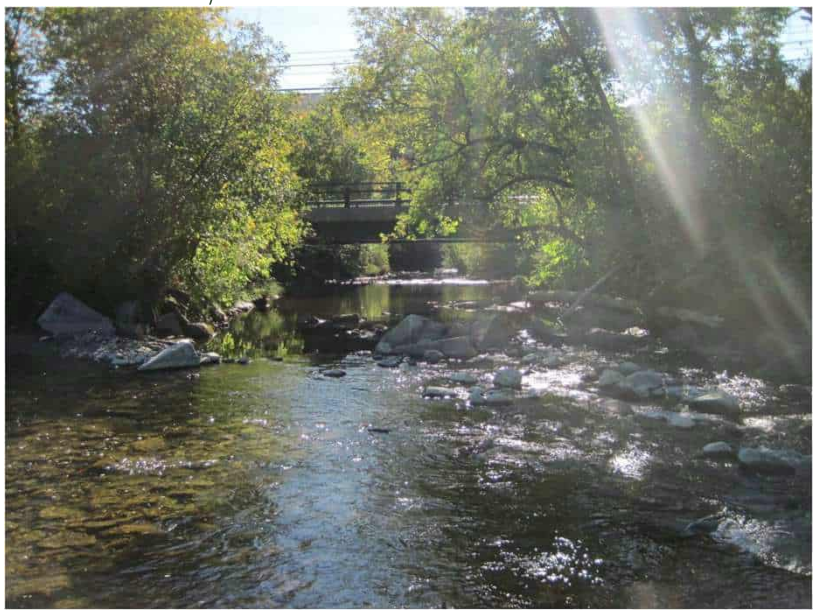
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Results – Cooper Brook Profile



Rt 15/Wolcott Street Bridge





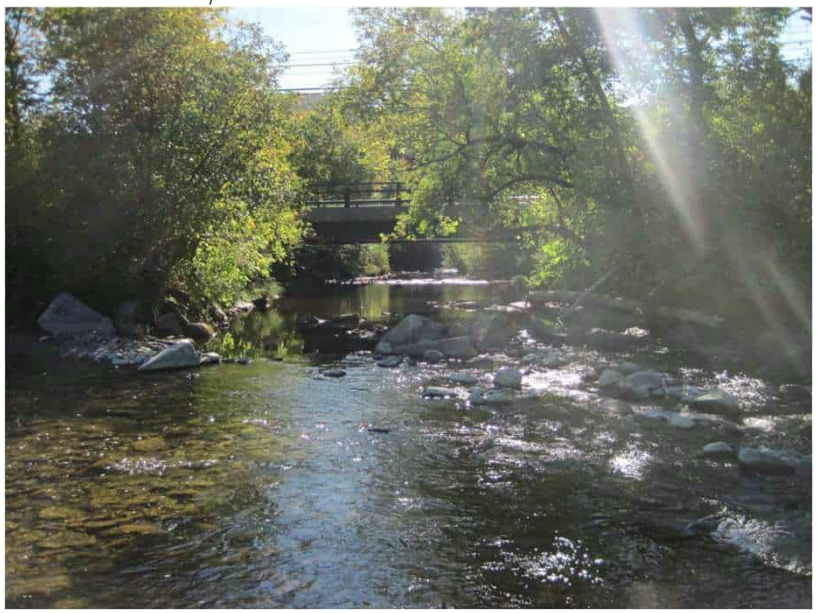
Problems

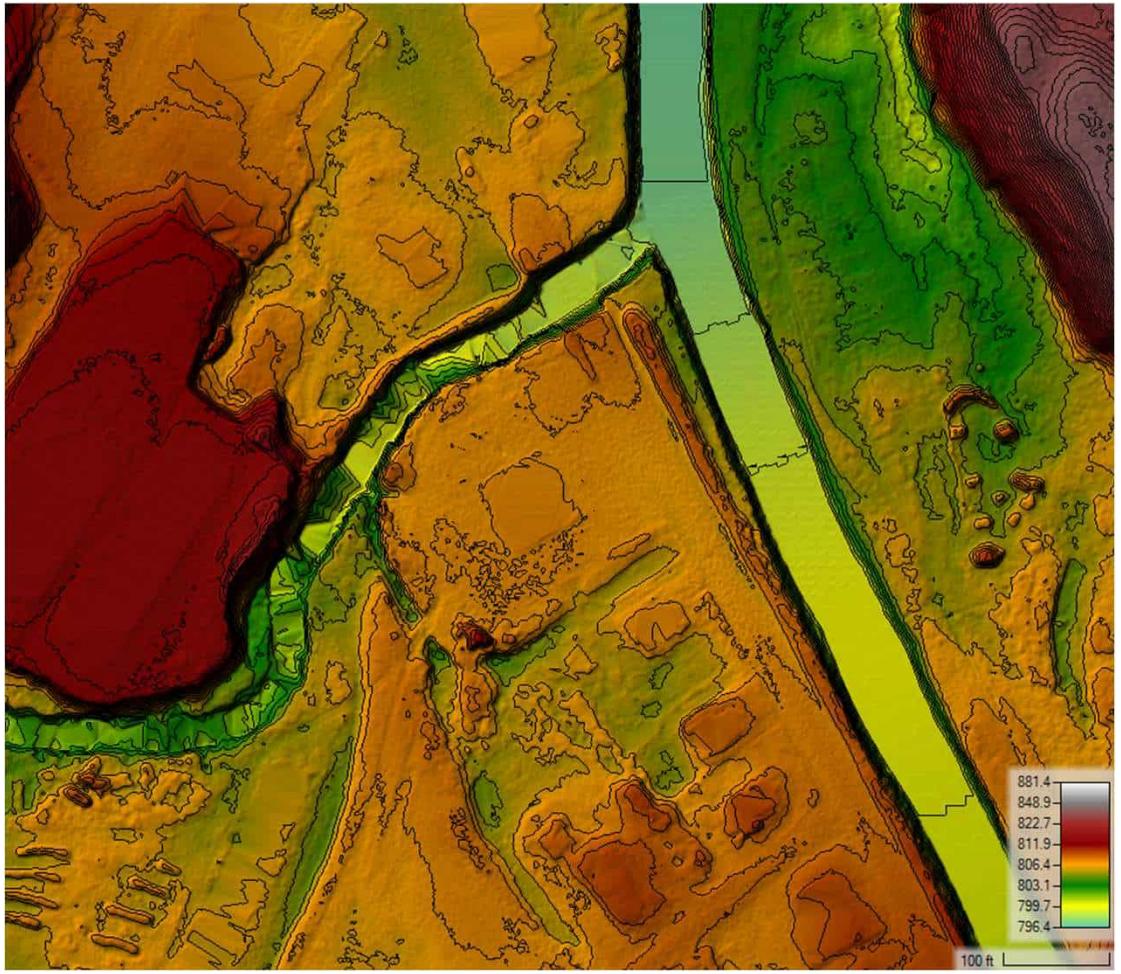
- Small floods cannot fit into bridge opening

Recommended Solutions

- Elevate bridge low chord
- Expand bridge opening width

Rt 15/Wolcott Street Bridge





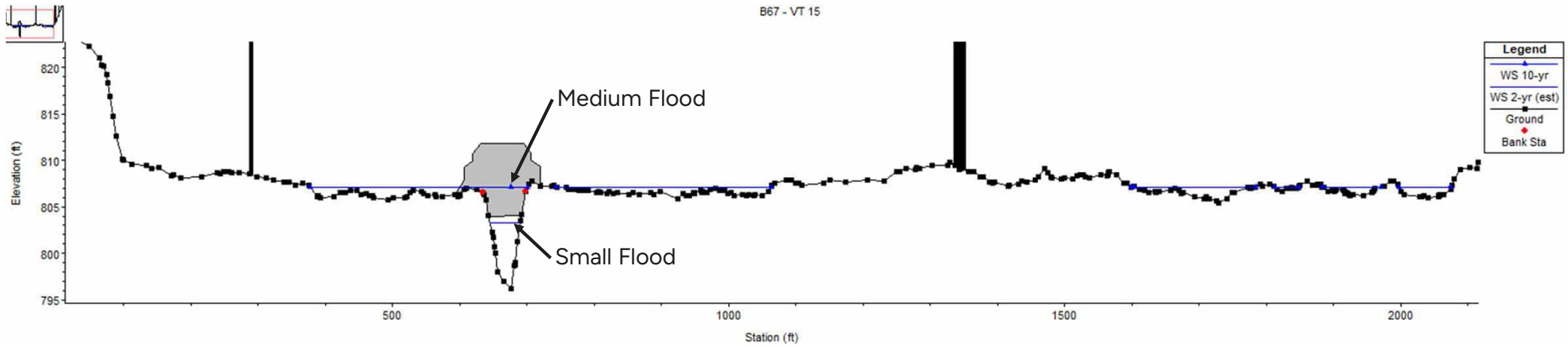
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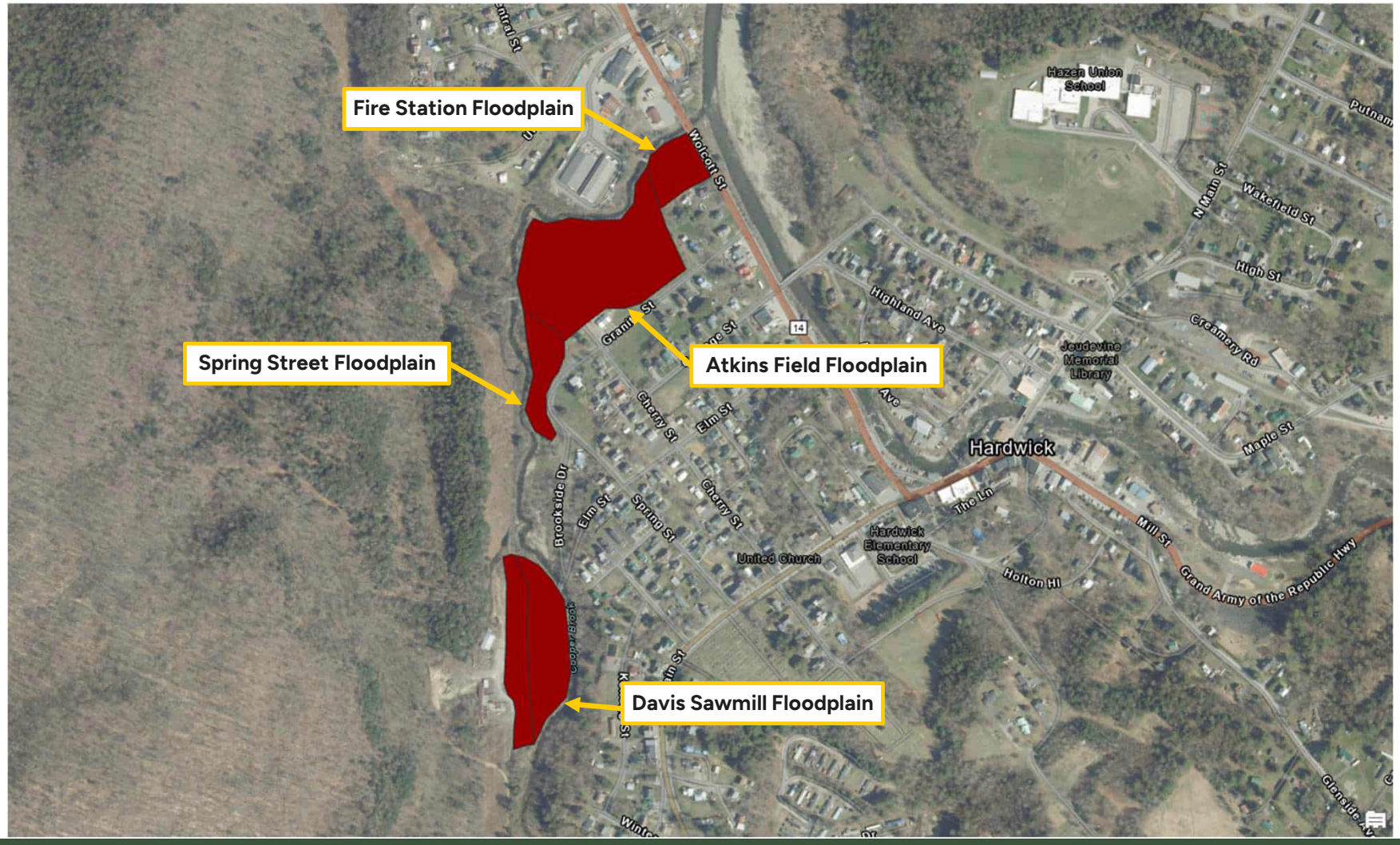
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Cross Section View



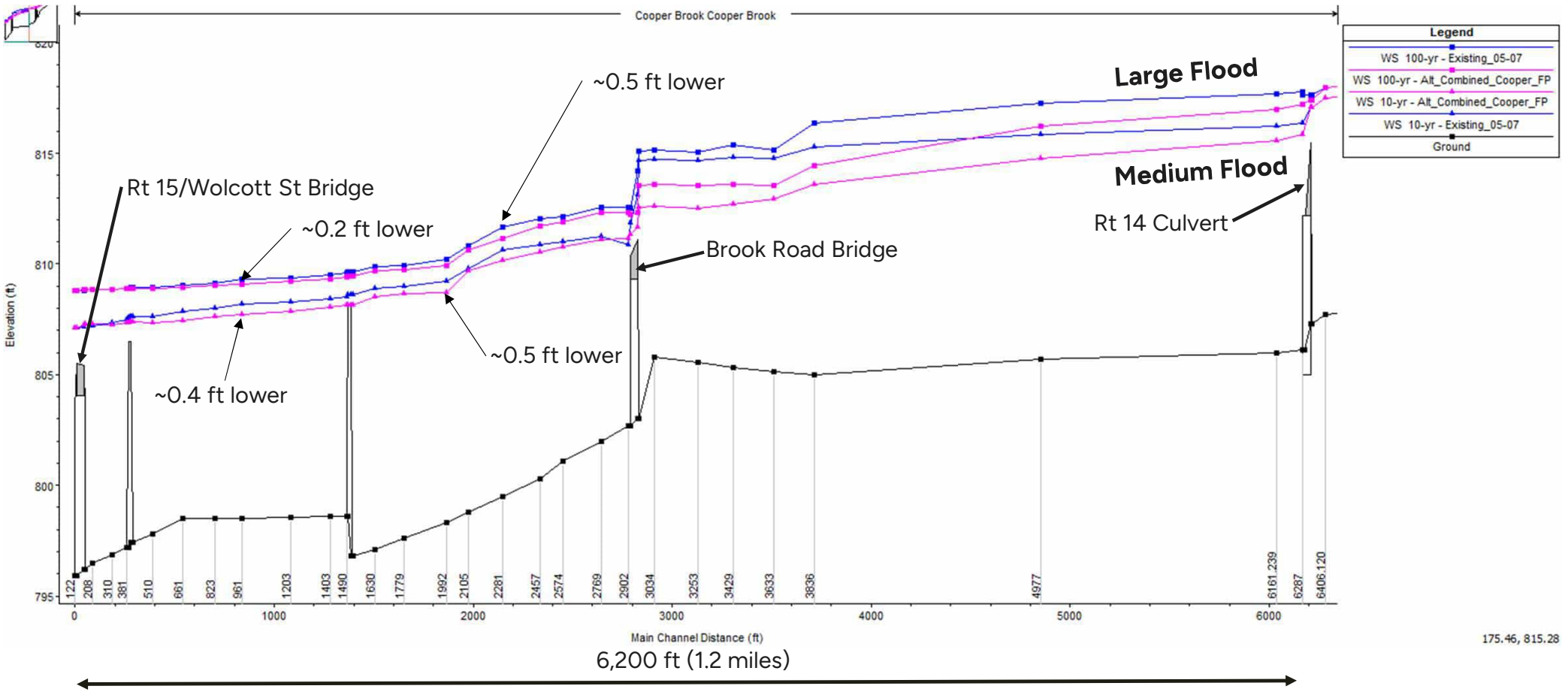
Combined Alternative



Results – Cooper Brook Profile

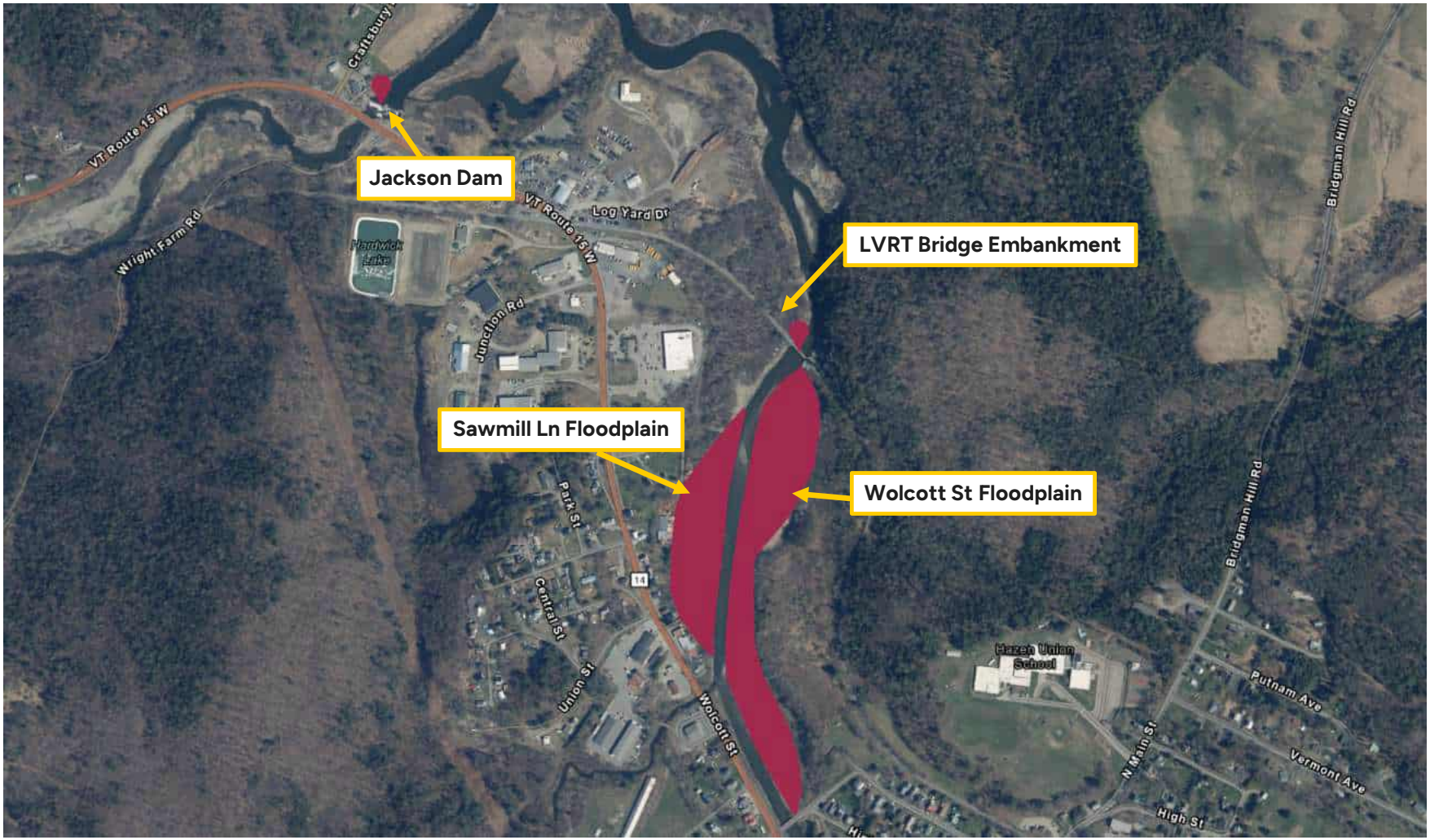
Existing Conditions WSE

Proposed Conditions WSE

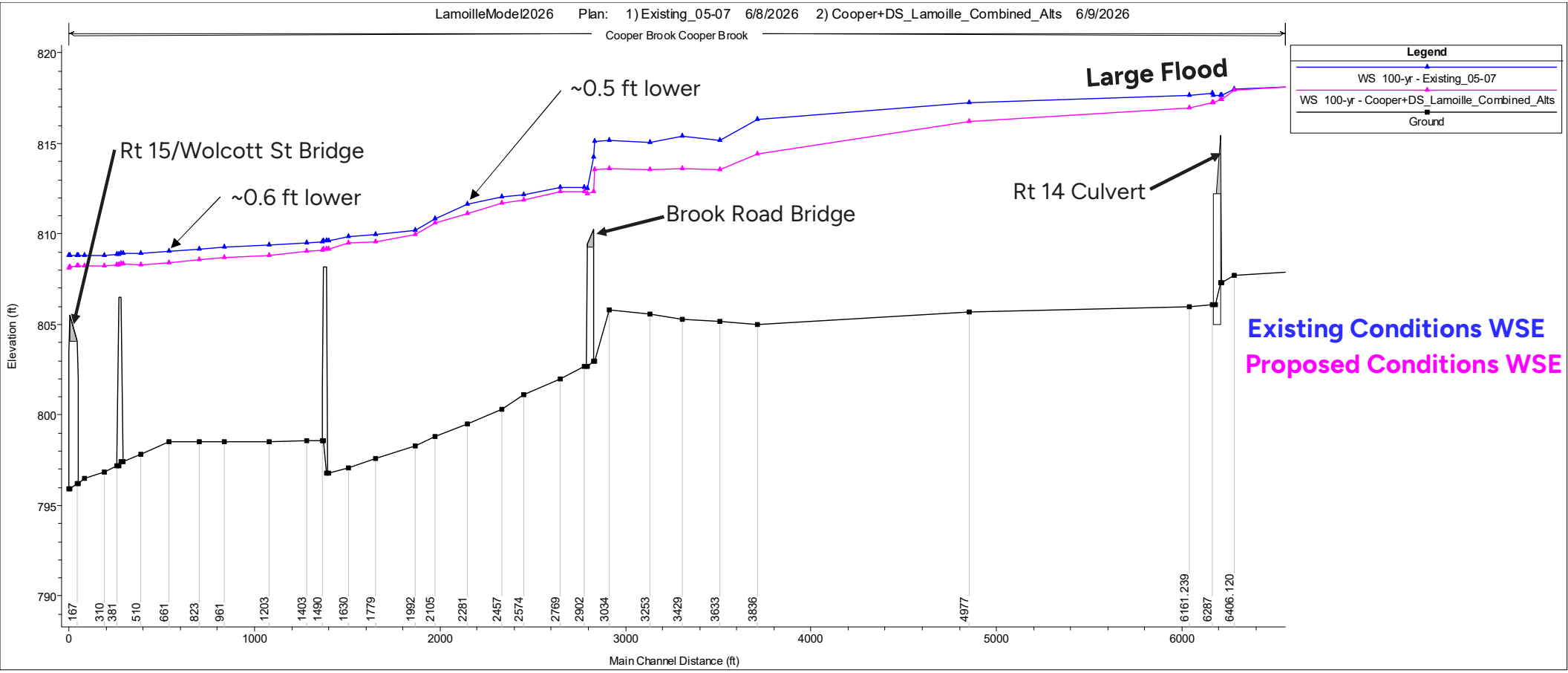


6,200 ft (1.2 miles)

Combined Flood Mitigation Alternatives



Results – Cooper Brook Profile



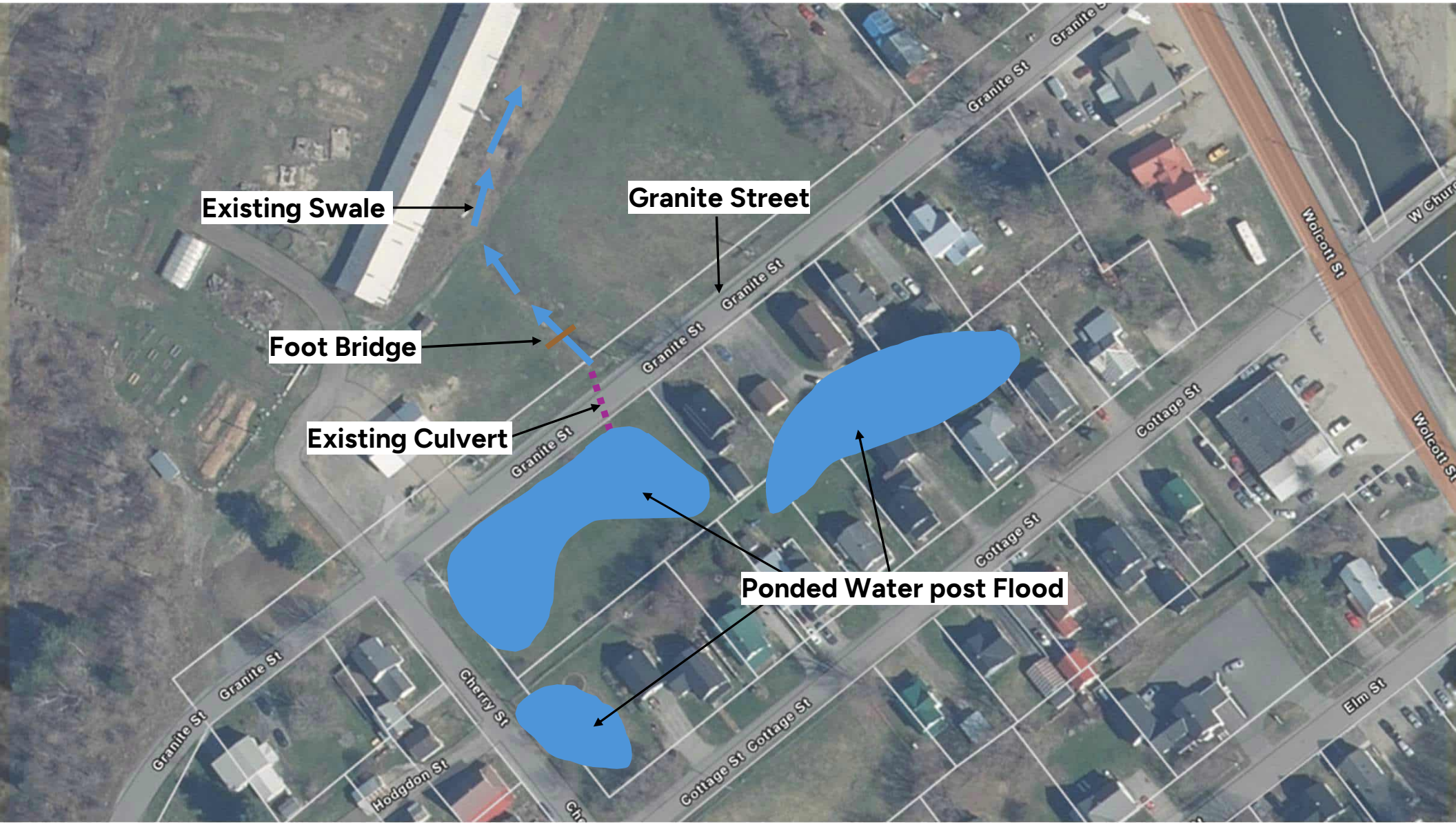
6,200 ft (1.2 miles)

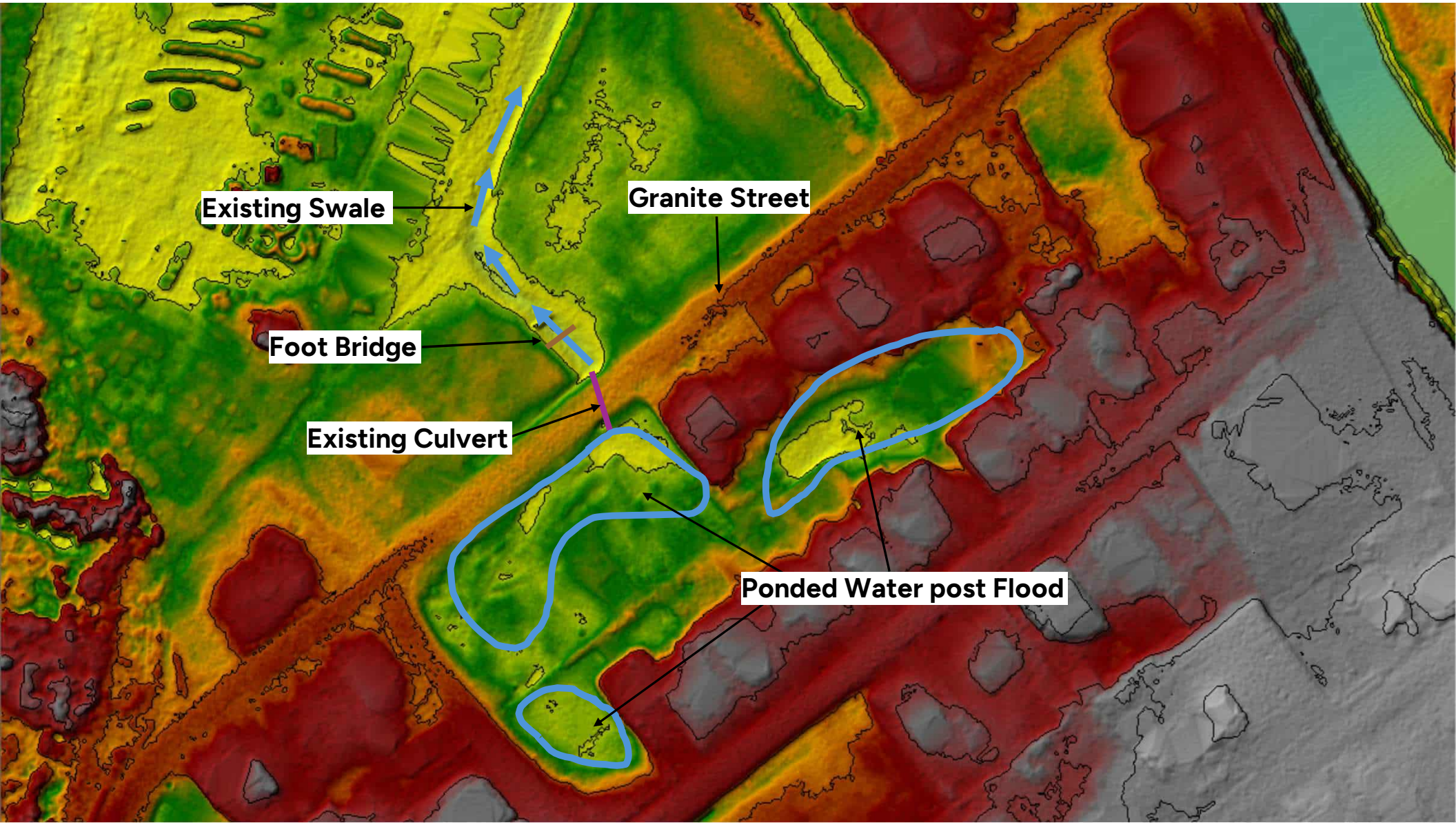
Post Flood Drainage

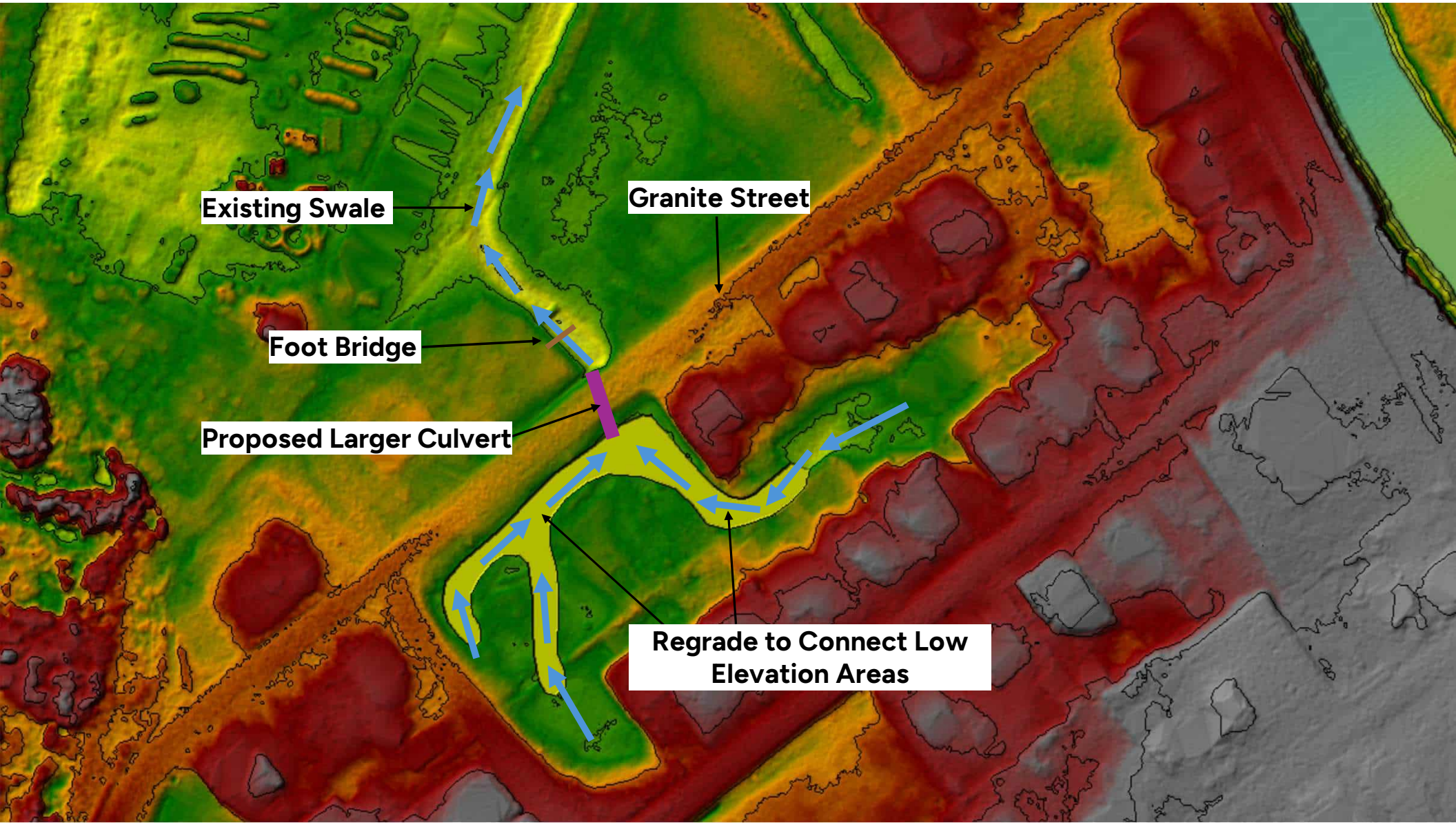


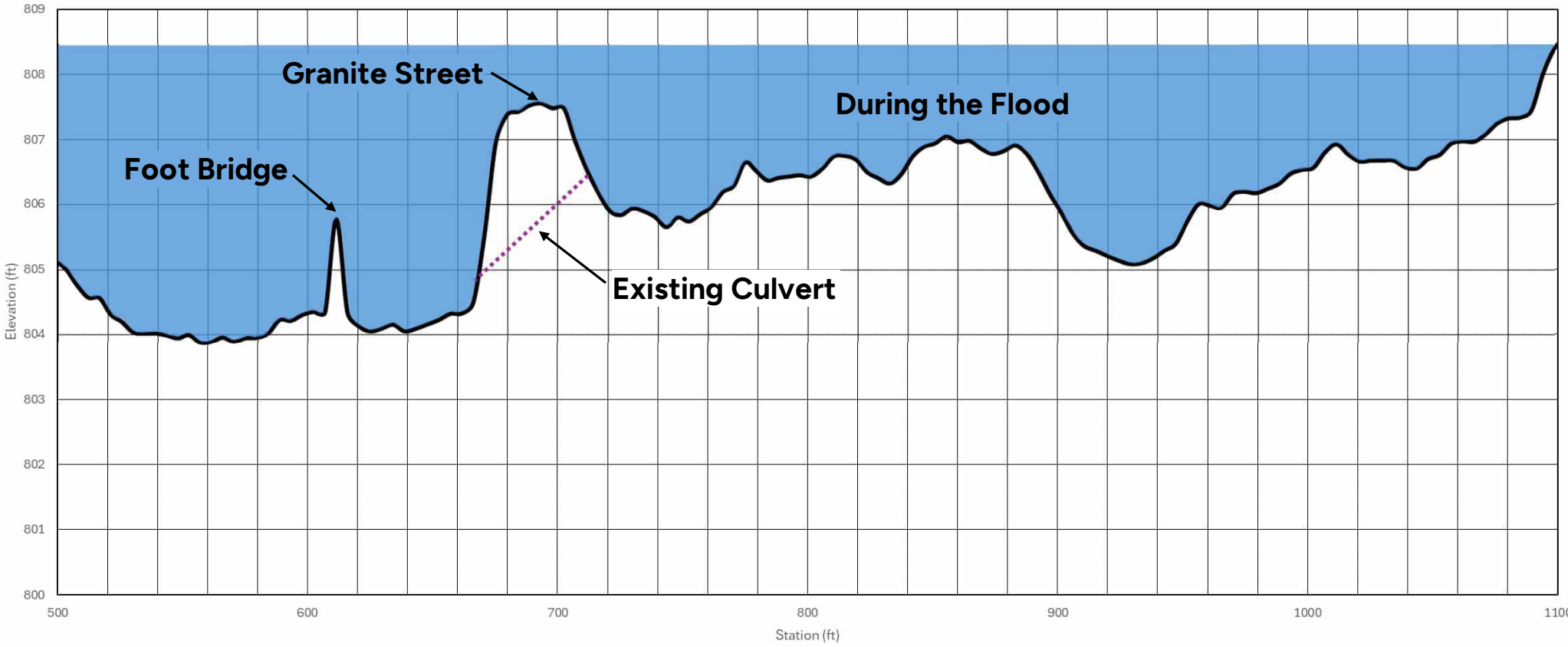
Post Flood Drainage

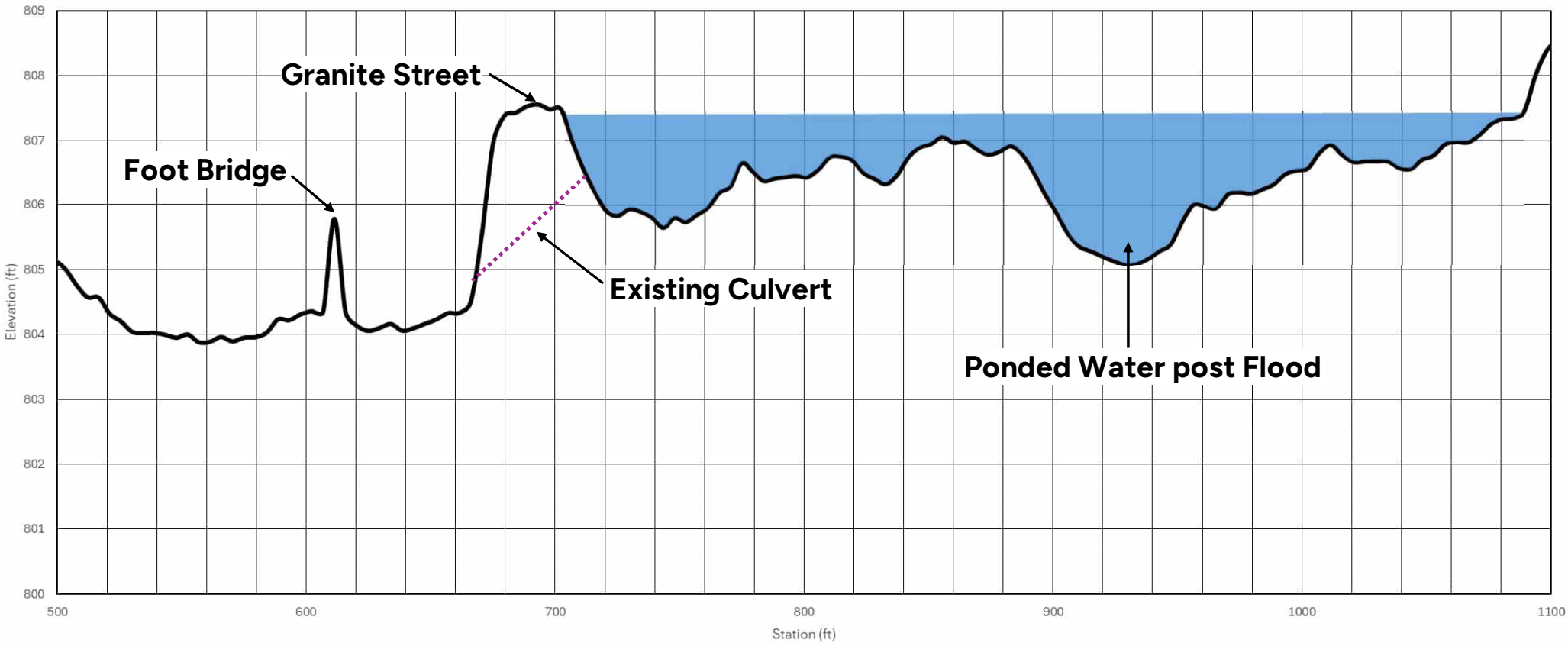


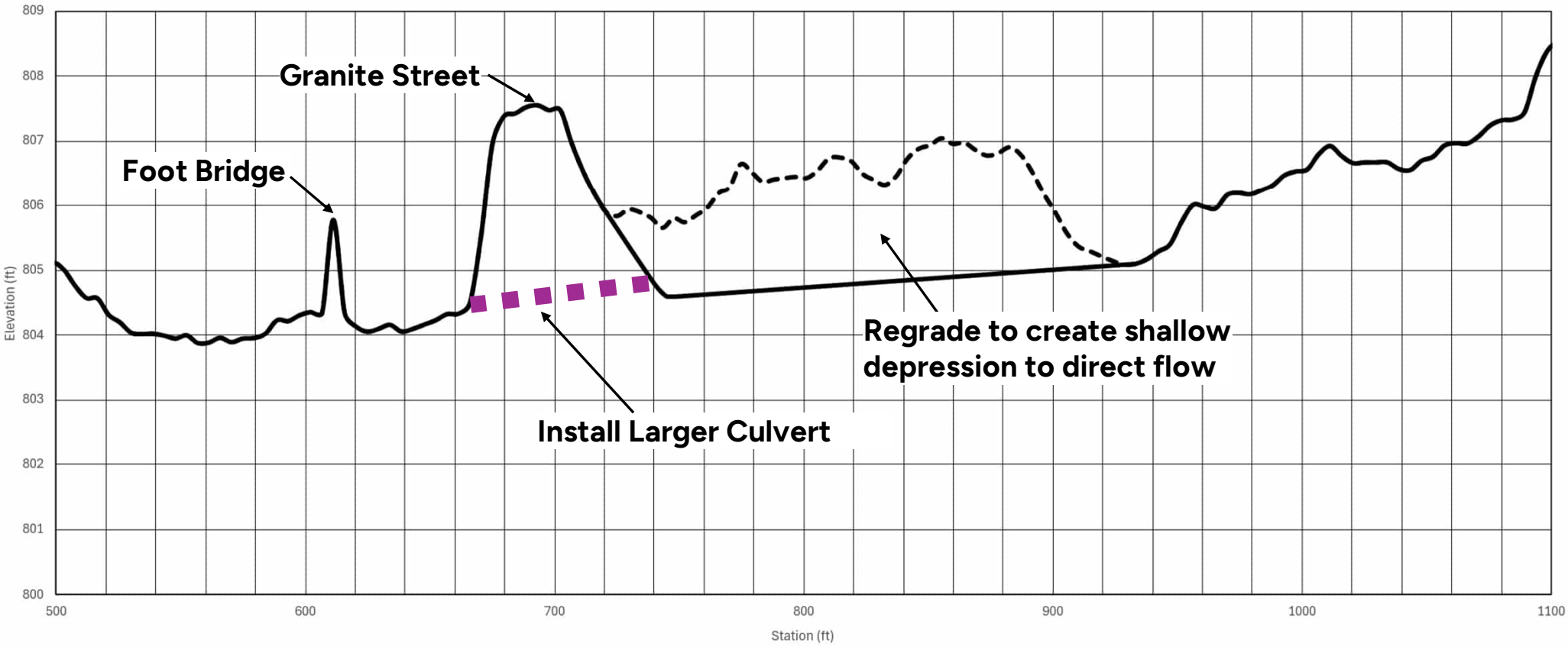

Existing Swale
Granite Street
Foot Bridge
Existing Culvert
Ponded Water post Flood
Granite St
Cottage St
Wolcott St
Cherry St
Hodgdon St
Elm St

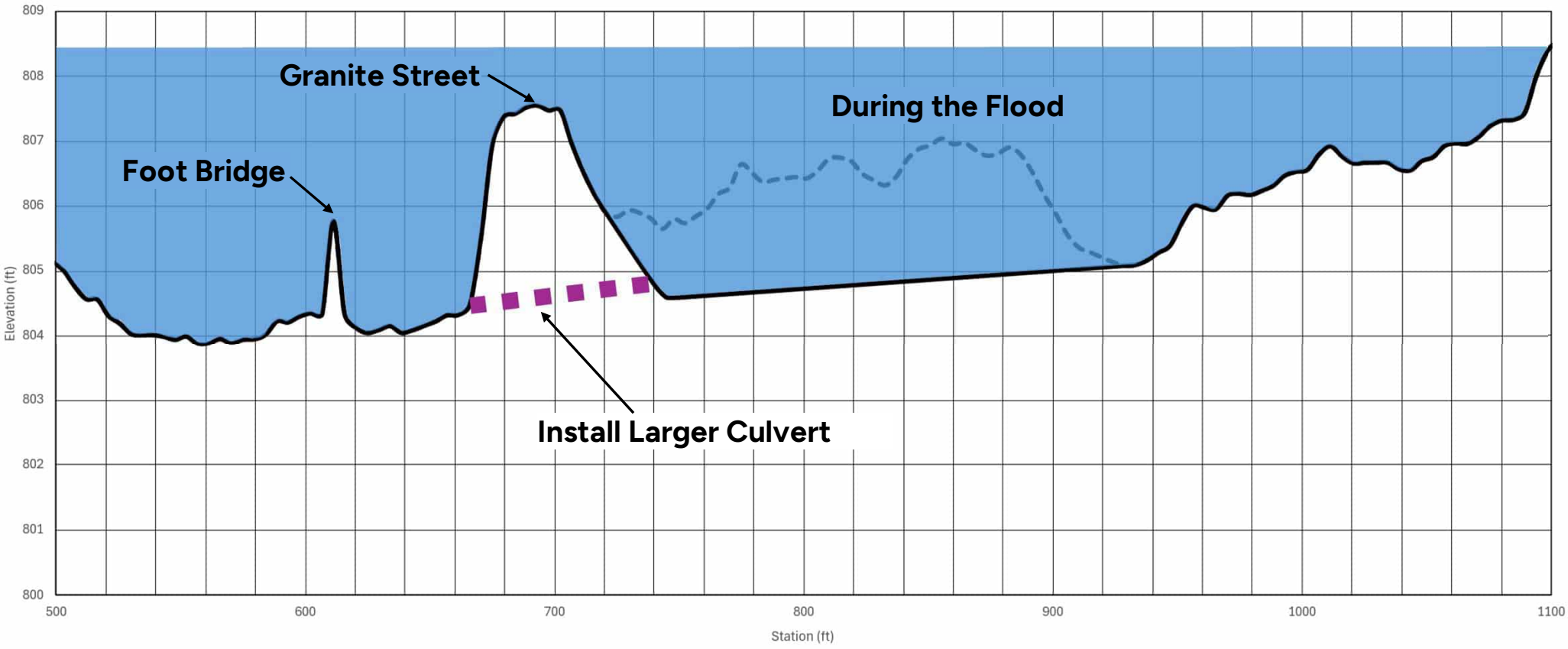

Existing Swale
Granite Street
Foot Bridge
Existing Culvert
Ponded Water post Flood

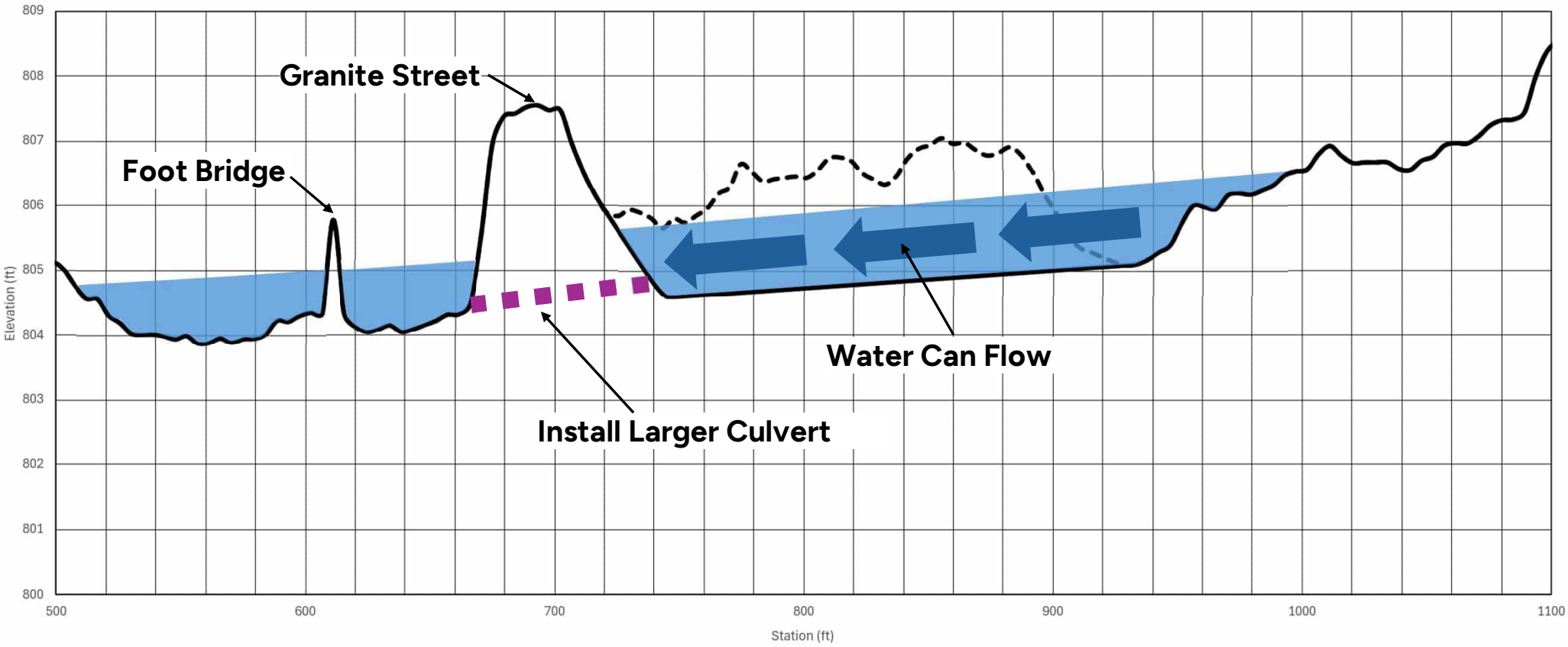

Existing Swale
Granite Street
Foot Bridge
Proposed Larger Culvert
Regrade to Connect Low Elevation Areas

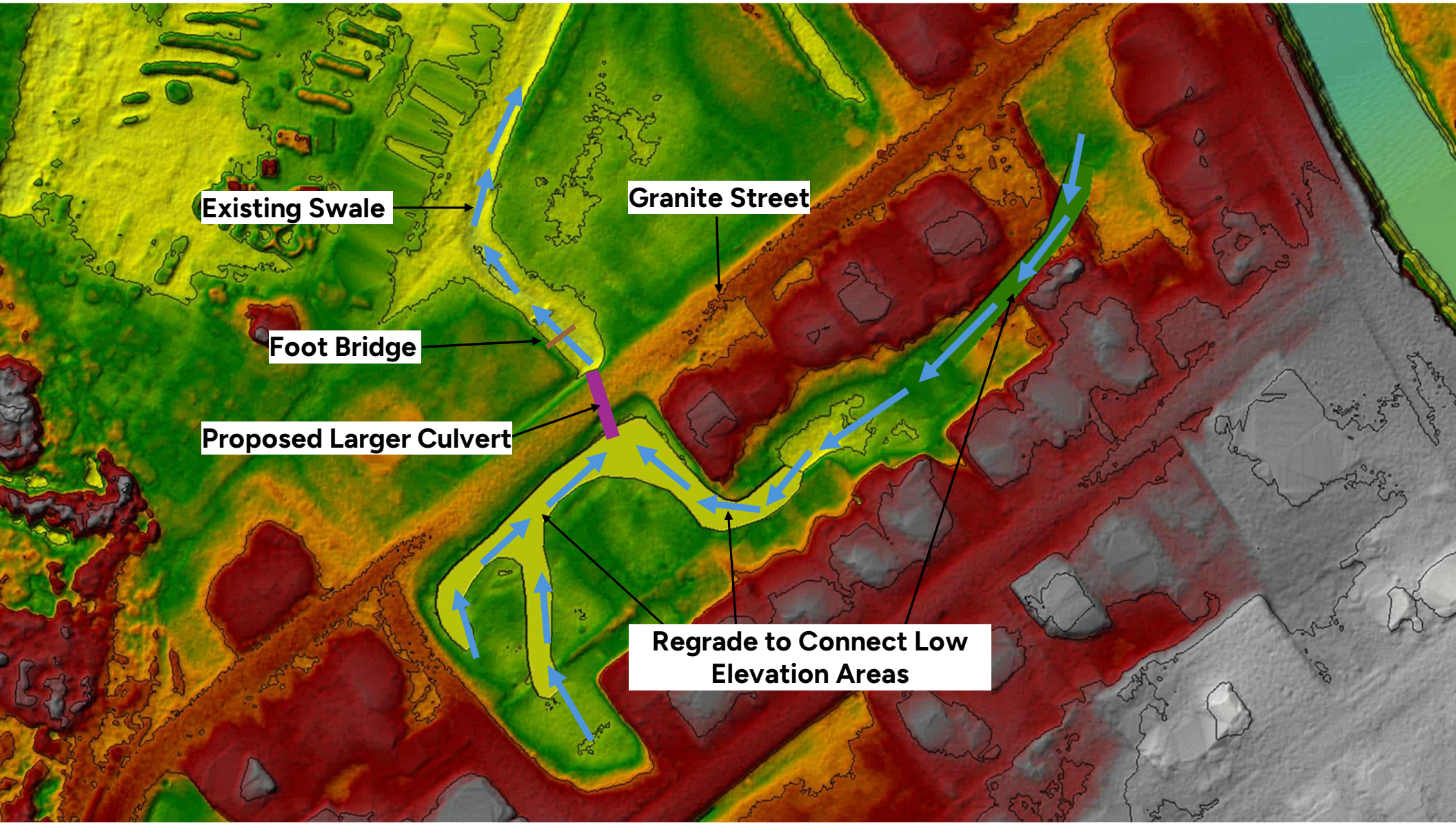

Granite Street
During the Flood
Foot Bridge
Existing Culvert
Elevation (ft)
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100
Station (ft)

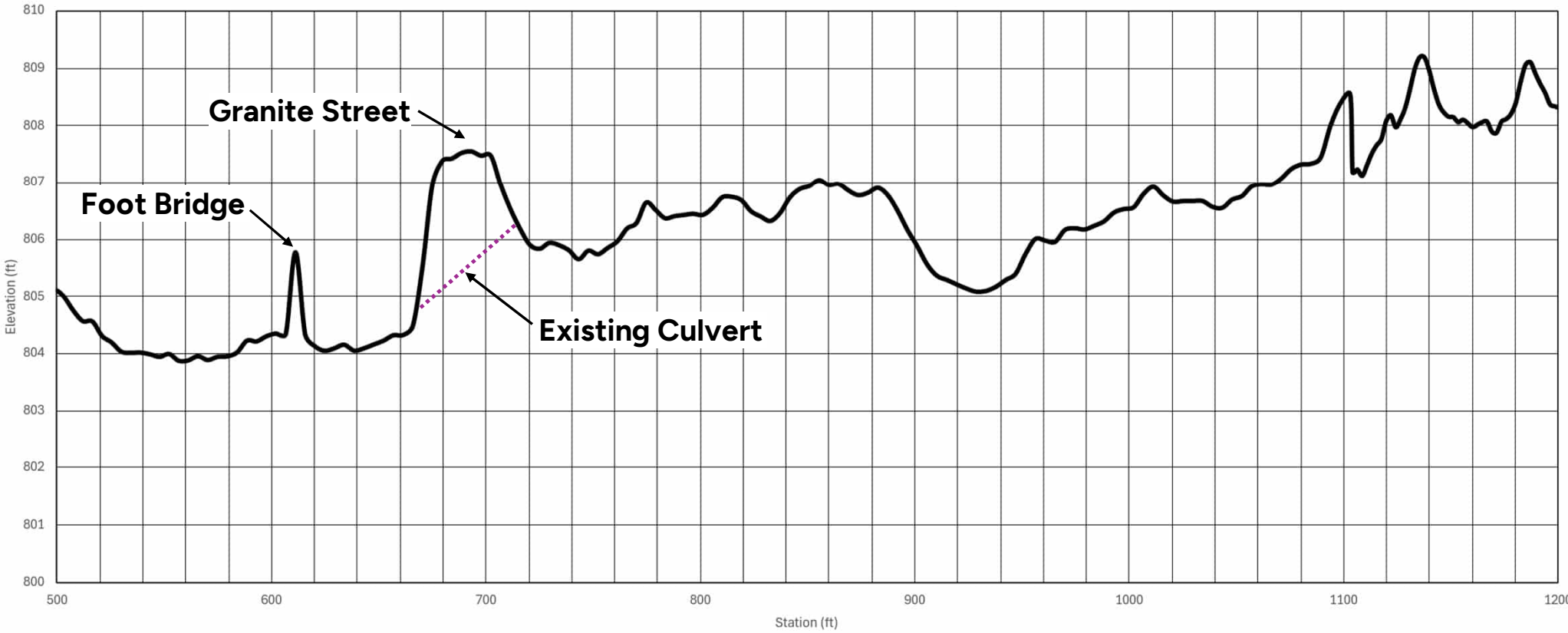

Granite Street
Foot Bridge
Existing Culvert
Ponded Water post Flood
Elevation (ft)
Station (ft)
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100

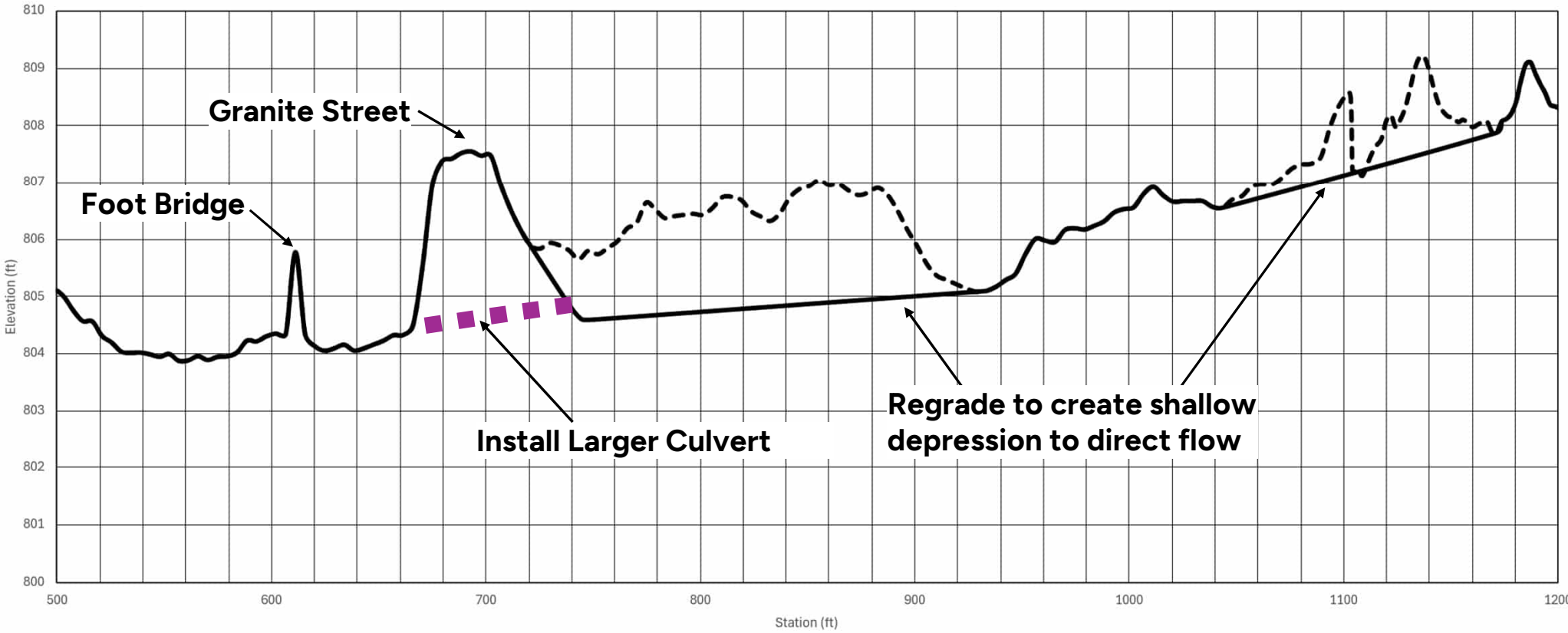

Granite Street
Foot Bridge
Regrade to create shallow depression to direct flow
Install Larger Culvert
Elevation (ft)
Station (ft)
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100


Granite Street
During the Flood
Foot Bridge
Install Larger Culvert
Elevation (ft)
Station (ft)
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100


Granite Street
Foot Bridge
Water Can Flow
Install Larger Culvert
Elevation (ft)
Station (ft)
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100


Existing Swale
Granite Street
Foot Bridge
Proposed Larger Culvert
Regrade to Connect Low Elevation Areas


Granite Street
Foot Bridge
Existing Culvert
Elevation (ft)
Station (ft)
810
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100
1200


Granite Street
Foot Bridge
Install Larger Culvert
Regrade to create shallow depression to direct flow
Elevation (ft)
Station (ft)
810
809
808
807
806
805
804
803
802
801
800
500
600
700
800
900
1000
1100
1200

Questions?

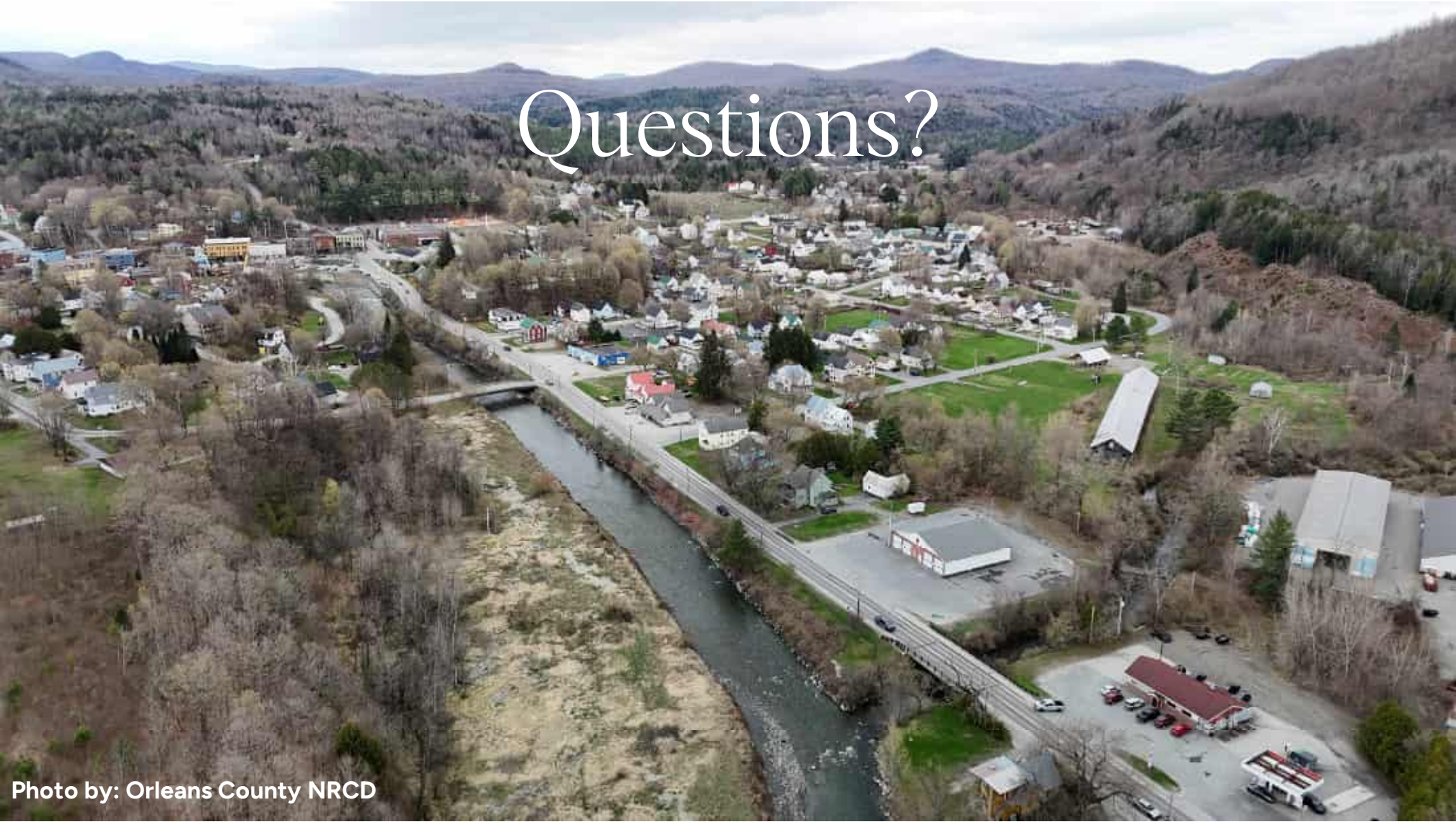


Photo by: Orleans County NRCD