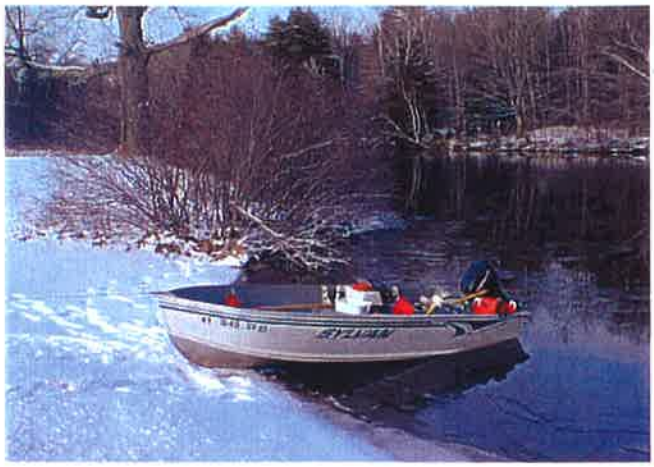
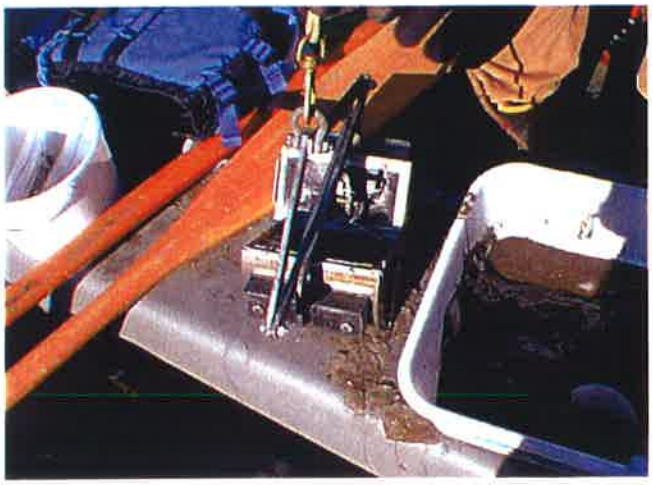
FINAL REPORT OF A SUBSTRATE SURVEY OF THE MALLISON, LITTLE FALLS, AND SACCARAPPA IMPOUNDMENTS, PRESUMPSCOT RIVER, MAINE

FEBRUARY 2001





PREPARED FOR:

AMERICAN RIVERS, INC. AND
THE FRIENDS OF THE PRESUMPSCOT RIVER

BY:

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1.0 INTRODUCTION

This report presents the complete results of a substrate survey conducted in three impoundments of the Presumpscot River for two not-for-profit organizations, American Rivers, Inc. and the Friends of the Presumpscot River, by Northern Ecological Associates, Inc. (NEA) of Portland, Maine. The objective of the survey was to characterize substrate type in each impoundment using a combination of photographs, field observations, and laboratory analysis of grain size composition (*i.e.*, percent silt, clay, sand, gravel, pebble, and cobble). The Presumpscot is a 25 mile-long river that flows through a series of impoundments formed by nine dams from its source in Sebago Lake to Casco Bay, in Cumberland County, Maine. Substrate samples were collected along five transects in the Mallison and Little Falls impoundments and four transects in the upper portion of the Saccarappa impoundment in late December 2000 (Figure 1). Additional sampling will be conducted along three transects in the lower Saccarappa impoundment in the spring of 2001, when ice leaves the lower impoundment. This report summarizes the final survey results for the Mallison and Little Falls impoundments and the upper portion of the Saccarappa impoundment. This final report supplements and supercedes a report submitted to the Federal Energy Regulatory Commission on February 2, 2001, in which only preliminary results were available for the Saccarappa impoundment.

Sampling was designed to expand and improve upon the results of a June, 1997, Ichthyological Associates, Inc. and Duke Engineering and Services [IA/DES] survey of fishery resources in the Presumpscot River that included qualitative observations of substrate type. The results of this survey were presented in a report completed for the S.D. Warren Company the following year (IA/DES 1998) and were submitted by S.D. Warren as part of its license applications to the Federal Energy Regulatory Commission. The 1997 survey included a characterization of small-mouth bass spawning habitat at various locations along the river, but was not designed or intended to be a substrate survey. Substrate types along the banks of the river in areas less than 10 feet deep were described along a series of transects in five impoundments. Substrate was classified as predominantly mud, sand, gravel, cobble, boulder, or bedrock and was determined visually in shallow water and by probing the bottom with a wooden pole. In the absence of any quantitative analysis of sediment size composition, and the fact that observations were limited to the banks of the river and did not include deeper water in the center of the river, this survey was not adequate for describing riverbed substrate in the Presumpscot River.

Section 2 of this report describes the methods used to collect and analyze the samples collected during this survey. Results are summarized in Section 3 and conclusions in Section 4. There are also three appendices. The first one includes the field notes, the second a complete, annotated photo documentation of each sample, and the third summarizes NEA's qualifications and experience.

2.0 METHODS

2.1 SITE DESCRIPTION

The three impoundments identified for this survey were the Saccarappa, Mallison, and Little Falls impoundments (Figure 1). The lower of these, the Saccarappa impoundment, is 5 miles long. It begins at the Saccarappa Dam in Westbrook, Maine, and ends approximately 750 ft below the Mallison Dam in South Windham, Maine. Proceeding up-river, the next impoundment that was surveyed is the Mallison impoundment, which is formed by the Mallison Dam and extends upstream to the Little Falls Dam. This impoundment is very short, measuring only half a mile in length. The third impoundment is 1.7 miles long and is located upstream of Little Falls Dam, between this dam and the Gambo Dam.

2.2 SURVEY DESIGN AND METHODOLOGY

Substrate samples were collected for this study at discrete locations along four transects in the Saccarappa impoundment, two transects in the Mallison impoundment, and three transects in the Little Falls impoundment in late December 2000 (Figure 1). Three more transects in the lower part of the Saccarappa impoundment could not be surveyed due to ice formation, but will be surveyed in the spring of 2001. Transects were located at more or less equal distances in each impoundment in order to obtain a representative characterization of substrate in each impoundment. Transects were located based on the following rationale: for Mallison and Little Falls, all five transects were located at sites that were surveyed by in 1997, although the NEA sampling along these transects extended across the full width of the river. Due to the greater length of the Saccarappa impoundment, additional transect sites were chosen in that impoundment to provide results that would be representative of the entire impoundment. Along each of the chosen transects, 5 discrete samples were collected, spaced at equal distances from one bank of the river to the other, starting with sample A on the left bank (looking upstream) and proceeding across the river to sample E on the right bank.

Sampling was conducted from a 15-foot aluminum boat using a 6 x 6 inch Wildco Ponar grab sampler (see photo on cover). The grab sampler was lowered over the side of the boat once the boat was in the correct position. The sampler is held open by a spring-released pin that falls out of a hole when the sampler contacts the bottom and allows the two jaws of the sampler to close as it is hauled back to the surface. It is designed to penetrate the bottom to a maximum depth of 2.75 inches, but the actual sampling depth achieved during this survey was limited in most cases to 1 – 2 inches. If a sample could not be collected the first time, repeated attempts were made until enough material was collected to allow an adequate characterization of sediment composition. This was not possible in all cases because of bedrock outcrops or the presence of large stones that could not easily be picked up in the sampler. Samples were rejected when material such as a stone or twig stuck in the jaws of the sampler and caused finer sediments to wash out of the sample. At a few stations, replicate samples were collected using a larger, heavier Ponar sampler that penetrated approximately two inches deeper into the sediment than the smaller one. Visual inspection of samples collected with the two samplers failed to reveal any significant differences between the two, so the smaller Ponar was used.

Geo-referenced locations of each transect were recorded using a portable GPS unit, and a digital photograph was recorded for each sample after it was emptied into a white plastic basin. Sediment was scooped into a plastic zip-lock bag and samples were labeled with the transect name, number, and the letters A-E, starting at the left bank (looking upstream) and proceeding across the river to the right bank. Depth was measured at each sampling location by counting the number of colored plastic ties attached at 1-ft intervals to the line that was attached to the Ponar, once it was on the bottom (Table 1). Field observations were recorded in a field notebook.

Sampling was conducted in the Saccarappa impoundment on December 21, in the Mallison impoundment in December 28, and in the Little Falls impoundment on December 29, 2000. As previously noted, ice formation in the lower part of the Saccarappa impoundment in late December prevented the sampling of three transects in the lower part of that impoundment.

2.3 SAMPLE ANALYSIS

Samples were sent to the University of New Hampshire's (UNH) Natural Resources Department's Soil Science Laboratory for initial processing. Samples were partitioned into two size components, less than (<) and greater than (>) 2 millimeters (mm) particle size. The finer material was processed at UNH and the coarser material was returned to NEA for processing.

Percent sample composition was determined for the < 2 mm and > 2 mm fractions of each sample once it was dried by passing sample material through a series of sieves with the appropriate mesh sizes and then weighing each fraction. Composition of the < 2 mm fraction was expressed as a percentage of the total weight of a 25 gram sub-sample. Sediment composition was determined for silt, clay, fine and very fine sand, medium sand, coarse sand, and very coarse sand. For this report, silt and clay have been combined into a single category, as have the four size categories of sand. For the > 2 mm particle size fraction, percent composition by weight was determined for fine and medium gravel, coarse gravel, small pebbles, large pebbles, and small cobble according to the size ranges given in Table 2. In some cases, there was insufficient coarse material to process or the > 2 mm size fraction was composed of organic matter.

In addition to a quantitative analysis of each sample, field observations were recorded and digital photos were taken of each sample. All field notes have been copied verbatim in Appendix A. Descriptions of each sample, including depth, are included with each photo in Appendix B.

3.0 RESULTS

The following results are based on a complete series of transects and samples from the Mallison and Little Falls impoundments and a partial series of transects in the Saccarappa impoundment. These results also include field observations made during sampling trips to each impoundment and digital photos of each sample.

3.1 SACCARAPPA IMPOUNDMENT

Five samples were collected on December 21, 2000, at each of four transects in the middle and upper end of this impoundment (Figure 1). One transect (SA4) was located in the middle of the impoundment, just north of Rousseau Road and south of where power lines cross the river; a second (SA5) was located approximately 0.6 miles south of the confluence of Little River; a third (SA6) just upstream of the mouth of the Little River; and, a fourth (SA7) 1,000 feet downstream of the lower end of the raceway below the Mallison Dam. The extreme upstream transect was in the same location as the IA/DES transect SAUS2.

Fine sediments (silt, clay, and sand) composed a much higher proportion of the samples collected in this impoundment than in the Mallison or Little Falls impoundments. This was especially true of the lower two transects (SA4 and SA5) where fine sediments made up more than 97% of total sample weight in 9 of the 10 samples (Table 3). Only 3 of the 10 samples from the upper two transects (SA6 and SA7) contained >97% fine sediment. Silt and clay accounted for a significant proportion of all five SA4 samples and the A and E samples at SA5, but fine sediments at the upper two transects were mostly sand. Gravel was found at the B and C sample locations of transect SA6, at SA7B, C, and D, and at one downstream site (SA5A). Small pebbles made up a significant proportion of sample SA7D. There were no large pebbles or cobbles in any of the samples collected in this impoundment.

The banks in the upper portion of this impoundment were reported in 1997 to be composed primarily of fine sediment, grading to sand, gravel, and cobble/boulder toward the center of the river. Results of the December 2000 survey revealed a significant amount of fine sediment in the upper portion of the Saccarappa impoundment, both on the banks and in the center of the river, but it was mostly sand, not silt or clay. Cobble and boulder were not found at transects SA6 or 7, but gravel was common and there were some small pebbles at the uppermost transect. Cobble and boulder were reported just below the dam in 1997, approximately 800 ft upstream from transect SA7. The NEA survey indicates that finer sediment (silt, clay, and sand) is more common in the center and the banks of the river in the middle portion of this impoundment, between Rousseau Road and Little River. Observations made in 1997 indicate that cobble, gravel, and bedrock with occasional boulders are also present at certain locations in the middle and lower portions of the Saccarappa impoundment.

3.2 MALLISON IMPOUNDMENT

Samples were collected along two transects in this impoundment on December 28, 2000. One transect (MADS2) was located approximately 800 feet upstream of a road that crosses the river just above the Mallison Dam and the other (MAUS2) just below the Little Falls Dam. Both of

these transects were surveyed by IA/DES in June 1997. Five samples were collected on the lower transect, but only two on the upper transect because there was so much current in the center and right side of the river that the Ponar could not be operated properly. The two MAUS2 samples were both taken from the left side of the river in only 1 ft of water.

Sand and/or rocky substrate predominated at all sample locations along transect MADS2 (Table 4). Even though very little coarse material (> 2 mm) was collected in samples A and B, 3-inch diameter stones were common at station B (see photo and field notes, Appendices A and B). Stones 2 – 4 inches in diameter were also present in the center of the river: sample C was a mixture of sand and large pebbles. Sample D was composed almost entirely of pebbles and small cobble. The largest rock collected at this location measured 2 x 8 inches. Gravel and pebbles made up most of sample E on the right bank. Sand and gravel, mixed with a lot of organic matter, were common on the left bank of transect MAUS2.

The IA/DES conclusion that sediments on the banks of this impoundment were "primarily clay mixed with varying amounts of sand, gravel, and cobble" was not verified by the NEA survey. Silt and clay were present on the left side of the river, but the predominant fine sediment was sand. Pebbles, cobbles, coarse gravel, and sand were the primary substrate types in the center and right side of the river at transect MADS2. Furthermore, the IA/DES survey inaccurately describes the right bank at this transect as "clay/silt grading to boulder/cobble." Sample MADS2-D was composed entirely of cobbles and pebbles and there was very little fine material on the right bank.

3.3 LITTLE FALLS IMPOUNDMENT

Sampling in this impoundment took place on December 29, 2000. Fourteen samples were collected along three transects. These were LFDS2, located approximately 0.3 miles above the Route 202 bridge in South Windham; LFUS1, located approximately half way between the two dams; and LFUS3, located approximately 0.4 miles downstream from Gambo Dam. All three of these transects were surveyed in 1997.

Fine sediments dominated all the samples from the lower transect (Table 5). Silt and clay made up >10% of the fine sediment in 4 of the 5 samples. A sample obtained with the large Ponar in the center of the river revealed that fine sediment formed a 1-2 inch layer over the top of sand. However, observations made in the field (Appendix A) indicated that the bottom on the right bank was "littered with fist sized cobble."

The substrate on the left side of the river at the next transect (LFUS1) was similar to the downstream transect, (*i.e.*, predominantly silt/clay and sand). However, the substrate at the center and right side of the river at this location was primarily made up of much coarser material. Small and large pebbles accounted for almost the entire C sample and were mixed with fine sediments, including silt and clay, on the right bank. No D sample was obtained because the stones were too large to fit in the Ponar grab. Some 1-3 inch stones were collected in the sampler, but fell out before they could be brought aboard the boat.

The last transect (LFUS3) was characterized by sand on the left bank (A), with very little silt and clay, and sand mixed with silt and clay on the right bank (E). Samples B, C, and D were composed almost entirely of small and large pebbles. Larger stones were collected, but not retained in the samples. Stones with an average size of 2 x 6 inches were collected and larger ones were observed (Appendix A). Rock ledge was seen on the right bank.

The December 2000 survey confirmed the predominance of fine sediment at all five stations on transect LFDS2, as reported in the IA/DES report, although sample analysis revealed that it was (by weight) primarily sand, not silt and clay. The NEA survey also confirmed the predominance of sand mixed with silt and clay on the banks at both upstream transects and the presence of pebbles, cobbles, and larger stones (boulders) in the center of the river (samples B-D) at both transects. Pebbles were also common in sample LFUS1-E, as observed in 1997.

4.0 CONCLUSIONS

The results of the December 2000 survey provide a quantitative description of riverbed substrate type in the three impoundments in the Presumpscot River. Sediment samples were collected at more or less regular intervals and at the same relative distance from shore along each transect. Sediment samples were analyzed using standard, accepted sediment composition analysis procedures, producing quantitative data that provided a consistent, accurate, and objective measure of substrate type. The information provided by this survey is therefore more useful in characterizing riverbed substrate types in the three impoundments that were surveyed than previously available information.

It is believed that substrate types in the upper and lower portions of the Little Falls impoundment were adequately represented by the nine samples collected along the two upstream transects and the five samples collected at the downstream location. It is also believed that substrate in the Mallison impoundment, which is about one-third the length of the Little Falls impoundment, can be accurately described based on the seven samples collected there. The samples collected in the upper portion of the Saccarappa impoundment are believed to accurately represent substrate types in the upper half of this impoundment, although there is apparently very coarse material (cobble and boulder) just below the Mallison Dam that was not sampled in this survey, but was observed in 1997 (IA/DES 1998).

The following conclusions are based on the results presented in this report.

- In deeper water, the substrate in the upper portion of the Little Falls impoundment and in the Mallison impoundment is composed primarily of gravel, pebble, and cobble. In places in both impoundments, rocky substrate is also common close to shore.

- Fine sediments (clay, silt, and sand), sometimes mixed with gravel and pebbles, predominate on the banks of the upper Little Falls impoundment and in the lower portion of the Little Falls impoundment.

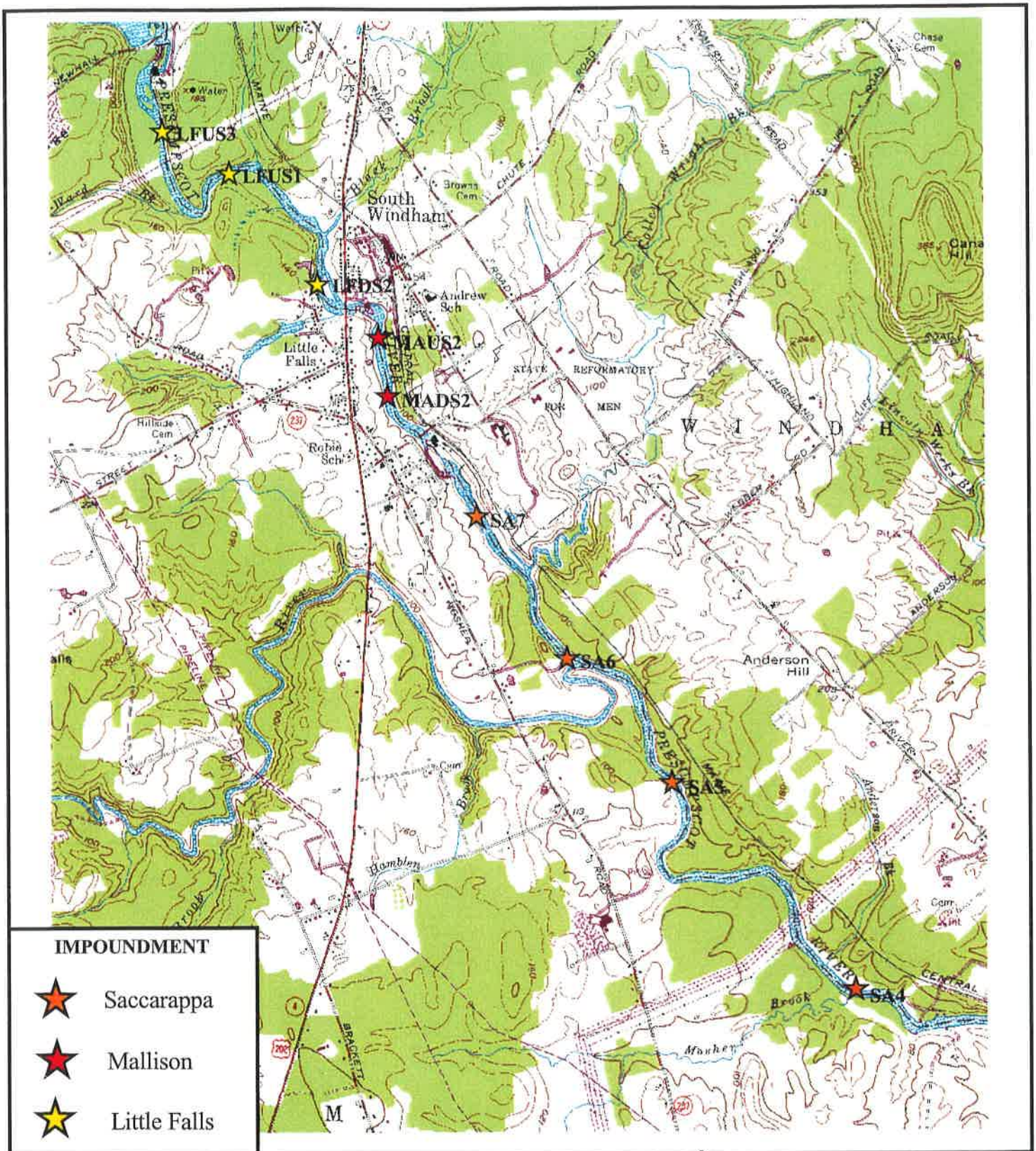
- Fine sediments are more common in the Saccarappa impoundment than in the upper two impoundments, especially in the middle of the impoundment, below the confluence of the Little River. Fine sediments in the upper portion of this impoundment were predominantly sand, with low amounts of silt and clay. Gravel and small pebbles were common above the Little River and cobble and boulder were reported in an earlier survey just below the Mallison Dam.

- In general, qualitative observations made in June 1997 of fine sediments along the banks of the Little Falls and Mallison impoundments, and in the upper portion of the Saccarappa impoundment, were confirmed by this survey. However, in some places rocky substrate – not noted in 1997 – was present. In all three impoundments, sand made up a much higher proportion, by weight, of the fine sediment near the banks than silt or clay.

- The general conclusion of the 1997 survey that "clay predominates throughout much of the impoundments" does not accurately describe the Little Falls, Mallison, or upper Saccarappa impoundments, not even in shallow water close to shore. The substrate in deeper water, in and near the center of the Little Falls and Mallison impoundments, is rocky (pebbles and small cobble) with gravel and some sand. Sand, gravel, and some small pebbles predominated in the center of the river in the upper Saccarappa impoundment.

5.0 LITERATURE CITED

Ichthyological Associates Inc. and Duke Engineering & Services. 1998. A baseline Investigation of the fisheries resources in the vicinity of the Dundee, Gambo, Little Falls, Mallison, and Saccarappa hydroelectric projects, FERC projects Nos 2942, 2931, 2941, 2932, and 2897, on the Presumpscot River, Cumberland County, Maine. 39pp +Tables and Figures.



Friends of the Presumpscot River
American Rivers, Inc.

NEA
NORTHERN ECOLOGICAL ASSOCIATES, INC

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500 0 500 Meters

Source: 7.5 minute Series Topographic Map

Figure 1. Substrate Sampling Locations December 2000

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Table 1. Depth (In Feet) At Each Sampling Location

Transect	A	B	C	D	E
SA4	4	12	17	15	5
SA5	7	8	8	11	6
SA6	8	9	9	6	4
SA7 (SAUS2)	5	6	7	6	5
MADS2	4	6	5	7	4
MAUS2	1	1			
LFDS2	3	6	6	7	6
LFUS1	3	5	10	7	12
LFUS3	3	10	14	9	5

Table 2. Classification of Substrate Types Used In This Survey

Size Category	Particle Diameter	
	(range in mm)	(range in inches)
Silt/Clay	< 0.05	
Sand	0.05 – 2	
Fine/Medium Gravel	2 – 8	
Coarse Gravel	8 – 16	5/16 – 5/8
Small Pebble	16 – 32	5/8 – 1.25
Large Pebble	32 - 64	1.25 – 2.5
Small Cobble	64 – 128	2.5 - 5

Table 3. Percent Composition (By Weight) of Riverbed Substrate in the Saccarappa Impoundment, Presumpscot River, Maine.

TRANSECT SA4	A	B	C	D	E
% total sample < 2 mm	**99.39**	**100.00**	**97.61**	**97.75**	**99.60**
% silt/clay	21.80	92.15	20.57	17.63	15.83
% sand	78.20	7.85	79.43	82.37	84.17
% total sample > 2 mm	**0.61**	**0.00**	**2.39**	**2.25**	**0.40**
% fine/medium gravel	See note "a"				
% coarse gravel					
% small pebble					
TRANSECT SA5	**A**	**B**	**C**	**D**	**E**
% total sample < 2 mm	**81.80**	**98.83**	**99.40**	**98.49**	**99.87**
% silt/clay	28.24	0.98	0.75	13.18	23.39
% sand	71.76	99.02	99.25	86.82	76.61
% total sample > 2 mm	**18.20**	**1.17**	**0.60**	**1.51**	**0.13**
% fine/medium gravel	86.91	See note "a"			
% coarse gravel	5.00				
% small pebble	8.08				
TRANSECT SA6	**A**	**B**	**C**	**D**	**E**
% total sample < 2 mm	**99.82**	**43.87**	**81.80**	**99.11**	**99.39**
% silt/clay	4.89	2.98	1.26	0.62	9.74
% sand	95.11	97.02	98.74	99.38	90.26
% total sample > 2 mm	**0.18**	**56.13**	**18.20**	**0.89**	**0.61**
% fine/medium gravel	See note "a"	93.02	96.21	See note "a"	
% coarse gravel		6.98	3.79		
% small pebble		0.00	0.00		
TRANSECT SA7(SAUS2)	**A**	**B**	**C**	**D**	**E**
% total sample < 2 mm	**96.00**	**62.21**	**87.73**	**43.09**	**92.19**
% silt/clay	11.69	6.99	1.11	2.41	9.73
% sand	88.31	93.01	98.89	97.59	90.27
% total sample > 2 mm	**4.00**	**37.79**	**12.27**	**56.91**	**7.81**
% fine/medium gravel	See note "b"	92.15	79.75	25.56	See note "b"
% coarse gravel		7.84	13.08	38.59	
% small pebble		0.00	7.17	35.84	

a = insufficient material for processing
b = organic matter

Table 4. Percent Composition (By Weight) of Riverbed Substrate in the Mallison Impoundment, Presumpscot River, Maine.

TRANSECT MADS2	A	B	C	D	E
% total sample < 2 mm	**98.71**	**96.33**	**48.25**	**0.00**	**7.57**
% silt/clay	4.45	1.85	2.07		13.35
% sand	95.55	98.15	97.93		86.65
% total sample > 2 mm	**1.29**	**3.67**	**51.75**	**100.00**	**92.43**
% fine/medium gravel	See note "a"	95.35	3.34	0.53	4.56
% coarse gravel		4.65	1.96	0.26	13.36
% small pebble		0.00	17.09	12.30	13.54
% large pebble		0.00	77.60	7.86	68.55
% small cobble		0.00	0.00	79.05	0.00
TRANSECT MAUS2	**A**	**B**	No samples collected		
% total sample < 2 mm	**64.26**	**95.83**			
% silt/clay	7.44	3.61			
% sand	92.56	96.39			
% total sample > 2 mm	**35.74**	**4.17**			
% fine/medium gravel	16.67	100.00			
% coarse gravel	83.33	0.00			
% small pebble	0.00	0.00			
% large pebble	0.00	0.00			
% small cobble	0.00	0.00			

a = insufficient material for processing

Table 5. Percent Composition (By Weight) of Riverbed Substrate in the Little Falls Impoundment, Presumpscot River, Maine.

TRANSECT LFDS2	A	B	C	D	E
% total sample < 2 mm	**99.77**	**94.95**	**96.07**	**99.12**	**97.81**
% silt/clay	16.01	13.81	10.61	5.37	23.00
% sand	83.99	86.19	89.39	94.63	77.00
% total sample >2 mm	**0.23**	**5.05**	**3.93**	**0.88**	**2.19**
% gravel	See note "a"				
% pebble					
% small cobble					
TRANSECT LFUS1	**A**	**B**	**C**	**D***	**E**
% total sample < 2 mm	**89.17**	**94.97**	**0.00**		**30.28**
% silt/clay	16.11	1.70			19.93
% sand	83.89	98.30			80.07
% total sample >2 mm	**10.83**	**5.03**	**100.00**		**69.72**
% fine/medium gravel	See note "a"	87.98	0.52		4.23
% coarse gravel		12.02	2.43		9.29
% small pebble		0.00	42.08		36.14
% large pebble		0.00	54.97		50.35
TRANSECT LFUS3	**A**	**B**	**C**	**D**	**E**
% total sample < 2 mm	**98.67**	**0.00**	**0.00**	**6.63**	**99.37**
% silt/clay	3.26			7.84	29.80
% sand	96.74			92.16	70.20
% total sample >2 mm	**1.33**	**100.00**	**100.00**	**93.37**	**0.63**
% fine/medium gravel	100.00	0.00	0.00	0.73	100.00
% coarse gravel	0.00	0.15	0.00	2.57	0.00
% small pebble	0.00	32.42	0.00	31.09	0.00
% large pebble	0.00	67.42	100.00	65.61	0.00

* Large cobbles on bottom, could not get a sample
a = insufficient material for processing