STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-6

Study No.: 230702 **Title:** Effects of sediment traps on Michigan river channels

Period Covered: October 1, 2004 to September 30, 2005

Study Objectives: To quantify the effect of sediment removal efforts on the channel morphology of select Michigan streams. More specifically, to 1) identify the rate and spatial extent of change in riverbed elevation and substrate conditions, and 2) relate these data to hydrologic, gradient, and valley characteristics of each stream.

Summary: I re-surveyed previously-established transects on the Little Manistee River, Silver Lead Creek, and Twomile Creek. In the Little Manistee River, slight changes have occurred in substrate upstream and downstream of a trap that has been operating since 2002, while bed elevation upstream and downstream of the trap has remained consistent. In Silver Lead Creek bed elevation and sand substrate decreased (33-60%) while gravel substrate increased (31-54%) both above and below the sediment trap. This trap was excavated in fall 2004 after pre-sediment trap channel morphology was surveyed. Silt and detritus substrates decreased upstream and downstream of the sediment trap in Twomile Creek from 2004-2005, nearly one year after excavation of the trap. Bed elevation above and below the sediment trap decreased by 0.42 and 0.13 ft, respectively, but sand substrates increased as well. Pebble count data from Silver Lead and Twomile creeks agreed with visual substrate observations and indicated an increase in coarser particle sizes in Silver Lead Creek and shift in fine particle sizes (decrease in silt and detritus, increase in sand) in Twomile Creek. Channel shape and lateral position was fairly constant from 2002 to 2005 in the Little Manistee River, and varied little by transect location (upstream or downstream of sediment trap). The most noticeable changes in channel shape occurred immediately upstream of the sediment traps in Silver Lead and Twomile creeks. Removal of a small vein of boulders from the channel during trap excavation (and likely excavation of the trap itself) initiated a headcut and increased the depth of the channel in Silver Lead Creek. Trap excavation also appeared to initiate a headcut above the sediment trap in Twomile Creek, causing a similar increase in the depth of the upstream channel.

Findings: Jobs 1–4 were scheduled for 2004-05, and progress is reported below.

Job 1. Title: Identify study rivers and develop sampling design.–No new rivers were identified for inclusion in this study during the past year. I will continue to try to find suitable study rivers (preferably those where pre-data can be collected prior to excavation of a sediment trap) in the future. I developed a schedule for re-visiting current study sites on a regular basis in upcoming years (Table 1). The Little Manistee River, Silver Lead Creek, and Twomile Creek sediment trap sites were scheduled for surveys in the 2005 field season. Since data collected previously from the Little Manistee River did not include distances and elevations for top-of-bank and water's edge, I made these measurements to correct data interpretation problems related to differences in stream discharge between surveys and to provide more meaningful channel profiles. I also added

pebble counts to substrate measurements made at permanent, benchmarked transects to correct for possible between-observer bias in the visual classification of substrate and allow for more repeatable substrate measurements during future surveys. In addition, I developed a Microsoft Access database to store and retrieve all data collected as part of this study. I error-checked all data collected from 2002-2005 and entered them into the database.

Job 2. Title: Survey bed elevations and substrate conditions.–I re-surveyed bed elevations and recorded substrate composition from visual observations and pebble counts at previously-established transects on the Little Manistee River, Silver Lead Creek, and Twomile Creek.

Job 3. Title: Analyze data.–Some changes have occurred in substrate upstream and downstream of a trap that has been operating since 2002 in the Little Manistee River. Both silt and sand substrates decreased slightly upstream of the trap from 2002-2005, while gravel increased slightly. Downstream of the trap, a small increase in the percent of silt substrate was offset by a 12.8% decrease in sand and a 12.6% increase in gravel (Table 2). However, pebble count data indicate that overall, coarser particle sizes are more frequent upstream of the sediment trap compared to below (Figure 1). Bed elevation upstream and downstream of the trap has remained relatively consistent (Table 2). Channel shape and lateral position was constant from 2002 to 2005, varying little by transect location (upstream or downstream of the sediment trap).

A noticeable decrease in sand substrate upstream (59.7%) and downstream (33.3%) of the sediment trap in Silver Lead Creek was accompanied by a decrease in bed elevation and increase gravel substrate throughout the study reach. The channel upstream of the trap downcut an average of 0.33 ft, and gravel substrate increased 54.4%. Downstream of the trap, bed elevation decreased 0.19 ft and gravel substrate increased 30.7% (Table 2). Removal of a small vein of boulders from the channel during trap excavation following the 2004 survey (and likely excavation of the trap itself) initiated a headcut above the sediment trap and increased the depth of the channel, but the lateral position of the channel remained constant.

Silt and detritus substrates decreased upstream and downstream of the sediment trap in Twomile Creek from 2004-2005, nearly one year after excavation of the trap. Bed elevation above and below the sediment trap decreased by 0.42 and 0.13 ft, respectively. Sand substrate increased as well, in part due to the decrease in silt and detritus substrates (Table 2). Similar to Silver Lead Creek, trap excavation appeared to initiate a headcut above the sediment trap in Twomile Creek, causing an increase in the depth of the channel. Lateral position of the channel remained the same.

Pebble count data from Silver Lead and Twomile creeks agreed with visual substrate observations and indicated an increase in coarser particle sizes in Silver Lead Creek and shift in fine particle sizes (decrease in silt and detritus, increase in sand) in Twomile Creek. Coarser particle sizes are more frequent upstream of the sediment trap in Silver Lead Creek, while fine substrate frequencies were similar above and below the sediment trap in Twomile Creek.

Job 4. Title: Write annual performance reports.–This progress report was prepared.

Prepared by: Todd C. Wills
Date: September 30, 2005

Table 1.–Survey schedule for active sediment trap evaluation sites. Years in which surveys are to be conducted are denoted by an "X". (* indicates first post-excavation survey.)

	River (Year excavated)					
Year	Mainstem Au Sable (2002)	East Branch Au Sable (2002)	Little Manistee (2001)	Boardman (2002)	Silver Lead Creek (2004)	Twomile Creek (2004)
2002	X	X	X*			
2003	X*	X*	X	X*	X	
2004	X	X		X	X	X
2005			X		X*	X*
2006					X	X
2007			X			
2008	X	X		X		
2009						
2010					X	X
2011			X			
2012	X	X		X		
2013						
2014					X	X
2015			X			
2016	X	X		X		
2017						
2018					X	X
2019			X			
2020	X	X		X		
2021						
2022					X	X

Table 2.–Summary of change in bed elevation and visually classified substrate data for study reaches of the Little Manistee River over a three-year period, Silver Lead Creek over a two-year period, and Twomile Creek over a one-year period. The Silver Lead Creek and Twomile Creek sediment traps were installed following the 2004 field season. The Little Manistee sediment trap was installed in 2001. Pre-excavation data were not collected on the Little Manistee River in 2001. Substrate categories (and dimensions in mm) were silt (0.004-0.063), sand (0.064-2), gravel (3-64), and small cobble (65-128).

				Percent change in substrate composition				
River	Time period	Up- or down-stream of trap	Change in bed elevation	Silt or detritus	Sand	Gravel	Small cobble	n [1]
Little Manistee	2002–2005	u	-0.05	-2.2	-3.3	+6.5	–	562
		d	+0.01	+3.2	-12.8	+12.6	-1.5	1188
Silver Lead Creek	2004–2005	u	-0.33	+3.6	-59.7	+54.4	–	481
		d	-0.19	+11.1	-33.3	+30.7	–	950
Twomile Creek	2004–2005	u	-0.42	-3.2	+16.3	–	–	327
		d	-0.13	-6.3	+24.3	–	–	747

[1] Total number of substrate observations used in the comparison.

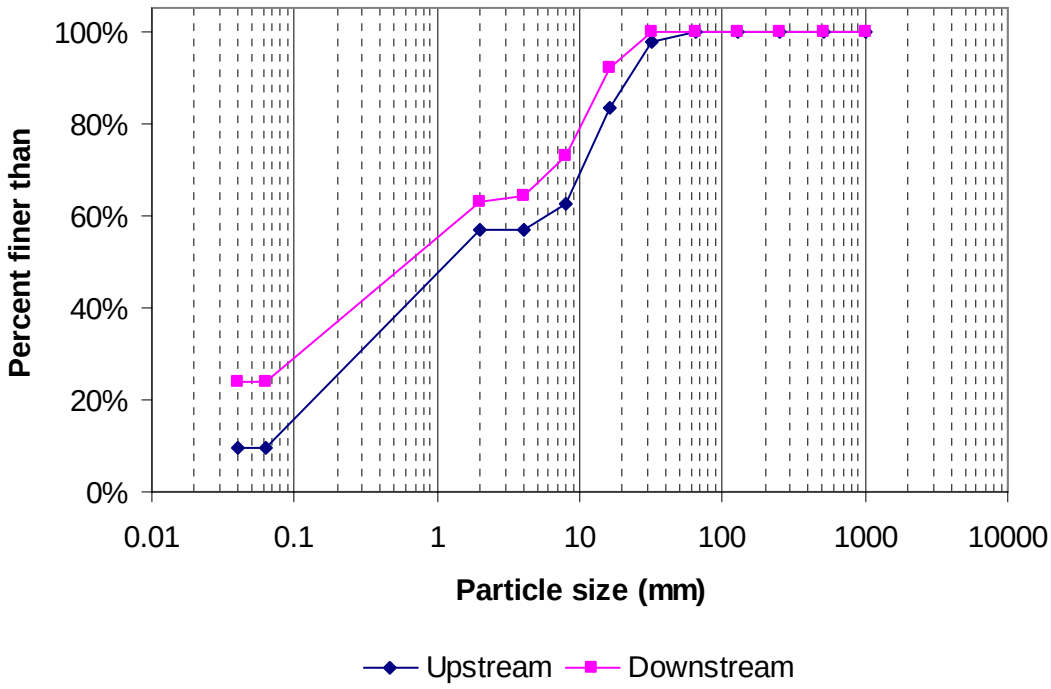

Figure 1.–Cumulative frequencies of substrate particle size from 2005 pebble counts in the Little Manistee River. Substrate particle size categories (and dimensions in mm) were organic and clay (0-0.04mm), silt (0.05-0.062mm), sand (0.063-2mm), very fine gravel (2-4mm), fine gravel (5-8mm), medium gravel (9-16mm), coarse gravel (17-32mm), very coarse gravel (33-64mm), small cobble (65-128mm), large cobble (129-256mm), small boulder (257-512mm), and medium boulder (>512mm).

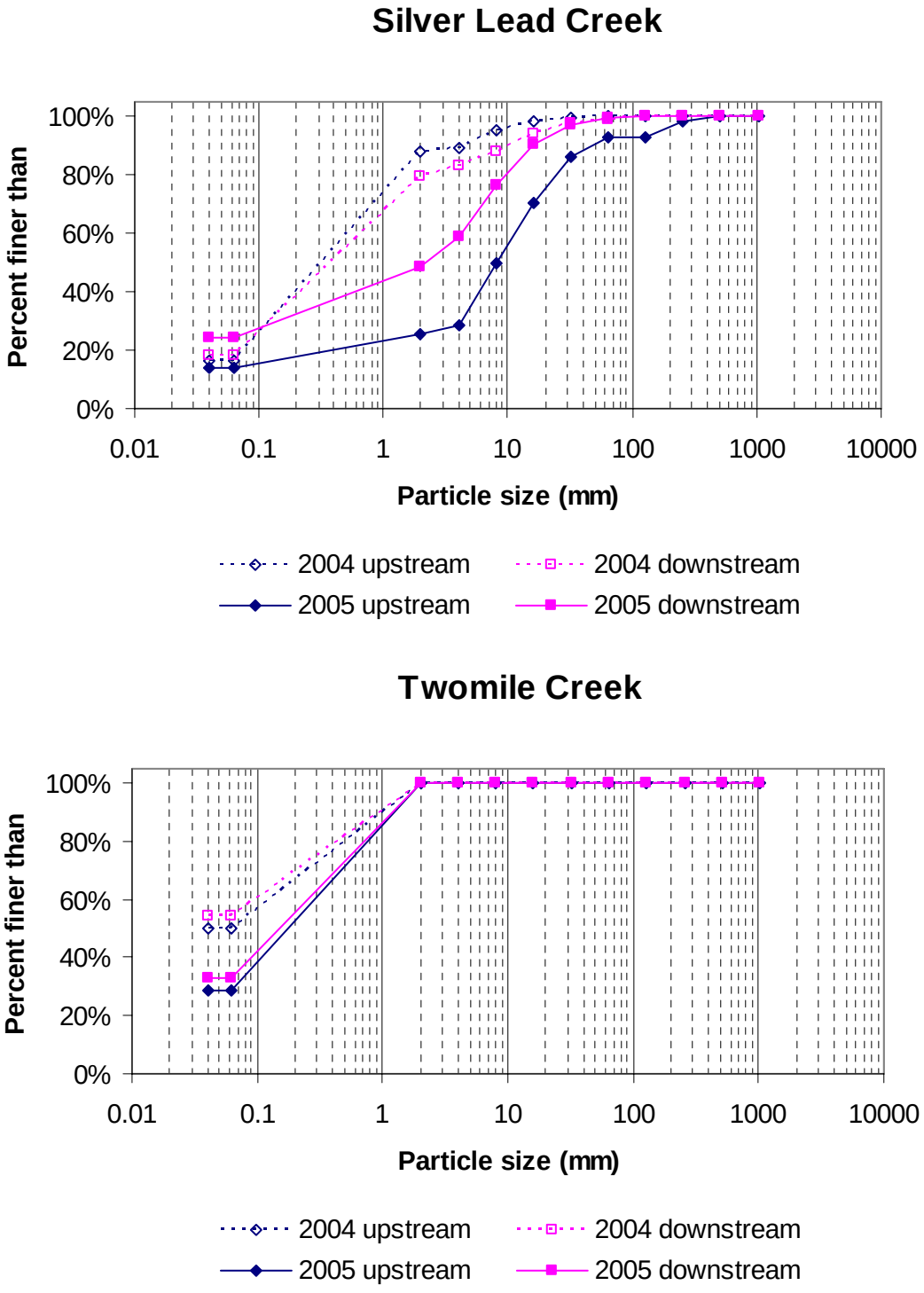

Figure 2.–Cumulative frequencies of substrate particle size from 2004 and 2005 pebble counts, before (2004) and after (2005) sediment trap construction in two study reaches. Substrate particle size categories (and dimensions in mm) were organic and clay (0-0.04mm), silt (0.05-0.062mm), sand (0.063-2mm), very fine gravel (2-4mm), fine gravel (5-8mm), medium gravel (9-16mm), coarse gravel (17-32mm), very coarse gravel (33-64mm), small cobble (65-128mm), large cobble (129-256mm), small boulder (257-512mm), and medium boulder (>512mm).