



Final Report

Environmental Protection Agency
Great Lakes Restoration Initiative
Improve Water Quality and Reduce Pollutants in Tamarack Creek
(Project No. EPA-R5-GL2014-2)

Prepared by: Muskegon River Watershed Assembly

Executive Summary

In 2015 the Muskegon River Watershed Assembly (MRWA) was awarded a Great Lakes Restoration Initiative (GLRI) grant administered through the Environmental Protection Agency. The primary purpose of the grant was to reduce NPS pollutants to Tamarack Creek, a tributary to the Muskegon River. The Muskegon River watershed, one of the largest in Michigan, encompasses over 2,700 square miles and contributes excessive sediment, nutrients and other pollutants to Lake Michigan. In the Muskegon River Watershed

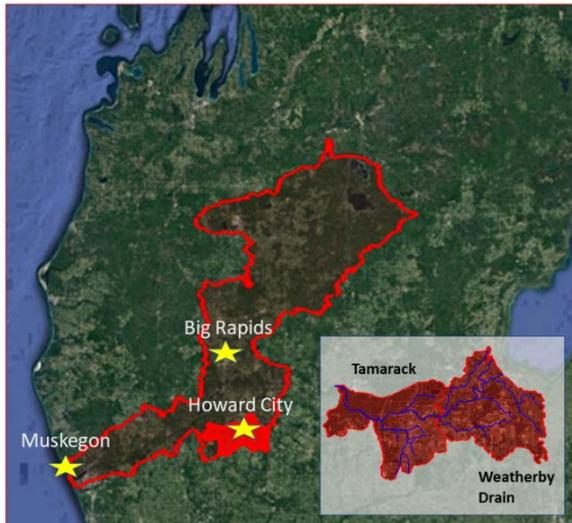


Figure 1. Map of the Muskegon River watershed. The shaded box depicts the two subbasins of the Tamarack Creek subwatershed where the BMP's were implemented.

Management Plan the Tamarack Creek subwatershed was identified as a critical area for implementing Best Management Practices (BMP's) because of in-stream temperature fluctuation, surface water runoff, and percentage of developed land use. Almost two-thirds of the acreage is agricultural resulting with the recommended (BMPs) listed as being agriculturally-based. Notably, most of the tributaries to the Muskegon River are groundwater fed but Tamarack Creek is predominantly runoff driven which increases the importance of implementing BMP's that decrease sedimentation and excessive nutrients from overland flow. To address the multiple impairments, we implemented a diverse suite of practices that included agricultural and stream improvement BMP's.

Agricultural BMP's implemented included:

- Buffer and filter strips (9 acres) – Established vegetated areas adjacent to Tamarack Creek and agricultural drainage ditches to remove sediment, organic matter, and other pollutants from runoff water and wastewater.
- Cover crops (2700 acres) – Planted a crop of close-growing plants during the fall in agricultural fields for soil improvement (decrease compaction) and erosion control.
- Road/Stream Crossing Improvements (5 sites) – Repaired road/stream crossings by grading, installation of spillways, stone riprap, check dams, slope stabilization, and temporary soil erosion controls.

Another BMP was to reduce streambank erosion at two community parks:

- Critical area stabilization (480 feet shoreline) – Stabilized two stream banks that were highly susceptible to erosion by implementing vegetative and structural BMPs. A stone toe and core logs were placed on the bank with native plantings on the riparian area. Both sites were at area parks that were specifically listed in the watershed management plan.

To successfully accomplish the BMP's the project partners (Appendix A) initiated an outreach campaign to educate agricultural producers about the importance of BMP's to the Tamarack Creek watershed. An "education first" strategy was used to sustain broad educational efforts to reach small and large agricultural producers. One of the first outreach activities was an open house organized by the MRWA and Montcalm Conservation District (MCD) on September 22nd, 2015. The intent was to inform agricultural producers and landowners how they could receive funding to install BMP's that targeted water quality improvements by reducing sediment, nutrients and pesticides. Information describing how BMP's could benefit agricultural production, cropland and the watershed was provided. During the open house the participants engaged with presenters from the Michigan State University Montcalm Extension, Natural Resources Conservation District, MRWA and MCD. During and after the meeting participants were actively recruited to implement BMP's. Following the meeting direct mailings were sent to area producers and property owners to determine level of interest and gain commitments for installing BMP's.

Education efforts were developed for agriculture producers, community members and high school students (described below). These community groups were directly involved in planning and implementation of the BMP's. Each installation provided experiential and place-based learning opportunities. To close-out the GLRI grant a "Conservation Tour" was held where agricultural producers and community members visited many of the cover crops, improved road-stream crossings and buffer strips and experienced how the watershed was improved through the efforts of many agencies, NGO's and project partners.

The annual pollutant load that was targeted for reduction for the combined BMP's equaled 4,495 pounds of nitrogen, 859 pounds of phosphorus, and 412 tons of sediment. To estimate the reduction in pollutants that were associated with the BMP's implemented in the project we used the EPA Region 5 Spreadsheet Tool for Estimating Pollutant Load (STEPL). The total estimated reductions during 2016 and 2017 were 2115 and 1773 pounds for nitrogen, 409 and 347 pounds for Phosphorous and 114 and 106 tons of sediment, respectively (Figure 2). The annual reductions were less than the initial project targets due to the reduction in buffer strips acreage; although this would not account for the entire difference. Notably, the two road/crossing culvert replacements that were added will provide additional annual reduction for years to come.

Overall, the project was successful in reducing annual pollutants into Tamarack Creek. At the onset of the project the partners hoped the agricultural producers and municipalities would view their experiences as valuable and they would continue to implement BMP's. Throughout the project the agricultural producers described how they had noticed a reduction in soil

compaction, erosion and nutrient scavenging while observing an increase in yields, which they largely attributed to the use of cover crops.

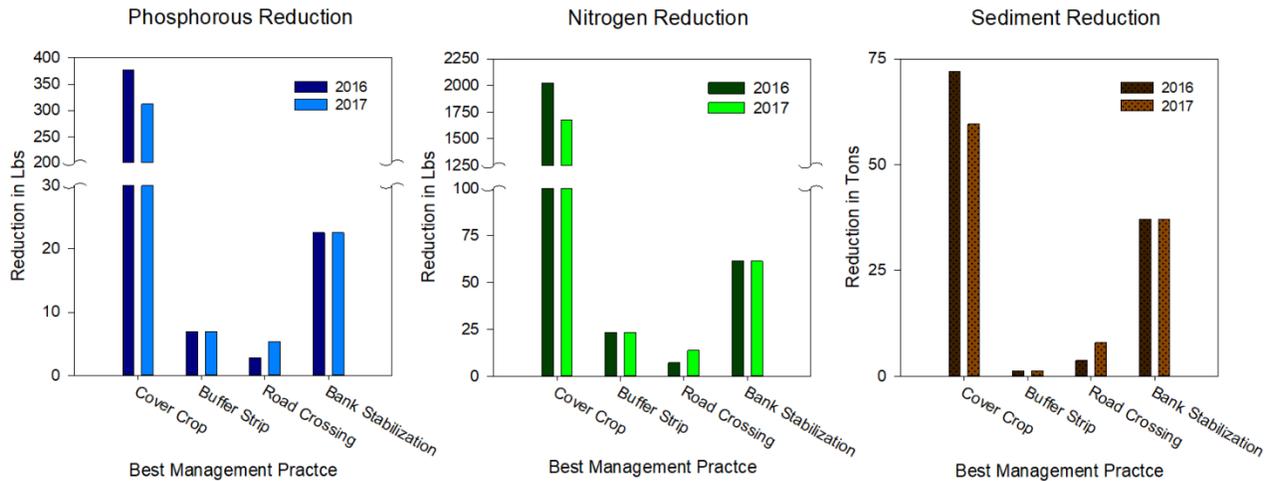


Figure 2. Estimated reductions in Phosphorous, Nitrogen and Sediment in 2016 and 2017 for each of the implemented BMP's.

Not only were they encouraged to continue planting cover crops, but they shared their success with other producers. Another sustainable activity was implementing BMP's for reducing erosion through improving road-stream crossings. The Montcalm County Road Commission has inventoried all the subwatershed crossings and are eager to continue addressing sites where pollutant load is increasing because of failing crossings.

Project Chronology

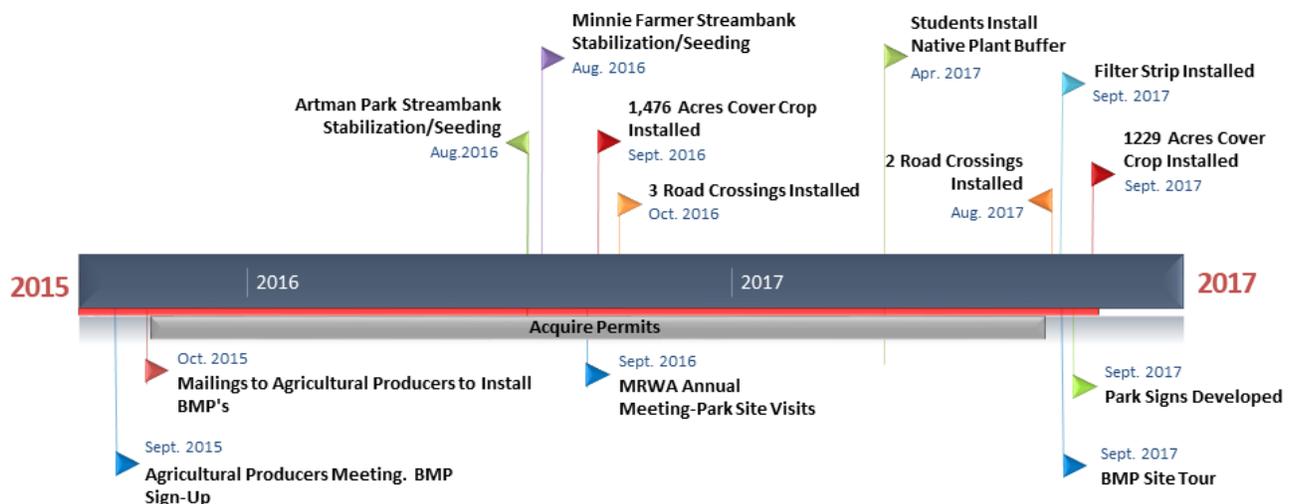


Figure 3. Major activities that occurred during the duration of the project.

Geographic Distribution of BMP's

The Tamarack Creek subwatershed covers almost 150 square miles with the majority located in Montcalm County, Michigan. All the BMP's implemented in the project were in the Weatherby Drain or the Lower Tamarack Creek subbasins (Figure 4). The town of Howard City falls within the eastern border of Lower Tamarack Creek and less than one mile from the western border of the Weatherby Drain. The 2700 acres of cover crops, and the five road/stream crossings were implemented in the Weatherby Drain subbasin which has an area of 28,348 acres with 52% of the land dedicated as cropland and 27% as pastureland. The two bank stabilizations and nine acres of buffer strip were implemented in the lower Tamarack Creek subbasin which has an area of 25,296 acres with 29% dedicated as cropland and 28% as pastureland. Both basins are runoff driven with low to moderate baseflows and moderate to high peak flows. This is unique to most other subbasins in the Muskegon River watershed which are hydrologically more stable with groundwater fed streams of high to moderate baseflows and low to moderate peak flows. Another unique feature of Tamarack Creek is how water chemistry is classified as eutrophic because of the high amount of nutrients.

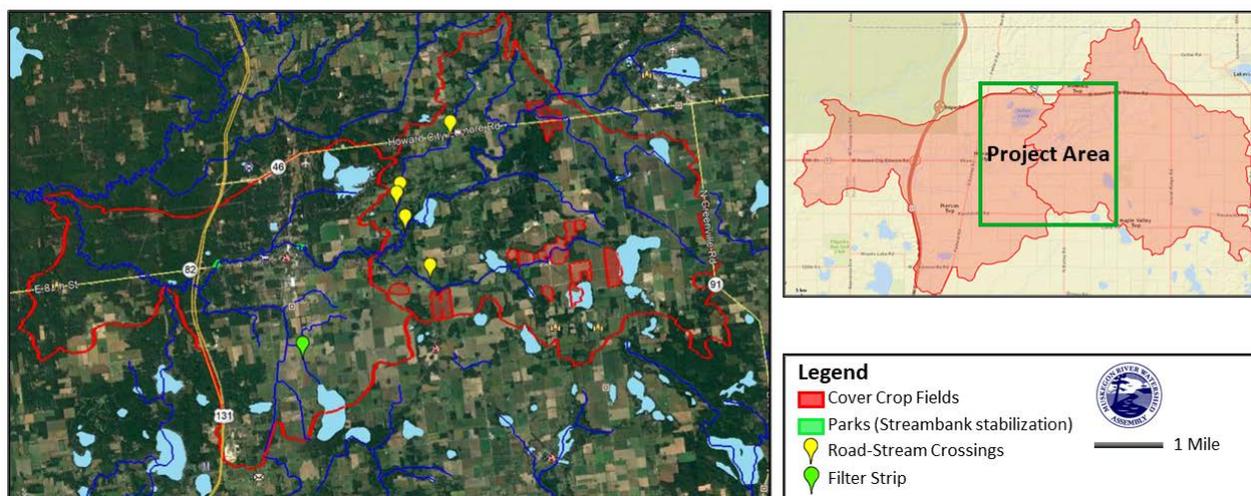


Figure 4. Location of BMP's in the Tamarack Creek subwatershed.

Cover Crops:

The practice of vegetative BMP's through the planting of cover crops is identified in the Management Plan and has been shown to reduce the high rates of sedimentation and excess nutrients common in agricultural areas. In the Tamarack Creek subwatershed many drainage ditches flow through the agricultural fields. Agricultural producers were recruited to install cover crops during a public meeting and through direct mailings (Figure3). The MCD contacted all interested agricultural producers and conducted personal consultations to discuss details of the project and determine appropriate cover crop locations. The cover crops were strategically located in croplands where a stream flowed through the field or was adjacent or near a stream to maximize benefit (Figure 5). In 2016 and 2017 agricultural producers installed

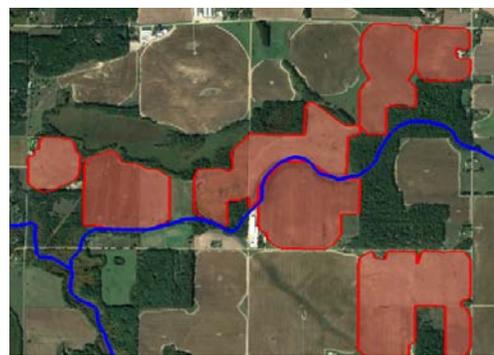


Figure 5. Example of cover crop location where BMP was installed directly adjacent to the stream.

cover crops in the Weatherby Drain sub-unit of the Tamarack Creek watershed. The acreage in 2016 and 2017 was 1471 and 1229, respectively. The cover crops consisted of rye, clover, oats and radishes and were applied through a dry aerial application. The total estimated reduction in pollutants over the two years were 3698 lbs. for Nitrogen, 688 lbs. for Phosphorous and 131 tons for sediment (Figure 2).

Buffer Strip:



Originally it was planned to install 24 acres of riparian buffer strips to remove sediment, organic matter and other pollutants from runoff water. However, it proved difficult to recruit agricultural producers for the specific practice because it would require taking land out of production. The MCD was able to gain commitment by one agricultural producer to install a 9-acre buffer strip. The annual estimated reduction in pollutants over the two years were 23.2 lbs. for Nitrogen, 7 lbs. for Phosphorous and 1.2 tons of sediment.

Parks Streambank Stabilization and Native Plantings:

Two parks, Minnie Farmer and Artman Park, were specifically listed in the Muskegon River Watershed Management Plan for installation of BMP's to address streambank erosion. Minnie Farmer Park, located in Howard City, and managed by the Village of Howard City was known to have 300' of eroding streambank. Artman Park, a mile west of Howard City and managed by Montcalm County Parks and Recreation, was known to have 290' of eroding streambank. Both parks had lawns which were mowed directly to the stream's edge and steep drop-offs at the water that were between 1-3 feet. Recent flooding at the sites had further eroded the banks and input sand and other pollutants into the river. The banks were severely undercut and laterally receding while the riparian areas provided little overhead canopy for the stream.

At both parks nature-like shorelines were installed. The shoreline was stabilized by placing a fieldstone toe at the water's edge, coir logs at the lower, middle and upper sections of the sloped bank and native grass plantings between the logs. To initiate a vegetative overhead canopy above the stream native seedlings were planted at the top of the bank with red maple, dogwood, tamarack and red pine.

At both parks MRWA collaborated with the Muskegon Conservation District and Montcalm Conservation District on site design and obtaining the necessary permits with the Muskegon Conservation District installing the shoreline BMP's. At Artman park the partners included the Montcalm County Parks and Recreation. At Minnie Farmer park partners included the Village

of Howard City. A key partner was Tri County Schools who provided 80 students in the 10th grade who installed natural shorelines through planting of native trees and shrubs. The students dedicated 1400 hours of work to the project.

The annual estimated reduction in pollutants at both parks were 61.3 lbs. for Nitrogen, 22.6 lbs. for Phosphorous and 37 tons for sediment.



Road Stream Crossings:

The Tamarack Creek subwatershed has many incorrectly sized and poorly placed bridge culverts. Half of the 123 road-stream crossings are in a designated drain or a channelized field and were designed to drain water and runoff quickly from the land, so crops would not become saturated. This is problematic due to how excessive nutrients and sediment are rapidly transported into the waterbodies without much filtering. Also, because there is little time for the water to soak into the ground and become cooled it exacerbates thermal pollution.

The original project plan was to replace two culverts, but the number increased to five when it was realized the expected acreage for buffer strips would not be achieved. Fortunately, the Road Commission for Montcalm County was prepared with three near shovel-ready projects for culvert replacements. All culverts were in Weatherby Drain and were undersized and perched with road approaches directing runoff into the creek. These impaired culverts increased flow erosion, input of nutrients and sediment, blocked fish passage and in high water impounded flow upstream of the crossing. The new culverts were designed to have a continuous streambed that mimicked the slope, structure, and dimensions of a natural streambed where overland flow would be diverted into retaining areas instead of directly into the creek. During 2016 two culverts were replaced and in 2017 three were completed. The Road Commission for Montcalm County provided engineering designs and installed the culverts. The MCD and MRWA worked with the Road Commission in site plan review and ensuring BMP criteria were met. The annual estimated reduction in pollutants at the five road stream crossings were 13.7 lbs. for Nitrogen, 5.3 lbs. for Phosphorous and 7 tons for sediment.



Significant outreach and education

Successful outreach and education was accomplished through implementing recommendations of the Muskegon River Watershed Plan. The plan identifies how education of 1) agricultural landowners and 2) K-12 students is critical to improving and protecting water resources. These two groups were specifically provided education on BMP's and had a major role in implementing them.

1. Agricultural Producers:

The Muskegon River Watershed Plan presents the following recommendations for engaging agricultural landowners.

"Before agricultural landowners will think about implementing any BMP on their land, they must first know the benefits of agricultural BMPs, how to install them, how much it will cost, and what organizations are available to assist them. Information on government funded incentive programs for farmers should also be distributed as part of the initial educational process."

One of the first outreach activities was an open house on September 22nd, 2015. The intent of the meeting was to educate and recruit agricultural producers to implement BMP's. The agricultural producers and landowners were informed how they could receive funding for installing BMP's targeted towards improving water quality and removing sediment, nutrients and pesticides. Information was provided that explained how BMP's could benefit agricultural production, cropland and the watershed. During the open house the participants engaged in discussions with presenters from the MSU Montcalm Extension, MCD and MRWA. Following the meeting direct mailings were sent to describe the project, and determine level of interest and gain commitments.

Throughout planning and implementation of the cover crop BMP the MCD provided personalized visits and consultations with the agricultural producers. The MCD explained the financial assistance and commitment, calculated environmental benefits, and assisted in determining locations where cover crops would be installed. These personal consultations established good relationships and built trust with each of the agricultural producers.

2. K-12 students (Tri County Schools)

The Muskegon River Watershed Plan presents the following recommendations for engaging K-12 students.

“MRWA staff will work with local school officials and science teachers to develop short and long-range plans for incorporating special ecosystem education into the classroom (i.e., Wetland Appreciation and Care Week- between Arbor Day and Earth Day). As a part of the curriculum, groups of students will learn to maintain local parks and wetlands so that they may be used for educational purposes for years to come.”

In April of 2017 the Tri County Area Schools 10th grade students provided 1400 hours to accomplish all the native plantings at Minnie Farmer and Artman parks. The native plantings were part of an experiential learning project focusing on the importance of natural shorelines, native plants and trees, and how BMP's (including the students work) improved Tamarack Creek, the Muskegon River, and Lake Michigan. The students high school teacher devoted 30 hours in organizing and accomplishing the project while MRWA and the MCD District Forester provided classroom instruction. Three different work stations were set-up for the students. The first was to learn about tree planting and to dig the holes, and to install and water the plants. The other two were designed for testing soils and learning about macroinvertebrates and invasive species.

3. Final Site Tour

A site tour of the BMP's was held near the end of the project (September 13th, 2017) to educate agricultural producers and area residents about the Tamarack Creek subwatershed, the success of the GLRI EPA grant project, and the benefits of using BMP's. The MCD and MRWA organized the event which was attended by nearly 30 participants and the project partners. A bus was used to transport the participants to select sites where they could see and learn about the installed BMP's. The MCD and MRWA led guided walks at Minnie Farmer and Artman parks, road stream crossings, and farmer fields to observe cover crops and native buffers. The participants asked many questions and requested information on how they could become involved in installing BMP's on their property and work with governmental agencies in identifying other areas that could benefit from BMP's. Encouragingly, dialogue continued after the meeting with follow-up phone calls and e-mails exchanged between participants and MRWA.

Challenges and Obstacles to Success

During the project, a few obstacles and challenges were faced which likely are experienced in similar projects. We found it was difficult to get buy-in from some agricultural producers. The subwatershed is dominated by a limited number of producers, many of them quite large, and they did not want to be burdened by what they considered to be a small grant. It was particularly difficult to get commitment for the buffer strips and an adjustment to the scope of work was required. The buffer strip acreage was reduced from 24 acres to 9 and the funding was used to install two additional road-stream crossings (See appendix B for modifications to proposed budget). Unlike the cover crops the buffer strips require taking land out of production and reduces the farmers potential income.

Another obstacle was the timing of installing the cover crops. The grant ended on September 30th of 2017 which was during a time when the crops are still being harvested. This made it

difficult for the cover crops to be installed before the deadline and the agricultural producers were required to hurry their schedule to meet the deadline. The last cover crop was installed very close to the deadline after much effort and constant encouragement by the Montcalm Conservation District.

Moving Forward

A strength of the project was the development of a strong and vibrant partnership among local conservation groups, municipalities and the community. The relationships created will continue to provide opportunity for collaborative conservation efforts. Notably, the Tri County Schools and municipalities plan on using the two parks where streambank BMP's were accomplished as demonstration and education sites where riparian BMP's may be highlighted and showcased. Also, signs were placed at both parks to inform park visitors of the importance of protecting stream habitats through implementing BMP's.

This project may also be used as a spring board for other nearby subwatersheds and communities where watershed management plans have recently been completed. Implementing similar projects would be efficiently accomplished because a process for BMP implementation and public outreach and engagement has been established and could be readily applied.

How may EPA assist the grantee in future efforts?

Continuing the work begun in this effort and expanding to other area watersheds would be beneficial. Without financial support by EPA and other agencies the implementation of diverse and extensive BMP's may not be realized. Recently watershed management plans were completed for nearby areas where many of the issues that affected the Tamarack Creek watershed were identified as impairments. With funding, the partnerships and knowledge established in this project could be applied to sustain and expand watershed restoration efforts.

APPENDIX A. List of all partners and their contribution

- Montcalm Conservation District



Assisted in all project components which included in-kind match, organization of field tour, outreach and consultation to agricultural producers, site plan development at two parks, and distribution of project material. The project could not have been accomplished without their dedication and efforts.

- Montcalm County Parks and Recreation:



Acquired permits and assisted in site plan design and review for Minnie Farmer park.

- Montcalm Road Commission



Assisted in selecting locations of road-stream crossings, acquired permits, developed site plans and was responsible for setting culverts, slope grading and other site improvements.

- Muskegon Conservation District:



Assisted in design and was responsible for installing the stream bank improvements at the two parks. Provided guidance on and calculated STEPL results.

- Tri County Area Schools



Provided 85 10th grade students to complete the native plantings at Minnie Farmer and Artman parks including red maple, dogwood, tamarack and red pine; dug all the holes, and installed and watered trees and shrubs.

- Village of Howard City



Acquired permits and assisted in site plan design and review for Artman park.

- Michigan State University Montcalm Extension



Assisted in planning, outreach and facilitating meeting with agricultural producers.

APPENDIX B. Projected budget against actual expenditures.

Two situations occurred which required modification of the original projected budget. The first involved how the project team was unable to find agricultural producers to commit enough acreage to filter strips and grassed waterways, with 9 acres and 0 acres installed, respectively. A request for the unused funding to be applied to 3 additional road stream crossings was approved by EPA and the work was accomplished in the summer of 2017. The second involved a change in staff at MRWA. The initial Program Manager left 5 months prior to the closing out of the grant. Many activities still needed to be accomplished, data organized and analyzed, and write-up of quarterly and final reports. A total of \$2000.00 was increased in Personnel wages in the Project Manager line item for additional hours to accomplish the grant requirements of finalizing installation of BMP's and reporting.

	EPA Original Budget	Modified Budget	Actual Expenses
Personnel			
Executive Director @ \$30 x approx.1 hr/week x 125 weeks	\$ 3,120.00	\$ 3,120.00	\$ 3,120.00
Program Director @ \$28 x approx.5 hr/week x 125 weeks	\$ 472.00	\$ 472.00	\$ 472.00
Project Manager @ \$19 x approx.5 hr/week x 125 weeks	\$ 11,856.00	\$ 13,856.00	\$ 13,855.94
TOTAL PERSONNEL	\$ 15,448.00	\$ 17,448.00	\$ 17,447.94
Fringe Benefits			
10% of Salary and wages	\$ 1,545.00	\$ 1,545.00	\$ 1,545.00
TOTAL FRINGE BENEFITS	\$ 1,545.00	\$ 1,545.00	\$ 1,545.00
Travel			
In State travel for staff: approx. 160 mi/mo @ \$.575/mi x 29 months	\$ 2,688.00	\$ 2,688.00	\$ 2,005.81
TOTAL TRAVEL	\$ 2,688.00	\$ 2,688.00	\$ 2,005.81
Supplies			
Office and related supplies to support project	\$ -		
TOTAL SUPPLIES	\$ -		
Other – Subaward contractual			
Montcalm Conservation Dist. Subaward TOTAL	\$ 3,000.00	\$ 3,000.00	\$ 3,000.00
Contractual			
Filter strips - 24 acres @ \$135/acre	\$ 3,240.00	\$ 1,215.00	\$ 1,215.00
Grassed waterways - 10 acres @ \$5,500/acre	\$ 55,000.00	\$ -	\$ -
Stream crossings - 5 crossings @ \$1,500/crossing	\$ 7,500.00	\$ -	\$ -
Cover Crops - 2000 acres @ \$90/acre	\$ 128,000.00	\$ 63,402.44	\$ 56,737.77
Road Stream Crossings - 2 @ \$55,000/ea	\$ 110,000.00	\$ 103,981.45	\$ 102,705.58
Park streambank restoration & buffer	\$ 28,000.00	\$ 28,000.00	\$ 23,878.87
TOTAL CONTRACTUAL	\$ 331,740.00	\$ 196,598.89	\$ 184,537.22
Indirect Charges			
Federal negotiated indirect rate - 15% of personnel & benefits	\$ 2,549.00	\$ 2,549.00	\$ 2,549.00
TOTAL INDIRECT	\$ 2,549.00	\$ 2,549.00	\$ 2,549.00
TOTAL FUNDING	\$ 356,970.00	\$ 223,828.89	\$ 211,084.97