MILONE & MACBROOM

# MEMORANDUM

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| **TO:** | Amy Sheldon, Landslide Natural Resources Planning<br>Kathleen Ramsay, Town of Middlebury |
| **FROM:** | Roy Schiff and Brian Cote, Milone & MacBroom |
| **RE:** | Project Narrative – Middlebury River Flood Mitigation Project |
| **DATE:** | Revised March 19, 2018 (original February 12, 2018) |
| **MMI #:** | 5032-02 |

## Introduction

East Middlebury Village has a history of flooding and damage caused by the Middlebury River. To address the historic damage due to flooding, the Town of Middlebury embarked on a townwide Hazard Mitigation Plan. As part of that process, the town retained Milone & MacBroom, Inc. (MMI) in 2013 to conduct a study developing a flood resiliency plan and to provide engineering design services for the preferred flood mitigation alternative (MMI, 2013).

## Project Need

The Middlebury River in the Village of East Middlebury is located on an alluvial fan at the base of Middlebury gorge, a location that is inherently geomorphically unstable due to excessive sediment deposition during floods (MMI, 2013). The channel has been historically altered and managed by gravel removal, straightening, and armoring as the channel moves around deposited sediment (SMRC, 2013). The river channel setting is dynamic and creates flood and erosion risks (LNRP, 2008).

The most recent flooding occurred July 1, 2017 where a nearly 10-year flood deposited excessive sediment on the alluvial fan channel blocking flow paths and leading to excessive erosion. Recent field assessment and accounts of the flood indicate that up to 50 feet of bank erosion took place during the flood. Accounts of building and releasing jams of sediment and large wood were recorded following the flood. The channel on the alluvial fan remains filled with sediment.

In 2011 during Tropical Storm Irene, several feet of sediment were deposited upstream of the Grist Mill Road Bridge, and over six feet of scour took place along the retaining wall just downstream of the bridge. Emergency repairs were conducted that included sediment removal from the channel and concrete grouting under the exposed base of the wall.

Following the flood recovery, concerns were voiced about both the habitat impacts of the work and the remaining risks during future floods. The flood recovery illustrated a need for the creation of a common vision (and design) for future river management. The goal of this project is to create a sustainable management strategy that reduces risks and environmental impacts over the long term in this dynamic river reach in a developed village setting.

## Project Design Overview

This project includes four primary components. Design plans have been prepared for the preferred alternative with illustrated details for each design element.

1. Remove large sediment deposits from chute entrances and the top of large bars.
2. Armor select sections of the Ossie Road Berm and upstream berms.
3. Repair the existing flood wall.
4. Extend the flood wall 150 feet downstream.

1. Hydraulic modeling illustrates that reconnecting four flood chutes and removing the large sediment bars would decrease flood levels and reduce erosion potential along the river banks near houses at the edge of the river corridor. The sediment removal would likely provide flood relief for 1 to 3 large floods until the chute entrances refilled. The majority of this work can be performed out of the active flowing water during low flow so habitat impacts would be minimized. The design has been prepared to restore the bankfull width of the channel while also concentrating low flows in the summer to achieve a balance between flood capacity and habitat maintenance. Sediment removal in these recent deposits will require little to no tree removal in the active river channel area.

   Specific thresholds triggering sediment removal have been established based on the modeling. These sediment removal limits are in the design plan set (See DE-1). Local reference elevations such as rebar rods or nails will be set for quick elevation determination in the future. The Town will monitor the elevations of the chute inlets so sediment cleanout can take place once the sediment buildup begins to increase risk due to increased flood levels and increased flood velocity that can lead to more erosion of the Ossie Road berm.

   The chute cleanout is only proposed during low flows when the water is several feet below the excavation areas (See DE-1). The only impact will be the crossing that will be made of river gravel from the excavation area. River impacts should be low as excavators will only touch native channel bed while the crossing is being built from

native river stone. Only then will trucks start to roll at high frequency but that will be above the existing river bed. The impact area is the base of the haul road in the channel. The excavation will take place in dry flood chutes and the top of sediment bars. There will be no habitat recovery needed other than the careful removal of the last foot of the base of the haul road in the channel. This approach is different than the flood recovery following Tropical Storm Irene where the sediment removal took place directly in the wet channel and had severe impacts to instream habitat. That damaging work required extensive habitat recovery. The proposed work is different and will not require instream habitat restoration.

2. Recent flooding has illustrated that water flows along the toe of the Ossie Road Berm and some local scour takes place. Hydraulic modeling shows that erosion can take place during large floods due to high velocity. The berm is reported to be unimproved largely consisting of a clay core with surrounding earth and some small stones. Berm armoring with large stone to resist the flood velocities shown in the hydraulic model is proposed in three locations where flow has concentrated: Along the Ossie Road Berm (750 feet); where the berm is being eroded with the river bank near Goodro Lumber Company (400 feet); and along the berm next to a flood chute upstream of the Grist Mill Road Bridge where erosion has taken place in the past (400 feet). The armoring also includes plugging a gap in a berm along the river upstream of the Grist Mill Road Bridge where flood waters currently leave the channel (100 feet). A deep key is proposed near Goodro Lumber where the channel is cutting down and undermining banks. A shallower key is proposed in other locations where down-cutting is not taking place.

3. The existing flood wall downstream of the Grist Mill Road Bridge that was undermined during Irene and subjected to local scour during the July 2017 flood is proposed to be repaired. Steel sheeting will be installed to stabilize the base of the wall and protect the wall from undermining that has taken place in the past. Hydraulic modeling shows that the base of the flood wall is prone to erosion. Ground anchors will also be installed to prevent the wall from tipping over.

4. A section of the Grist Mill Road flood wall previously tipped over. The existing wall is proposed to be extended 150 feet downstream to fill the gap of the previously failed wall section.

The total project cost is estimated to $1,782,000 (Table 1).

TABLE 1
Project Summary

| ID | Alternative | Probable Construction Cost | Life Expectancy | Notes |
|---|---|---|---|---|
| 1 | Remove sediment from chute entrances and the top of large bars | $ 342,500 | 1-3 large floods | Increase flood capacity and sediment/debris storage area, and reduce need for work in wet channel. |
| 2 | Armor select sections of the Ossie Road Berm and upstream berm | $ 459,500 | 20 | Armor downstream berm where flood flows run along face. Monitor other locations. |
| 3 | Repair existing flood wall | $ 330,000 | 50 | Install Ground Anchors per details and construction sequence. Install permanent sheet piling for scour protection at toe of existing wall. |
| 4 | Extend flood wall 150 feet downstream | $ 650,000 | 75 | Proposed concrete flood wall. Install permanent sheet piling for scour protection at toe of proposed flood wall. |
| **TOTAL** | | **$ 1,782,000** | | |

## Sediment and Erosion Control

The proposed project minimizes impacts as the majority of the work will be taking place along berms in the floodplain away from the river channel or at dry chutes or sediment bars that are not in flowing water. Existing coarse sediment will be used to isolate work areas that are next to flowing water, such as the berm armoring near Goodro Lumber that is coincident with the river bank. The work area will be isolated from moving water to contain sediment.

## Construction Access

Three access locations are proposed to complete the project. Access to the downstream chutes and berm is proposed through the junkyard property. The access (length ~ 420 feet) connects Ossie Road (VT Route 116) to the river and passes by a residence and through the junkyard. Moving scrap metal and miscellaneous parts away from the river is anticipated during the work at this access location. The temporary river crossing will be made using river cobble and gravel with two or three 24-inch culverts. These small structures can handle the low flow and small floods that are likely during construction. No tree removal is anticipated at this access. Nearly 130 truckloads of stone armor will need to be imported at this location and 200 truckloads of sediment will be exported. It is estimated that 10 truckloads of large wood would be exported at this location. The work using this access location could take 2 to 3 weeks, depending on flows and weather.

Access is proposed at Goodro Lumber Company to reach two work areas. The first access (length ~ 790 feet) passes through the lumber yard and heads to the river at the southwest corner of the property. The temporary river crossing will be made using river cobble and gravel with two or three 24-inch culverts. A few small trees may need to be removed at this

access. Nearly 120 truckloads of stone armor will need to be imported at this location and 200 truckloads of sediment will be exported. It is estimated that 10 truckloads of large wood would be exported at this location. The work using this access location could take 2 to 3 weeks, depending on flows and weather.

The second access at Goodro Lumber Company is about 1,000 feet long. It passes through the lumber yard and then heads south through the forest where some trees would need to be removed. The temporary river crossing will be made using river cobble and gravel with two or three 24-inch culverts. Nearly 150 truckloads of sediment and 10 truckloads of large wood would be exported at this location. The work using this access location could take 1 to 2 weeks, depending on flows and weather.

Access to the flood chute area between Grist Mill Road and Lower Plains Road is proposed at two residential properties. The access (length ~ 350 feet) passes between two houses and heads south to the river. Since this floodplain area is a bit open due to regular flood disturbance, all of the sites near Lower Plains Road can be reached from this location. A few small trees may need to be removed at this access. Nearly 30 truckloads of stone armor will need to be imported at this location, and 20 truckloads of sediment and 10 truckloads of large wood would be exported at this location. The work using this access location could take 1 to 2 weeks, depending on flows and weather.

## Future Maintenance

Ideally, residents and business owners would migrate away from the hazardous areas along the Middlebury River in the long term. For now, the proposed project will reduce risks to infrastructure and private property in the area. Sediment removal is a temporary solution that will likely require future maintenance following large floods. It is anticipated that this aspect of the project may need to be repeated by the Town after a few large floods have occurred as sediment levels increase in deposition areas. Sediment removal thresholds are set on the design plans that will require annual monitoring and after large floods. Sediment removal thresholds are linked to reducing flood and erosion risks, reducing habitat impacts, and reducing maintenance costs.

Permits will be required from both Vermont DEC and US Army Corps to perform sediment maintenance. These regulatory agencies will consider if the sediment removal thresholds have been reached to justify maintenance. Clearly the Town will notify landowners, if they have not already called the Town, to discuss using existing access points. DEC, DFW, and Army Corps will need to reapprove sediment management and likely compare current monitoring data to thresholds on the plans.

In addition to the sediment removal approach presented in the design plans and described above, modeling suggests that sediment removal will be required at the Grist Mill Road Bridge to keep it functioning properly and limit the chance of damages to the bridge. Hydraulic modeling was performed to see how much sediment would lead to violation of bridge design guidance and recommendations. The bridge is out of design when 1 foot of extra space (i.e., freeboard) does not exist during the 50-year design flood (VTrans, 2015). Furthermore, the bridge enters a caution state when 20% of the opening, or 2.3 feet, does not remain open during the design flood at which point structures can be prone to clogging (Furniss et al., 1998). Hydraulic modeling was performed to set sediment removal thresholds at the Grist Mill Road Bridge (Table 2).

**TABLE 2**
**Grist Mill Road Bridge Sediment Management Thresholds**

| Condition | Sediment Deposit (feet) | Bridge Opening Height (feet) | Bed Elevation (feet NAVD88) |
|---|---|---|---|
| Existing | N/A | 11.4 | 437.6 |
| Caution / Monitor | 3.5 | 7.9 | 441.1 |
| Action / Remove Sed. | 4.3 | 7.2 | 441.8 |

The ballpark cost for the post flood sediment removal from all of the filled chutes, deposited bars and in front of the Grist Mill Road Bridge is $200,000. This assumes that a local contractor will do the work for the town and that the sediment spoils will be hauled to a local site out of the floodplain and river corridor. We suspect that future maintenance may not be required at all areas at one time. Based on past flood patterns, sediment removal at a third of the project chutes and bars may be needed once every 10 years. The future maintenance could thus cost $65,000 every 10 years.

## Cited References

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VTrans, 2015. Hydraulics Manual. Vermont Agency of Transportation, Montpelier, VT.