

Bradley Drain two-stage ditch improves stream channel stability

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Waterbody improved: Bradley Drain (part of AUID number 040500050208-02) is in the Collier Creek subwatershed within the Upper Maple River watershed located in Clinton County, Michigan. Collier Creek is listed on the Clean Water Act Section 303(d) list of impaired waters. Collier Creek is not meeting the Other Indigenous Aquatic Life and Wildlife Designated Use due to phosphorus. A phosphorus Total Maximum Daily Load was completed in 2009.

GRTS number: 97547411-05

Problem: The Upper Maple River Watershed Management Plan identified Bradley Drain as a critical stream bank erosion site. Stream bank erosion and sediment loading were excessive (Figure 1). Preliminary data indicated that the erosion rate on the Bradley Drain was 0.2 to 0.6 feet per year. The dominant land use in the Bradley Drain watershed is agriculture. While land use has not changed recently, factors such as lack of riparian buffers, increased field drainage, and loss of wetlands has increased flow in the Bradley Drain.

Project highlights: Remediation work occurred on 8,700 feet of the Bradley Drain in the fall of 2013. The project mainly focused on areas of the drain that were highly channelized historically. The preferred best practice was to create an extensive two-stage ditch to reduce water velocity and stream bank erosion during high rain and snow melt events.

Results: Cross section data prior to construction shows the shape of the incised stream channel and the post-construction cross section shows the creation of the two-stage ditch with the increased flood prone area (Figure 2). Post-construction photographs demonstrate the increased connectivity with the floodplain and the progression of vegetation establishment within the two-stage ditch (Figure 3). The width of the flood prone area roughly doubled in the post-construction channel (Table 1 and Table 2). Channel entrenchment ratio (an expression of floodplain access) increased and bank height ratio (an expression of channel incision) decreased after construction (Table 3 and Table 4). Using the Environmental Protection Agency's stream function assessment protocol, entrenchment ratios and bank height ratios were "Not functioning" prior to channel construction, and "Functioning" after construction. Annual loads were estimated to be reduced by 1,044 tons of sediment; 1,201 pounds of phosphorus; and 2,401 pounds of nitrogen.

Partners and Funding: Partners in the two-stage ditch installation were the Clinton Conservation District, Streamside Ecological Services, the Gratiot County Drain Commissioner, and the Michigan Department of Environmental Quality. The total project cost was approximately \$112,000, which was secured through a Section 319 grant and \$75,000 in local match.

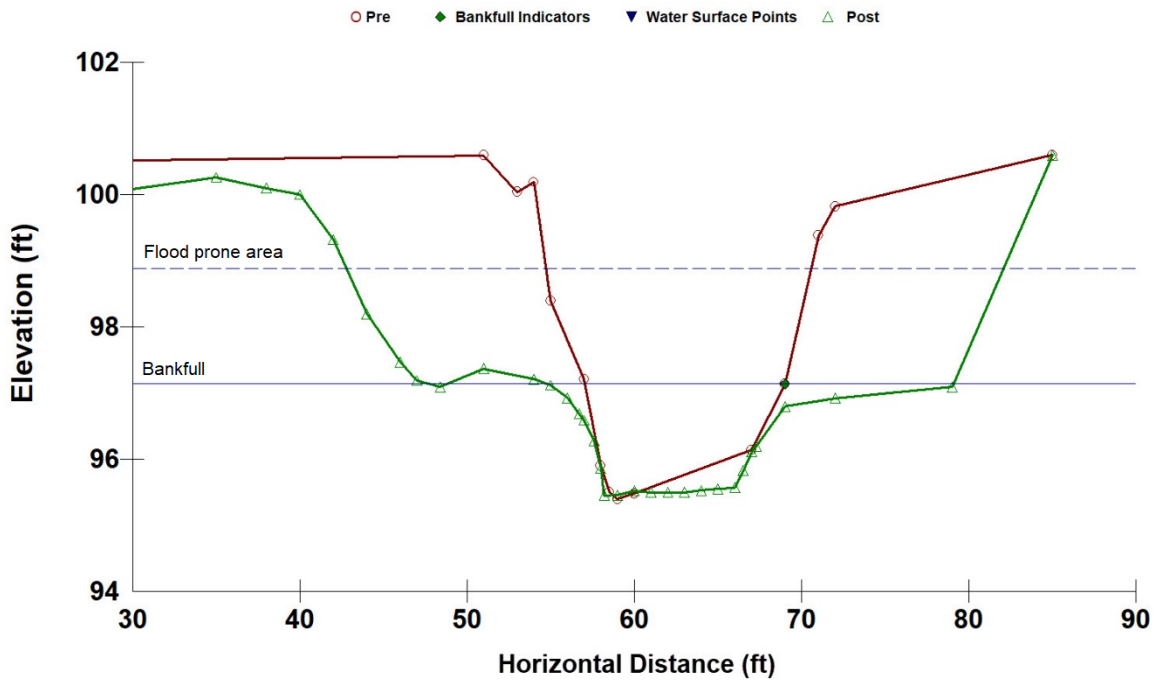
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Figures:

Figure 1. Before construction picture of Bradley Drain with extensive stream bank erosion.



Figure 2. Bradley Drain pre- and post-restoration channel cross section.



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Figure 3. Bradley Drain one year and three years post-construction of a two-stage ditch during base flow conditions (top) and during high flow after rain (bottom).



Tables:

Table 1. Width of flood prone area in 2012, before construction.

Upstream station	Middle station	Downstream station
18.8 ft.	26.5 ft.	20.2 ft.

Table 2. Width of flood prone area in 2015, after construction.

Upstream riffle	Downstream riffle	Downstream run
42.5 ft.	36.0 ft.	39.0 ft.

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Table 3. Channel morphology function data, prior to construction (2012).

Stream function metric	Upstream station	Middle station	Downstream station
Entrenchment ratio	1.3 (not functioning)	1.3 (not functioning)	1.6 (not functioning)
Bank height ratio	2.6 (not functioning)	3.6 (not functioning)	3.4 (not functioning)

Table 4. Channel morphology function data, after construction (2016).

Stream function metric	Upstream riffle	Downstream riffle	Downstream run
Entrenchment ratio	3.0 (functioning)	2.3 (functioning)	2.5 (functioning)
Bank height ratio	1.0 (functioning)	1.2 (functioning)	1.0 (functioning)

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