STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-80-R-4

Study No.: 702 **Title:** Effects of sediment traps on Michigan river channels

Period Covered: October 1, 2002 to September 30, 2003

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 identified three new river reaches for field surveys in summer 2003. One reach (Silver Lead Creek) was surveyed prior to installation of a sediment trap, and one reach (Boardman River) was surveyed about one year after sediment trap installation. The third reach (West Branch Big Creek) was surveyed prior to the expansion of an existing sediment trap. I established permanent transects for monitoring bed elevations and substrate characteristics through time in the three reaches, and re-surveyed previously established transects in the Au Sable, East Branch Au Sable, and Little Manistee rivers. Run habitat and sand substrates predominated in surveyed reaches of Silver Lead Creek and West Branch Big Creek, while run habitat and gravel substrate predominated in the surveyed reach of the Boardman River. Gravel, small cobble, and woody substrates generally increased from 2002 to 2003 in surveyed reaches of the Au Sable, East Branch Au Sable, and Little Manistee rivers. Change in mean depth varied across the same time period by river and transect location (upstream or downstream of sediment trap).

Findings: Jobs 1, 2, 3, and 4 were scheduled for 2002-03, and progress is reported below.

Job 1. Title: Identify study rivers and develop sampling design.–Rivers scheduled for new sediment traps were given highest priority for inclusion in this study, followed by rivers where sediment traps were recently excavated. I established transects to evaluate one new sediment trap that is scheduled for installation in the fall of 2003 in Silver Lead Creek (Marquette County), downstream of the former K.I. Sawyer Air Force Base. I also established new transects in the Boardman River (Kalkaska County) at the Crofton sediment trap site downstream of Crofton Creek, and in West Branch Big Creek (Crawford County), upstream from Town Line Road. The Crofton trap was installed in 2002, while the West Branch Big Creek trap has been installed for some time but its size will be doubled in the fall of 2003. Silver Lead Creek and the Boardman River are medium- to high-gradient streams that flow through unconfined alluvial valleys, while West Branch Big Creek is a low gradient stream that flows through a broad glacial-fluvial valley. All stream reaches have groundwater-dominated hydrology (Seelbach et al. 1997).

No changes were made to the sampling design developed in 2002. Future survey methods will be modified slightly to address data interpretation problems related to differences in stream discharge between surveys and possible between-observer bias in identification of substrate composition.

Job 2. Title: Survey bed elevations and substrate conditions.–I surveyed bed elevations and recorded substrate conditions at newly-established transects in Silver Lead Creek, the Boardman River, and West Branch Big Creek. Locations of benchmarks and transect pins were noted and their GPS coordinates recorded at all surveyed reaches for future reference (Figures 1 to 3). I also re-surveyed transects for two traps installed in 2002, one on the Au Sable River (Crawford County) in the reach formerly occupied by Salling Pond, and one in the East Branch Au Sable River (Crawford County) downstream of Wilcox Bridge Road. Transects in the Little Manistee River (Lake County) at the Wagley sediment trap site, downstream of Bass Lake Road, were also re-surveyed. The Wagley trap was installed in 2001. Troy Zorn, MDNR Fisheries Division, established all previously-surveyed transects in spring 2002. Lineal mapping of substrate on the East Branch Au Sable River was scheduled for fall 2002 but could not be completed due to time constraints. No lineal mapping of substrate conditions occurred on Silver Lead Creek, the Boardman River, or West Branch Big Creek. Lineal mapping of substrate conditions in these streams will be completed in 2004 as time permits.

Job 3. Title: Analyze data.– Run habitat predominated for study reaches of the three newly-surveyed rivers. Run, riffle, and pool habitat was found at 83, 17, and 0 % respectively of the Silver Lead Creek study transects, and 75, 25, and 0 % respectively of the Boardman River study transects. All of the West Branch Big Creek study transects were located in areas of run habitat. I defined run, riffle, and pool habitats similar to Armantrout (1998).

Two newly surveyed reaches had mostly sand or finer substrates above and below each sediment trap site. More than 70% of the Silver Lead Creek reach and more than 90% of the West Branch Big Creek reach consisted of sand and finer substrates (Table 1). Wood constituted less than 2.5% of the substrate above and below these sites. Although a small sediment trap has been in operation on West Branch Big Creek for some time, little difference in substrates upstream or downstream from the trap was apparent. On the Boardman River, where a trap has been in place for over a year, gravel composed 52% of the substrate upstream of the trap and 43% of the substrate downstream of the trap. Wood substrate was slightly more abundant downstream from the Boardman River trap compared to upstream of the trap. Mean wetted depth above and below the sediment trap was less than 1 ft in all newly surveyed reaches (Table 1).

At the Au Sable River site, silt and sand substrates decreased upstream and downstream of the sediment trap, resulting in an overall increase in the amount of exposed gravel and wood from 2002 to 2003 (Table 2). Changes in substrate composition were not consistently related to changes in mean water depth. Mean depth increased upstream of the trap, which suggests downcutting, but depth decreased slightly downstream of the sediment trap, which suggests deposition had occurred. The apparent increase in mean depth upstream of the sediment trap may be due to unresolved measurement error at the first transect location (Table 2). Some adjustments in the shape of the channel are noticeable at transects upstream and downstream of the trap, although the lateral position of the channel remained stable (Figure 1).

Silt and sand substrates decreased from 2002 to 2003 upstream of the trap on the East Branch Au Sable River. Silt substrate slightly increased downstream of the sediment trap, but sand substrate decreased. The overall decrease in sand substrates upstream and downstream of the sediment trap resulted in an increase in the amount of gravel and small cobble substrates, similar to the sediment trap site on the Au Sable River. Percentage of wood substrate decreased upstream of the sediment trap and increased downstream of the sediment trap. Mean depth decreased upstream of the sediment trap, but remained relatively stable downstream of the trap (Table 2). The relatively large decrease in water depth upstream of the trap was unexpected in light of the large increases in coarse substrates and decreases in finer substrates. I hypothesize that between-observer bias in substrate identification may account for this incongruity. Future survey methods

will be modified to address these problems. Overall shape and lateral position of the channel remained stable (Figure 2).

At the Little Manistee location, silt and sand substrates upstream and downstream of the sediment trap decreased from 2002 to 2003, similar to both the Au Sable and East Branch Au Sable sediment trap sites. Gravel substrates decreased slightly upstream of the trap, possibly due to a greater proportion of the substrate being categorized as small cobble. Downstream of the trap, gravel substrates increased, with a slight decrease in the amount of small cobble. Woody substrate increased both above and below the trap. Mean depth changed slightly, with a small decrease in depth above the trap and a small increase in depth below the trap. The shape and position of the channel remained stable (Figure 3).

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

Literature Cited:

Armantrout, N.B., compiler. 1998. Glossary of aquatic habitat inventory terminology. American Fisheries Society, Bethesda, Maryland.

Seelbach, P.W., M.J. Wiley, J.C. Kotanchik, and M.E. Baker. 1997. A landscape-based ecological classification system for river valley segments in Lower Michigan. Michigan Department of Natural Resources, Fisheries Research Report 2036, Ann Arbor.

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Table 1.–Summary of depth and substrate data for reaches of Silver Lead Creek prior to sediment trap construction, the Boardman River approximately one year after sediment trap construction, and West Branch Big Creek prior to the expansion of an existing sand trap. Substrate categories (and dimensions in mm) were silt (0.004-0.063), sand (0.063-2), gravel (2-64), small cobble (64-128), large cobble (128-256), boulder (>256), and wood.

River	U or D of trap[1]	Depth[2] (ft)	Percent substrate composition						
			Silt or detritus	Sand	Gravel	Small cobble	Wood	Other	n[3]
Silver Lead Creek	u	0.69	14.3	58.7	25.0	0.2	1.0	0.8	412
Silver Lead Creek	d	0.69	14.3	62.8	13.3	6.2	2.4	1.0	837
Boardman	u	0.87	14.2	30.9	52.1	1.4	1.2	0.2	424
Boardman	d	0.67	22.4	25.2	43.0	0.0	7.4	2.0	952
W. Br. Big Creek	u	0.63	28.0	69.2	0.0	0.0	1.7	1.1	522
W. Br. Big Creek	d	0.82	24.9	68.7	0.4	0.0	0.7	5.3	841

[1]U=upstream; D=downstream
[2]Mean wetted depth
[3]Number of substrate observations

Table 2.–Summary of change in depth and substrate data for reaches of the Au Sable, East Branch Au Sable, and Little Manistee rivers over a one-year period. The Au Sable and East Branch Au Sable river sediment traps were installed in 2002, while the Little Manistee River sediment trap was installed in 2001. Negative values indicate a decrease in depth or percent substrate composition. Substrate categories (and dimensions in mm) were silt (0.004-0.063), sand (0.063-2), gravel (2-64), small cobble (64-128), large cobble (128-256), boulder (>256), and wood.

River	Year	U or D of trap[1]	Change in mean depth (ft)	Percent change in substrate composition					
				Silt or detritus	Sand	Gravel	Small cobble	Wood	n[2]
Au Sable	2002-03	u	+0.32	-12.6	-4.0	+8.6	0.0	+11.1	938
Au Sable	2002-03	d	-0.15	-6.0	-6.8	+5.3	0.0	+9.2	1960
E. Br. Au Sable	2002-03	u	-0.58	-3.8	-37.0	+36.5	+4.9	+2.9	730
E. Br. Au Sable	2002-03	d	+0.06	+8.5	-25.0	+8.0	+5.8	+3.3	1343
Little Manistee	2002-03	u	-0.12	-1.1	-15.2	-4.4	+15.5	+3.6	997
Little Manistee	2002-03	d	+0.09	-6.0	-6.3	+11.6	-0.9	+3.1	2070

[1]U=upstream; D=downstream
[2]Total number of substrate observations made during both surveys combined.

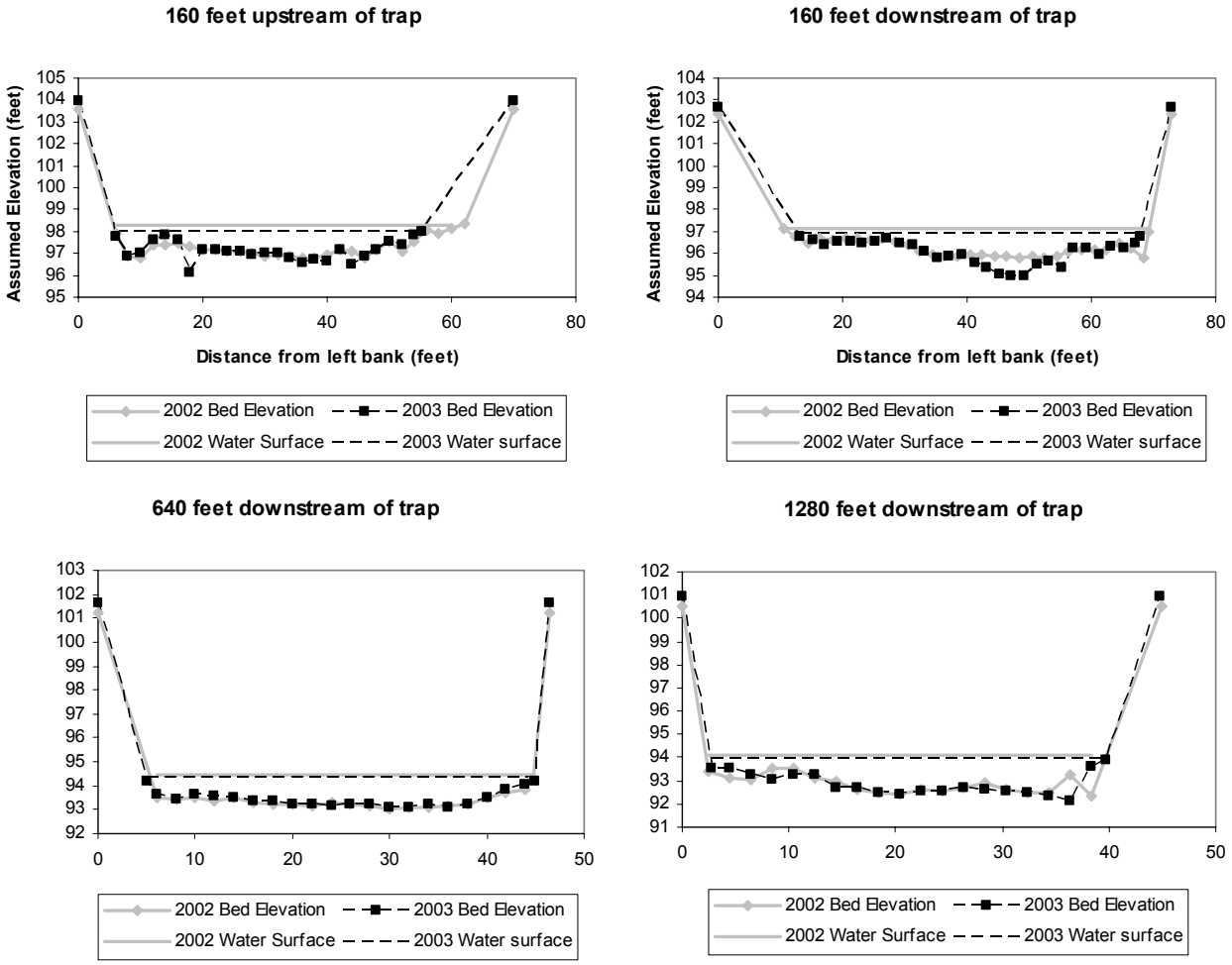

Figure 1.–Selected channel profiles from 2002 and 2003 surveys at four transects associated with the sediment trap installed on the Au Sable River in 2002. Horizontal lines indicate water surface elevation for each year that surveys were made. Values for transect locations upstream and downstream of the trap are approximate.

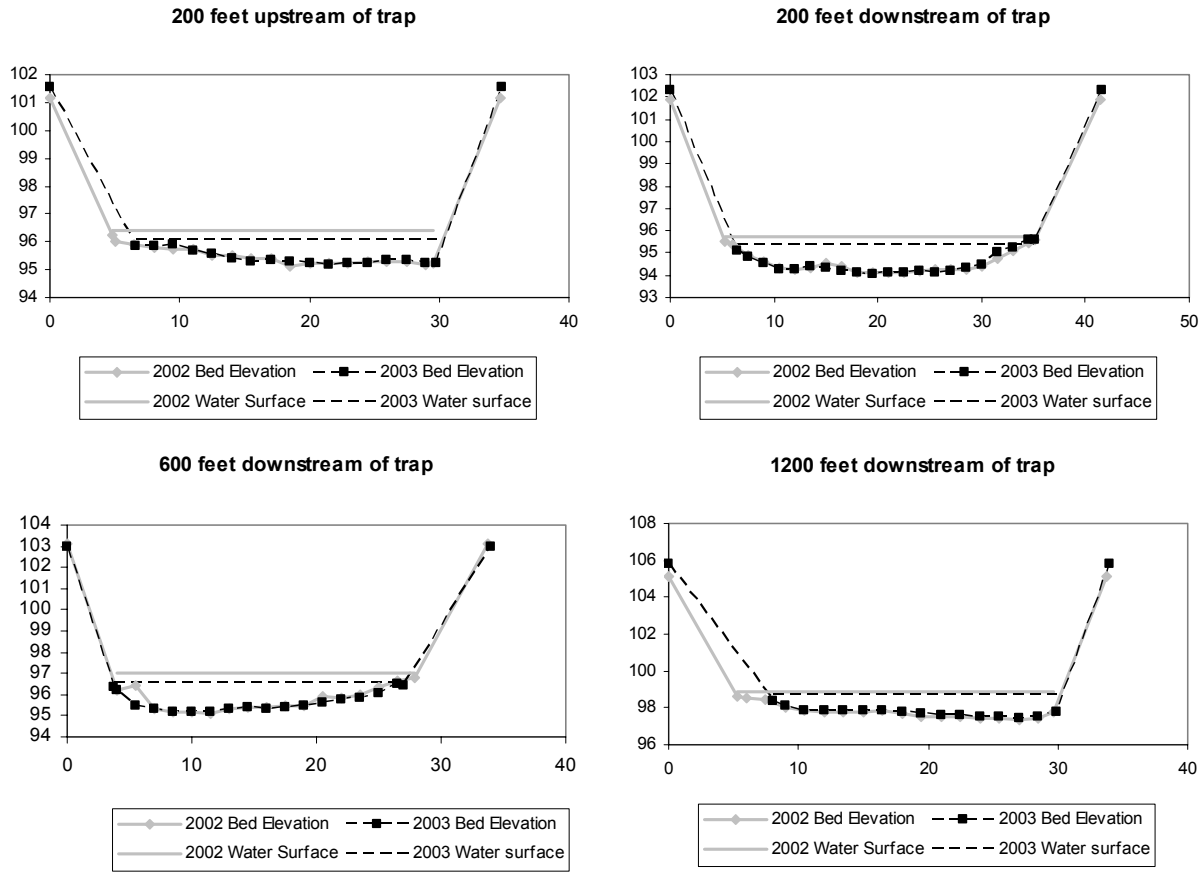

Figure 2.–Selected channel profiles from 2002 and 2003 surveys at four transects associated with the sediment trap installed on the East Branch Au Sable River in 2002. Horizontal lines indicate water surface elevation for each year that surveys were made. Values for transect locations upstream and downstream of the trap are approximate.

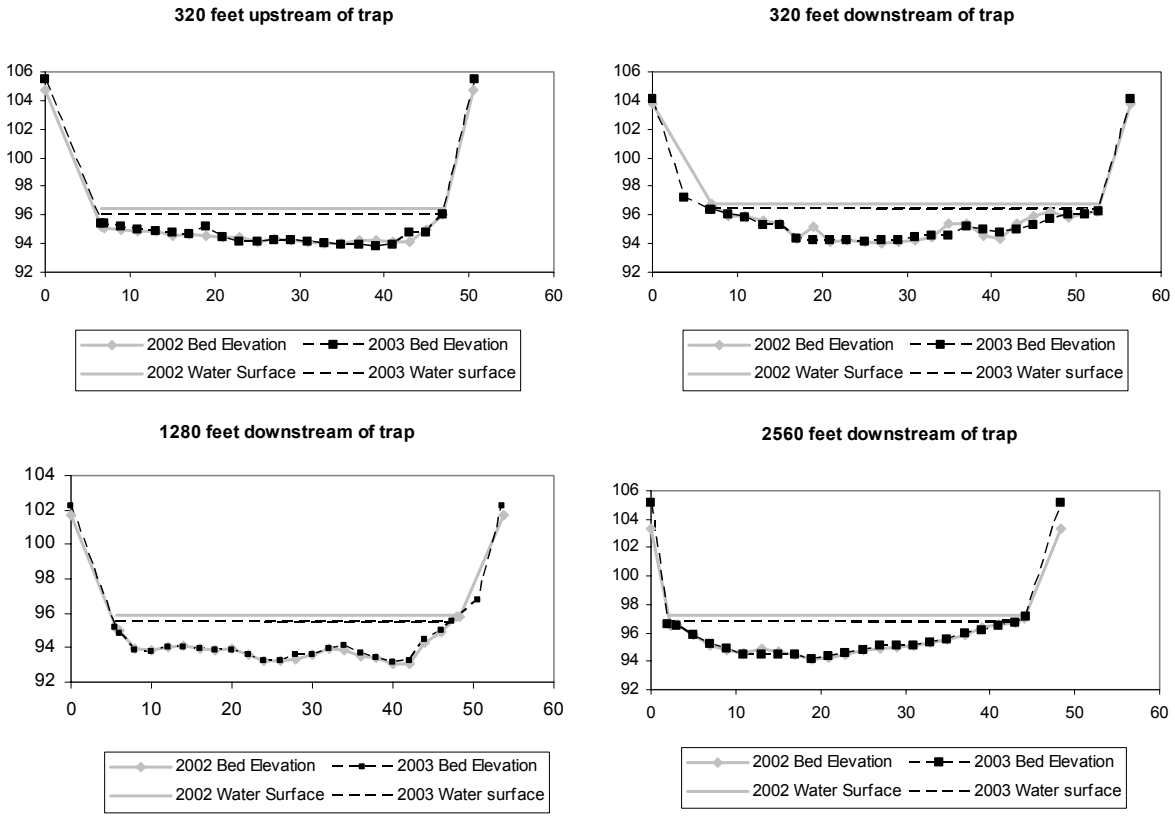

Figure 3.–Selected channel profiles from 2002 and 2003 surveys at four transects associated with the sediment trap installed on the Little Manistee River in 2001. Horizontal lines indicate water surface elevation for each year that surveys were made. Values for transect locations upstream and downstream of the trap are approximate.