STUDY PERFORMANCE REPORT

State: Michigan

Project No.: F-80-R-3

Study No.: 702

Title: Effects of sediment traps on Michigan river channels

Period Covered: October 1, 2001 to September 30, 2002

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 four river reaches for field surveys in summer 2002. Two reaches (Au Sable and East Branch Au Sable rivers) were surveyed prior to installation of sand traps, and one reach (Little Manistee River) was surveyed about one year after sand trap installation. I developed and implemented a sampling design for monitoring bed elevations and substrate characteristics through time. Permanent transects were established in the three aforementioned reaches, and previously existing transects were re-surveyed in the Manistee River. Run habitat and sand substrates predominated in surveyed reaches of the Au Sable, East Branch Au Sable, and Little Manistee rivers.

Findings: Jobs 1, 2, 3, and 4 were scheduled for 2001-02, and progress is reported below.

Job 1. Title: Identify study rivers and develop sampling design.–Rivers scheduled for new installation of sand traps were given highest priority for inclusion in this study, followed by rivers where sand traps were recently installed. Transects were established to evaluate two new sand traps that were installed in 2002. These traps were located on the Au Sable River in the reach formerly occupied by Salling Pond, and in the East Branch Au Sable River downstream of Wilcox Bridge Road. New transects were also established in the Little Manistee River at the Wagley sand trap site downstream of Bass Lake Road. The Wagley trap was installed in 2001. All three reaches have groundwater-dominated hydrology, flow through glacial-fluvial channels, low to very low channel gradients, and very similar river valley segment attributes (Seelbach et al. 1997). We also re-surveyed transects established when sand traps were dug on the Manistee River, upstream of the city of Grayling, in the early 1990s. Several rivers scheduled to have sand traps installed in 2003 were also identified.

Sampling methodology was developed through consultation with Dr. Peter Whiting, a fluvial geomorphologist at Case Western Reserve University. The following are highlights of field sampling methods developed for this study.

1. Sampling frequency: For some representative traps, attempt to re-survey the site at least quarterly for two years after the trap is initially installed to characterize seasonal changes in bed topography (sediment accumulation and flushing) and to document initial responses of the channel to the sand trap. Visit sites during June and October if only 2 visits per year are possible. Less frequent visits (every 3-4 years) can be made if little change in channel morphology occurs within the first two years.

2. Spatial mapping of substrate: Make spatial maps of substrate using GPS to delineate boundaries. Substrate types would include areas of pure sand, pure gravel, mixed sand and gravel, etc.
3. Surveys of streambed elevations (relative to benchmarks) at permanent transects: Establish elevation benchmarks and transects upstream and downstream of the trap. Transects nearest the trap should be established far enough away that they will not be directly affected by digging activity. Space between transects is scaled relative to stream widths, i.e. transects are roughly spaced 1, 2, 4, 8, 16, 32, 64, and 128 stream widths upstream or downstream of the sand trap boundary. Record major habitat type (i.e. riffle, run, pool) for each transect. Try to have transects at each major habitat type, and add transects if necessary (or feasible) to accomplish this. Upstream transects will serve as "controls" for the sand trap treatment. Obtain GPS coordinates and note locations for all elevation benchmarks and transect headpins. Record channel width for each transect, and depth and substrate at about 20 equally-spaced points along the transect line. Add more points where bed elevation starts to change abruptly. This occurred at all sites surveyed in 2002.
4. Additional non-surveyed transects: Set up additional transects 1 and 2 m above and below each of the above transects to obtain additional observations on depth and substrate. Use a similar number of points per transect. This will result in at least 900 substrate observations below a sand trap. This occurred at all sites surveyed in 2002.

Job 2. Title: <u>Survey bed elevations and substrate conditions.</u>–Bed elevations were surveyed and substrate conditions recorded at newly-established transects in the Au Sable, East Branch Au Sable, and Little Manistee rivers. Transects were also re-surveyed for two traps installed on the Upper Manistee River in the early 1990's. Scheduling constraints prevented fall surveys on any rivers in 2002. Lineal mapping of substrate conditions occurred on the Little Manistee and Au Sable rivers (Figure1), and is scheduled to occur on the East Branch Au Sable River in fall 2002.

Job 3. Title: <u>Analyze data.</u>–Run habitat predominated for study reaches of the three newly-surveyed rivers. Run, riffle, and pool habitat comprised 82, 9, and 9 % respectively of the Little Manistee River study transects, and 89, 4, and 7 % respectively of the East Branch Au Sable River study transects. Transect-based data on meso-habitat were not collected for the Au Sable River transects, but it was estimated to have had 75-90% run habitat also (Zorn, personal observation).

All reaches had predominantly sand or finer substrates above and below each trap site (Table 1, Figure 1). More than 90% of the Au Sable River reach and more than 70% of the East Branch Au Sable reach consisted of sand and finer substrates. On the Little Manistee River, where a trap has been operating for over a year and excavated five times, values for percent sand and finer substrates were 63% upstream of the trap and 73% downstream of the trap. However, one local resident (Dave McIntyre) said that large areas of newly exposed gravel have appeared since excavation of the sand trap has occurred. Locations of benchmarks and transect pins were noted and their GPS coordinates recorded for future reference (Figures 1 to 3).

Reconnaissance quality, lineal maps of predominant substrate conditions were produced by using a GPS and canoeing several miles of Au Sable and Little Manistee river reaches that may potentially be affected by each sand trap. These maps indicated that fine substrates were most common throughout each reach that was sampled by canoe.

Transects previously established by consultants (Marty Boote, Limnotech) at two sand traps installed in the early 1990's on the upper Manistee River were also re-surveyed. Comparison between 1993 and 2002 transect data for the first trap (trap T04) suggested that substantial lateral channel movement may have occurred, but these data seemed too sketchy for drawing conclusions. Bed elevation data collected in 1998 at the other sand trap (T05) was better suited for comparison with data collected 2002. This trap was located adjacent to the Upper Manistee River State Forest Campground (T27N R4W Sec. 7) and was initially installed in October 1995. Transects were established 200 feet upstream and 200, 600, and 1800 feet downstream of the trap. Transects were initially surveyed in 1995, but lack of benchmark reference information precluded comparisons between these data and 1998 and 2002 data. Comparisons between the 1998 and 2002 survey data are complicated by inadequate information (particularly for 1998 surveys) as to the identity and elevation relationships between benchmarks used. The same benchmarks appeared to be used at transects 200 and 600 feet downstream of the sand trap, while different benchmarks appeared to be used at the 200 feet upstream and 1800 feet downstream transects (Figure 4). Nevertheless, there appear to be some patterns. The transect upstream of the sand trap seems to show relatively little change between time periods, though slight lateral movement of the channel may have occurred. Some downcutting and lateral channel movement appears to have occurred since 1998 at the transect 200 feet below the sand trap, while aggradation of the channel seems apparent transect 600 feet downstream. There appear to have been some channel adjustments at the transect 1800 feet downstream of the sand trap, but differences in benchmarks used (and possibly survey methods used in emergent wetland reaches) preclude meaningful comparisons between years. Four hundred and twenty point observations of substrate composition around these four transects characterized them as 28% silt/detritus and 72% sand in 2002. No historic substrate composition data were available for comparison.

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

Literature Cited:

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 Division, Research Report 2036, Ann Arbor.

Prepared by: Troy G. Zorn
Date: September 30, 2002

Table 1.–Summary of depth and substrate data for reaches of the Au Sable and East Branch Au Sable rivers prior to sediment trap construction and for the Little Manistee River approximately one year after sediment trap co struction. Substrate categories (and dimensions in mm) were silt (0.004-0.063), sand (0.063-2), gravel (2-64), small cobble (64-128), and large cobble (128-256).

			Percent substrate composition					
River	Up- or downstream of trap	Mean depth (ft)	Silt or detritus	Sand	Gravel	Small cobble	Wood	n
Ausable	u	1.05	43.1	53.2	0.6		3.1	515
Ausable	d	0.90	37.5	55.0	3.4		4.1	1032
East Branch AuSable	u	1.10	21.0	52.5	23.1		3.4	381
East Branch AuSable	d	1.21	26.2	44.9	28.1	0.1	0.7	684
Little Manistee	u	1.66	11.8	50.7	36.5		1.0	493
Little Manistee	d	1.74	20.8	52.2	24.1	1.4	1.4	1037

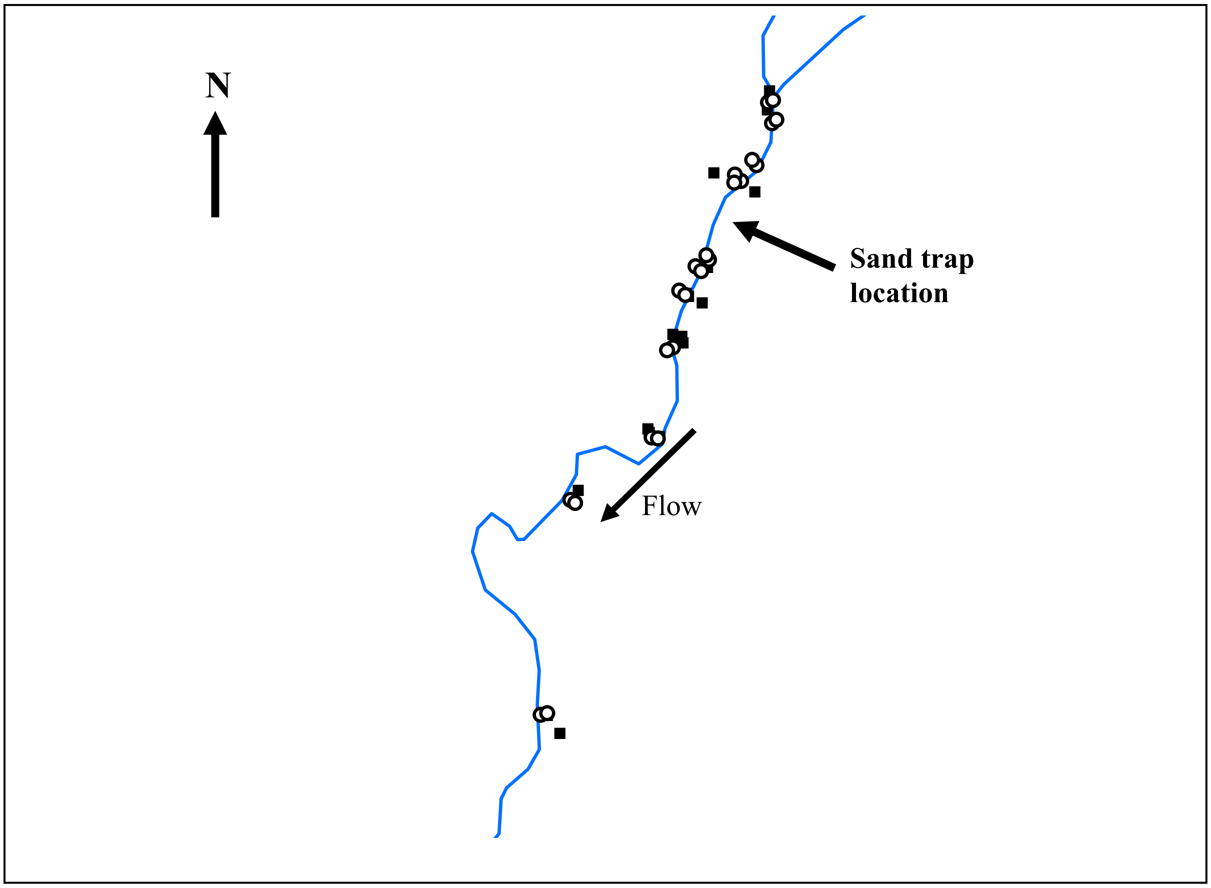

Figure 1.–Map of the East Branch Au Sable River showing transect (open circles) and benchmark (black squares) locations.

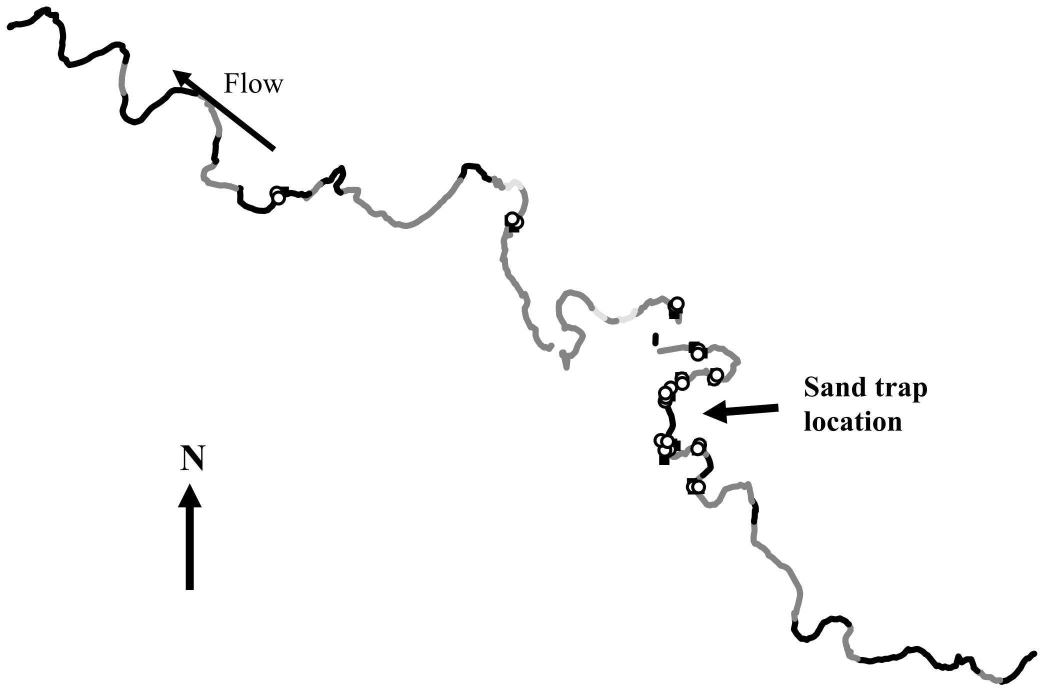

Figure 2.–Map of substrate in Little Manistee River showing transect (open circles) and benchmark (black squares) locations. Shading of map corresponds to predominant substrate conditions as follows: black = sand or finer substrates; dark gray = more sand than gravel; light gray = more gravel than sand.

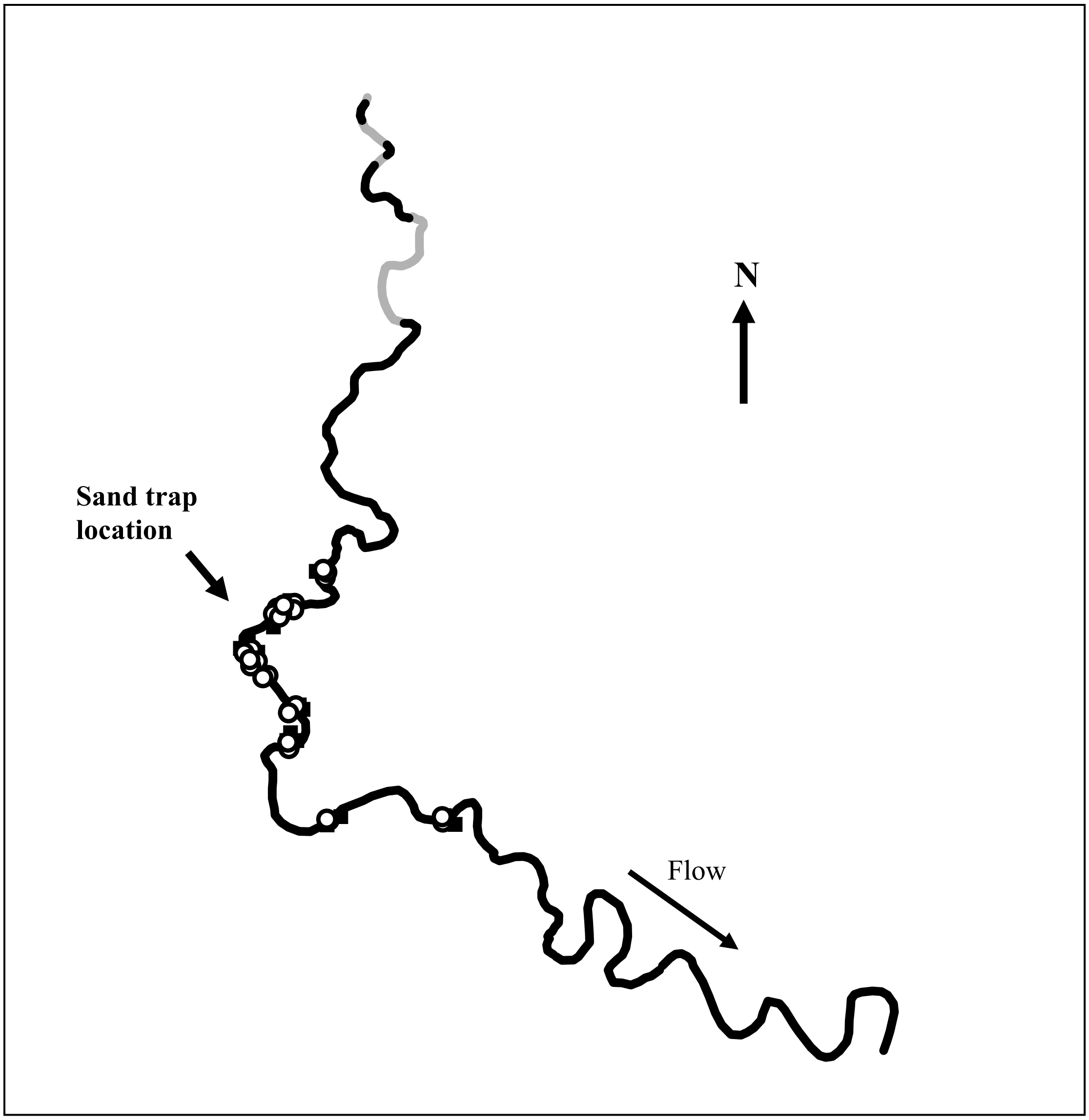

Figure 3.–Map of the Au Sable River showing transect headpins (open circles) and benchmark (black squares) locations. Shading of map corresponds to predominant substrate conditions as follows: black = sand; gray = gravel.

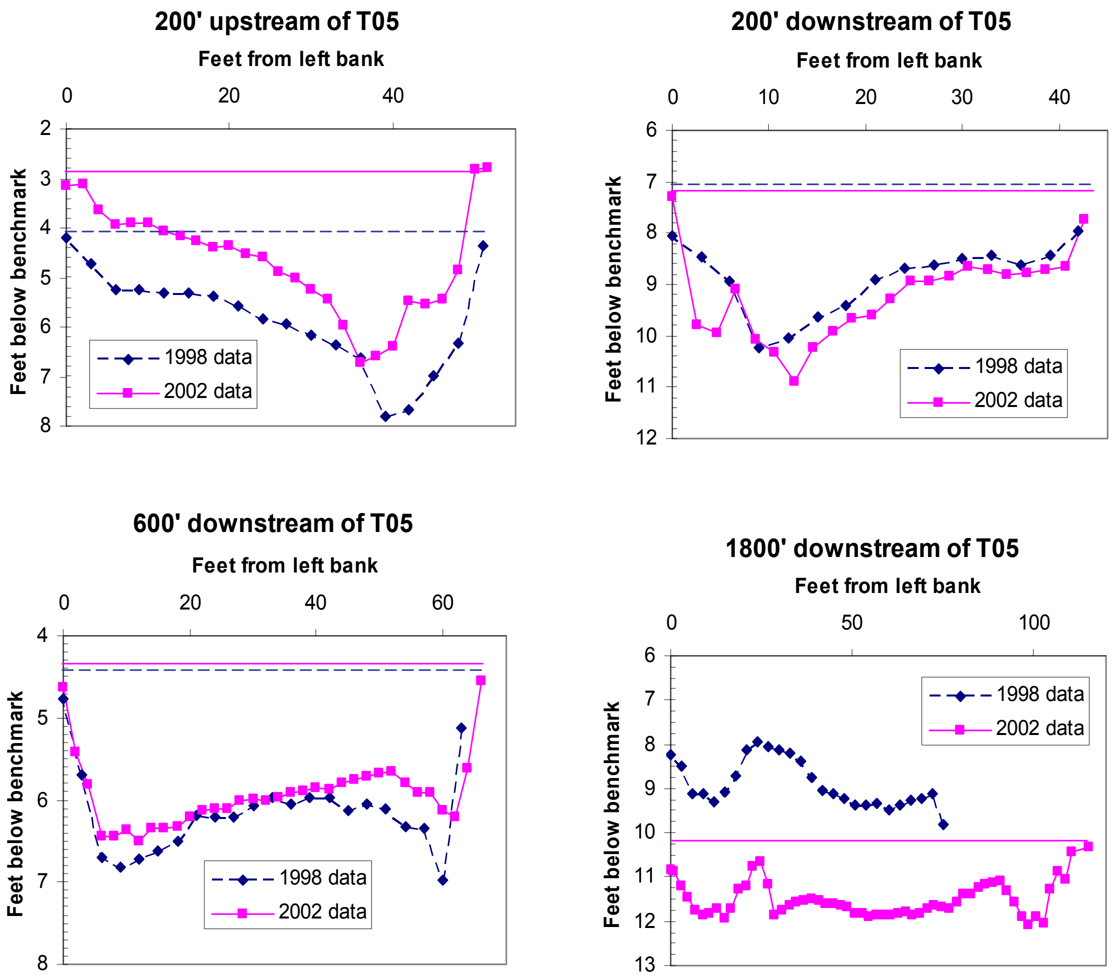

Figure 4.–Bed elevation profiles from 1998 and 2002 surveys at four transects associated with sand trap T05 installed on the Manistee River at the Upper Manistee River State Forest Campground in 1995. Horizontal lines indicate water surface elevation for each year that surveys were conducted. Water surface elevation data were unavailable in 1998 for the transect 1800 ft downstream of T05.