Peters Creek Stream Restoration Improves Channel Stability and Reduces Pollutants

Waterbody improved: Peters Creek (AUID number 040500020403-01) is a 14 square mile subwatershed within the Macatawa River watershed. Peters Creek is located in Allegan and Ottawa Counties in Michigan and is listed on the Clean Water Act Section 303(d) list of impaired waters. Peters Creek is not meeting the Other Indigenous Aquatic Life and Wildlife Designated Use due to sedimentation/siltation and phosphorus. Peters Creek is also not meeting the Warm Water Fishery Designated Use due to sedimentation/siltation. A phosphorus Total Maximum Daily Load (TMDL) was completed in 2000 for the Lake Macatawa watershed and in 2002 sediment was incorporated into the TMDL.

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Problem: Lake Macatawa is a drowned river mouth where the Macatawa River enters Lake Michigan. Lake Macatawa has a well-documented phosphorus problem (TMDL developed in 2000) and receives excess nutrients, sediment, and *E. colii* from all its tributaries. Local research determined that the Peters Creek subwatershed exports the highest amount of sediment of any major tributary to the Macatawa River Watershed (Macatawa Watershed Management Plan, 2012; Appendix V Sediment Studies addendum, 2013). Runoff and increased peak flows during storm events have increased streambank erosion in Peters Creek.

Project highlights: Natural Channel Design (NCD) was used to decrease sediment and nutrient loads by increasing floodplain connection and improving stream function. NCD is an approach that recreates a channel modeled on the form of a stable, reference channel. The goal is that the stream will therefore function as a natural system, to transport its sediment and water and has the appropriate dimension, pattern and profile for the valley type and boundary conditions under which it exists. Remediation work occurred along approximately 600 feet of Peters Creek and was completed in July of 2019. The project was located upstream of an already existing foot bridge near the confluence of Peters Creek with the Macatawa River (Figure 1). This was an area of Peters Creek that was severely eroding with numerous fallen trees and was contributing unnaturally high sediment loads to the stream (Figure 2). A 2-stage channel was installed to reduce water velocity and excessive stream bank erosion during high rain and snow melt events (Figure 3). In addition to the 2-stage channel, toe wood, a J-hook, and a log riffle were installed (Figures 4-6). After construction, coconut matting and sod were placed for immediate stabilization (Figures 7-9). The use of NCD techniques resulted in the reduction of sediment and phosphorus loads and increased channel stability. The increased channel stability was observed during a post construction bankfull event, with the water completely contained within the 2-stage channel (Figure 10).

Results: Sediment and phosphorus loadings were estimated using the Region 5 Model for Estimating Pollutant Load Reductions (Table 1). Sediment loading from Peters Creek prior to construction was estimated to be 84 tons/year, or the equivalent of approximately seven dump truck loads. The estimated sediment loading post construction was 1.7 tons/year, or the equivalent of 0.2 dump truck loads.

The phosphorus loading from Peters Creek was estimated to be 78 pounds per year prior to construction and 0.5 pounds of phosphorus per year after construction. Literature shows that the amount of algae that can be produced from one pound of phosphorus can range from 500-28,000 pounds. Based on this estimate, the amount of algae that could have been produced from phosphorus loading in Peters Creek prior to construction was 39,000-2,184,000 pounds and was reduced to 250-14,000 pounds.

During the summer of 2018, cross sectional data was collected prior to construction. Construction was completed in July 2019. Between July and October 2019, Peters Creek experienced 3 bankfull events. Therefore, post construction cross sectional data was collected at the end of October 2019. After 3 bankfull events, the stream was functioning as designed with bedform development, riffle shaping, reduced erosion, transport and mobilization of upstream sediment loads, and channel sorting of substrate with no apparent aggradation or degradation of the bed or floodplain.

The pre crosssection shows the shape of the incised stream channel and the post cross section shows the creation of the 2-stage channel with the increased flood prone area (Figure 11). The width of the flood prone area increased by approximately 50 percent in the post-construction channel (Table 2). Channel entrenchment ratio (an expression of floodplain access) increased and bank height ratio (an expression of channel incision) decreased after construction (Table 2). Using the U.S. Environmental Protection Agency's stream function assessment protocol, entrenchment ratios went from "Not functioning" in the pre channel shape to "Functioning at risk" in the post channel shape. There were some site limitations due to an existing foot bridge at the downstream side of the project area, which resulted in the functioning at risk category. However, portions of the restored site have provided full access to the floodplain. Bank height ratio was "Not functioning" prior to channel construction, and "Functioning" after construction.

Partners and Funding: Partners in the Peters Creek stream restoration were the Outdoor Discovery Center Network, Niswander Environmental, and the Michigan Department of Environment, Great Lakes, and Energy. The project design and construction costs were approximately $123,300, which was secured through a Section 319 grant, and approximately $44,130 in local match funds. In addition to Nonpoint Source funding, public and private dollars have been used in the Peters Creek subwatershed to implement Best Management Practices through Project Clarity. These projects have included two water control structures, 1,895 acres of cover crops, 356 acres converted to no-till, 3,052 acres treated with gypsum (to prevent phosphorus loss), 5,297 feet of grassed waterways, and 2,300 feet of 2-stage channel construction.

In total, this includes approximately $650,250 in local funding and approximately $185,605 in farmer match and grants.

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Figures:

Figure 1. Aerial of Peters Creek in April 2016 from Google Earth before construction occurred. The blue line depicts the location of Peters Creek at the confluence with the Macatawa River. The red arrow depicts the direction of flow. The approximate GPS coordinates are: 42.781733 and -86.002073.

Figure 2. Before construction pictures in Peters Creek with stream bank erosion, sand deposition, and fallen trees.

Figure 3. Aerial view during channel restoration construction in July 2019.

Figure 4. Installation of toe wood into the banks of Peters Creek.

Figure 5. Construction of a J-hook in Peters Creek.

Figure 6. Construction of a log riffle in Peters Creek.

Figure 7. Panoramic view of coconut matting on erosional areas after construction on Peters Creek.

Figure 8. Sod mat was placed after construction on Peters Creek.

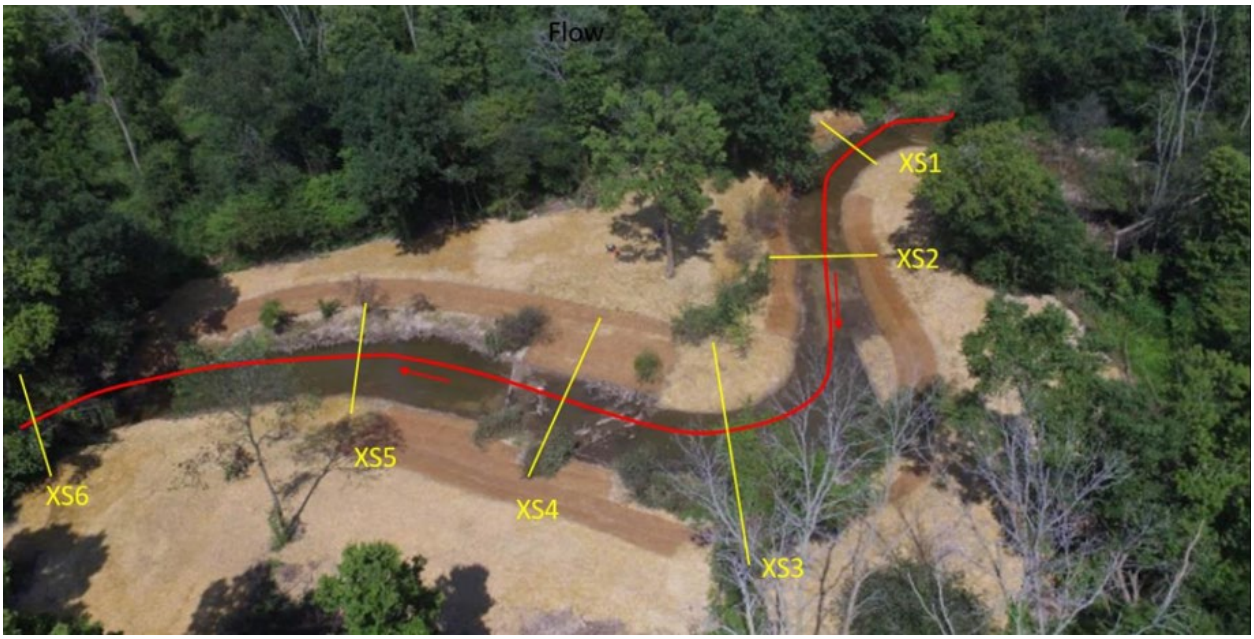

Figure 9. Post restoration aerial photograph of the project area. The red line indicates the general location of the longitudinal profile, the yellow lines mark the cross section locations, and the red arrow indicates the direction of flow.


Figure 10. Looking downstream at Peters Creek during post bankfull event.

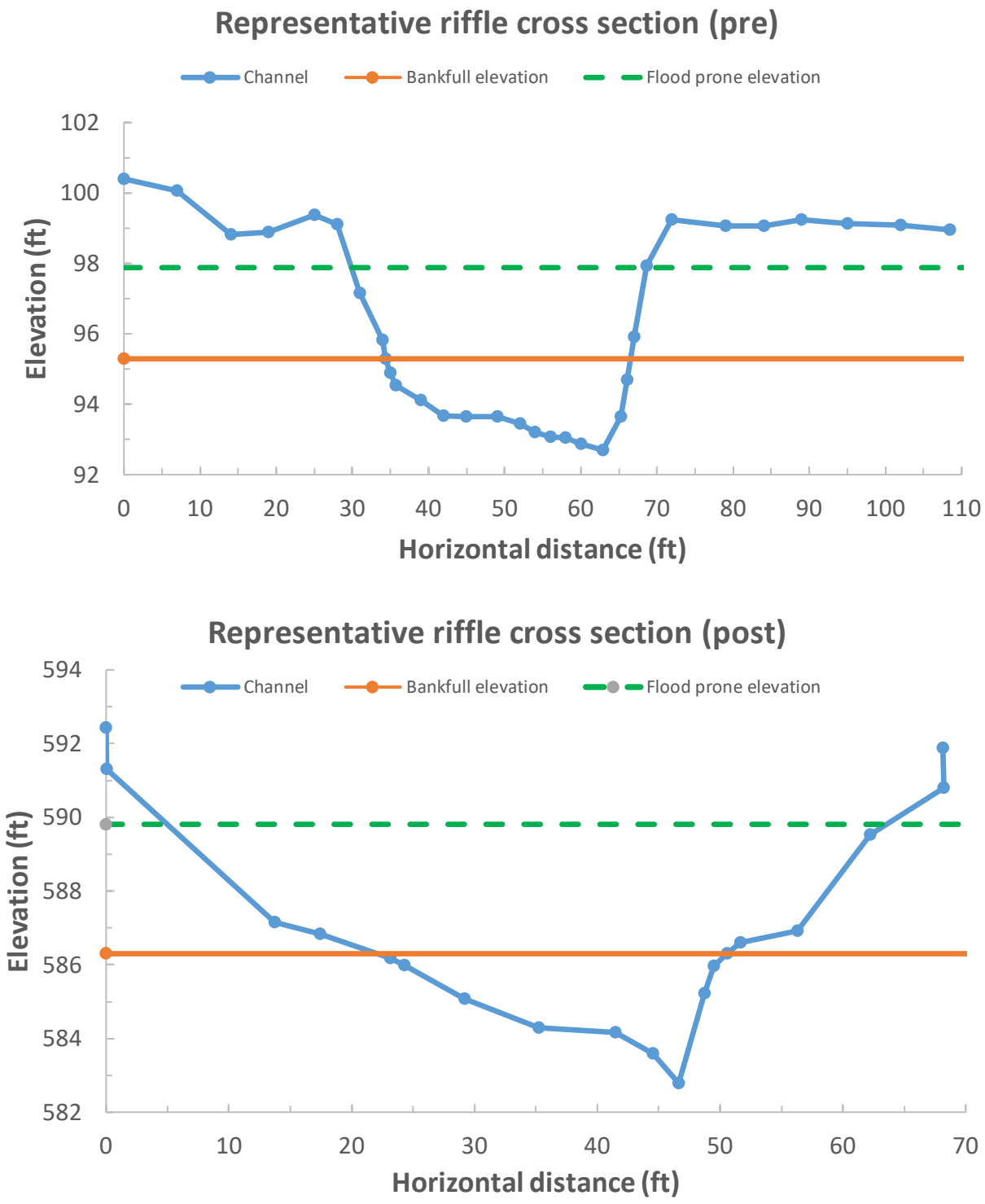

Figure 11. Peters Creek pre- and post-restoration channel cross sections.

Tables:

Table 1. Pre (2018) and post (2019) construction estimated sediment and phosphorus loads from Peters Creek to the Macatawa River.

Pollutant	Pre	Post
Sediment tons/year	84	1.7
Phosphorus pounds/year	78	0.5

Table 2. Pre (2018) and post (2019) channel morphology function.

Stream function metric	Pre	Post
Flood prone width (feet)	38.52	58.50
Entrenchment ratio	1.2 (not functioning)	2.06 (functioning at risk)
Bank height ratio	2.53 (not functioning)	1.0 (functioning)

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References:

Macatawa Area Coordinating Council. (2012). Macatawa Watershed Plan.

Muskegon River Watershed Assembly. (2013). Appendix V Sediment Studies. Addendum to Macatawa Watershed Plan.