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APPENDIX A - 1999 MA DEP DWM PARKER RIVER WATERSHED QA/QC REPORT

INTRODUCTION

The following data were collected in 1999 as part of the MA DEP DWM Parker River Watershed assessment:

- *In –situ* Hydrolab® readings on two lakes (Baldpate Pond in Boxford and Rock Pond in Georgetown)
- Fish tissue toxics data on two lakes (Baldpate Pond and Rock Pond)
- Benthic macroinvertebrates and aquatic habitat assessment at a total of eight biomonitoring stations in both the mainstem Parker River and selected tributaries.

In-situ water quality measurements were reviewed independently by the DWM Hydrolab® Coordinator and Database Manager. Fish tissue monitoring data was reviewed independently by the Wall Experiment Station's (WES) Quality Assurance Program, the Division of Watershed Management's (DWM) Quality Control Officer, DWM Assessment Coordinator, and the DWM Database Manager. A programmatic QA/QC review was performed for benthic macroinvertebrate data, consistent with the 1999 benthic macroinvertebrate QAPP (now CN 7.0). In general, data that fell outside established QA/QC acceptance criteria were investigated and may have been subject to censoring.

Quality assurance and quality control (QA/QC) activities conducted before, during and after the survey included:

- production of a Quality Assurance Project Plan (QAPP) for fish contaminant monitoring (now CN 13.0)
- production of a QAPP for benthic macroinvertebrate collection (now CN 7.0)
- Implementation of field and lab quality control procedures, including that for Hydrolab® multiprobe use (now CN 4.0) and fish collection/preparation for fish tissue analysis (now CN 40.0)
- post-monitoring data review and validation.

This QA/QC Report is divided into five sections: Introduction, Field and Laboratory QA/QC Objectives, Criteria and Procedures; Data Validation, Analytical Methods and Method Detection Limits (MDL), and Conclusions.

A.1 FIELD AND LABORATORY QA/QC OBJECTIVES, CRITERIA AND PROCEDURES

Data collected by DWM in 1999 in the Parker River Watershed were reviewed for conformance to field and laboratory data quality objectives. Section A.1.1 outlines the Hydrolab® QA/QC procedures. Section A.1.2 provides fish tissue laboratory quality control data. Section A.1.3 briefly discusses quality control for the benthic macroinvertebrate monitoring.

A.1.1 *In-situ* Water Quality Data

Trained DWM staff members conducted *in-situ* measurements using a Hydrolab® Series 3 Multiprobe instrument that simultaneously measures dissolved oxygen, temperature, pH, conductivity, and depth, and provides calculated estimates for total dissolved solids and % saturation of oxygen.

To ensure the quality of the *in-situ* data, the following QA/QC steps were taken.

- Pre-Survey Calibration and Check: Standard pre-survey calibration of the Hydrolab® unit was conducted in accordance with the DWM Standard Operating Procedure (SOP) for Hydrolab® use. After the instrument was calibrated and before the instrument was released to field staff, an instrument check using both a low ionic standard and filtered de-ionized water was performed. The purpose of this check is to make sure that the instrument is providing stable readings as the waters in Massachusetts are typically of low ionic strength. If the instrument failed acceptance criteria, it was not released to field staff until the source of error was identified and corrected.

- Post-Survey Check: A standard post survey check of the Hydrolab® unit was performed in accordance with the DWM SOP for Hydrolab® use. Upon return of the Hydrolab® unit to DWM's lab after a survey run, a visual inspection was performed to identify any physical damage that may have occurred in the field. The calibration of the unit was then checked against both a low ionic standard and filtered de-ionized water. The results of the post survey calibration check were compared to the pre-calibration results. If visual damage was observed and/or post calibration acceptance criteria were not achieved, the source of error was investigated and data collected in the field may have been subject to qualification or censoring.

- Data Reduction: The Hydrolab® Coordinator and Database Manager reviewed the Hydrolab® data for instability, instrument malfunction, operator technique and aberrant trends. If any of these conditions were detected, the data were investigated and may have been recommended for censoring. The Database Manager electronically tagged all data recommended for censoring in the database.

A.1.2 Fish Tissue Data

Fish were collected and processed according to the DWM 1999 SOP for fish contaminant monitoring (now CN 40.0). This SOP adheres to EPA-approved laboratory QA/QC methodologies (EPA 823-R-95-007). Laboratory data quality was assessed at WES by analyzing the following quality control samples:

1) Laboratory Reagent Blank/Method Blank (LRB) – Clean clam tissue matrix extracted with every sample set to ensure that the system is free of target analytes (< MDL) and to assess the potential for blank contamination.

2) Laboratory Fortified Blank (LFB) – Clean clam tissue matrix spiked with a low concentration of target compounds. LFB results are used to establish *accuracy* of system's performance. The acceptable laboratory % recovery range is typically 80 – 120%.

3) Laboratory Fortified Matrix (LFM) – Tissue matrix spiked with a low concentration of a target compound. LFM and LFM duplicate results are used to establish *accuracy* of the extraction and analytical process. The acceptable laboratory % recovery range is typically between 70 – 130% for metal analysis and 60 –140% for PCB/Organochlorine Pesticide analysis.

4) Quality Control Standard (QCS) – A pre-spiked secondary tissue sample. QCS results are used to establish *accuracy* in the extraction and test methods. The acceptable laboratory % recovery range is typically between 80–120%.

5) Laboratory sample duplicates --- A second lab sample is taken the blended fish tissue slurry for analysis of all analytes. Used to estimate analytical precision, the acceptable laboratory relative percent difference (RPD) for lab duplicates is typically 80-120%.

The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. WES laboratory releases tissue data when their established QA/QC criteria are met. Refer to WES's Quality Assurance Plan (MA DEP 1995) for specific laboratory analytical QA/QC criteria and acceptance limits.

A.1.3 Benthic Macroinvertebrate Data

Macroinvertebrate sampling and processing was conducted by DWM biologists, as described in the SOP *Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates* (now 39.0), which is based on EPA Rapid Bioassessment Protocols (RBP III). The QAPP for 1999 biomonitoring outlined general QC steps that included:

1) thorough rinsing of sampling equipment between stations to prevent inter-station effects,

2) duplication and checking (for transcription errors) of documentation and database entries, and
3) in-house spot-checking (among two DWM biologists) of taxa identifications for accuracy.

A.2 DATA VALIDATION

Data validation procedures, as outlined in DWM's draft Data Validation SOP (draft, 2001; CN 56.0) were applied to Hydrolab® and fish tissue data. The annual Data Validation Report summarizing 1999 DWM monitoring QA/QC results is also available as a separate evaluation of 1999 data as a whole (for the "yellow" basins: Merrimack, Boston Harbor, Cape Cod, Narragansett/Mt. Hope Bay, French/Quinebaug and Parker).

Assessment and validation of the benthic macroinvertebrate and habitat data collected for the Parker watershed is not covered here. DWM QA/QC assessment of benthic/habitat data is typically more general in nature (ie. adherence to the SOP and QAPP, discussions with primary staff on QAPP implementation, etc.).

A.2.1 *In-situ* Hydrolab® Data

Hydrolab® depth profiles at Rock Pond and Baldpate Pond were evaluated for the following:

consistency with the Hydrolab® SOP (specifically, the requirement for five, sequential readings one-minute-apart at appropriate depths, proper field use, etc.),

- accuracy and precision of readings, as assessed through review of pre-survey calibration/check and post-survey check data, as well as field notes for any information on faulty operation and/or unusual field conditions, and
- representativeness of data (review of fieldsheets and notes for any information that might indicate non-representativeness; eg., not taken at the deep hole).

Conclusion(s):

Hydrolab® profiles taken in May 1999 at Rock Pond and Baldpate Pond accurately captured representative water quality conditions at the time of sampling. Data for dissolved oxygen, conductivity, pH, temperature, total dissolved solids and percent oxygen saturation were accepted without qualification. No data were censored.

A.2.2 Fish Tissue Data

Tables A.2-1 through A.2-5 provide specific QA/QC data for laboratory fish tissue analysis. Since there were no field duplicates (additional three fish composite of one species) taken, estimates of overall precision (as RPD) were not possible; precision data provided here is based on lab duplicates. Although DWM now typically collects two same-species, three-fish composites from the same waterbody at a rate of 10% of waterbodies sampled (as a field "duplicate"), this was not performed in 1999 for the Parker watershed. While this information would have been helpful in assessing in-lake/in-river variability in tissue concentrations for same-specie fish, lack of field duplicates does not render the 1999 Parker fish tissue data unusable.

Sample holding times prior to analysis and extract holding times prior to GC injection were met for all samples.

Table A.2-1. 1999 MA DEP DWM Parker River Watershed laboratory QA/QC blank data for organics in fish tissue. (Data expressed in µg/g wet weight unless otherwise noted.)

DATE ANALYZED	LABORATORY SAMPLE NUMBER	ANALYTE		
		% Lipid	Pesticides	PCBs
2 December 1999	BLANK - 1	0.07	ND	ND
3 December 1999	BLANK - 2	0.09	ND	ND
7 December 1999	BLANK - 3	0.09	ND	ND
8 December 1999	BLANK - 4	0.08	ND	ND
9 December 1999	BLANK - 5	0.07	ND	ND
10 December 1999	BLANK - 6	0.09	ND	ND
14 December 1999	BLANK - 7	0.07	ND	ND
15 December 1999	BLANK - 8	0.15	ND	ND
16 December 1999	BLANK - 9	0.16	ND	ND
17 December 1999	BLANK - 10	0.10	ND	ND
21 December 1999	BLANK - 11	0.12	ND	ND
22 December 1999	BLANK - 12	0.09	ND	ND

ND - Not detected or the analytical result is at or below the established method detection limit (listed in section A.3).

Table A.2-2. 1999 MA DEP DWM Parker River Watershed laboratory QA/QC duplicate data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g wet weight unless otherwise noted.)

DATE ANALYZED	LABORATORY SAMPLE NUMBER	ANALYTE		
		Pesticides*	PCBs*	% Lipid
3 December 1999	L990067-7	DDE 0.012 DDT 0.012	BZ# 118 0.0030	0.22
	L990067-7 duplicate	DDE 0.012 DDT 0.014	BZ# 118 0.0027	0.19
	relative percent difference	DDE 0% DDT 15.4%	BZ# 118 10.53%	15%
10 December 1999	L990178-24	ND	ND	0.20
	L990178-24 duplicate	ND	ND	0.23
	relative percent difference	NA	NA	14%
15 December 1999	L990212-3	ND	ND	0.63
	L990212-3 duplicate	ND	ND	0.63
	relative percent difference	NA	NA	0%

NA - not applicable

ND - not detected

***NOTE:** Fish tissue organic analytes (listed in Section A.3) not appearing in the above table were included in the analysis and were not detected.

Table A.2-3. 1999 MA DEP DWM Parker River Watershed laboratory QA/QC lab fortified matrix and matrix spike duplicate data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g wet weight unless otherwise noted.)

DATE ANALYZED	**21 December 1999**	**21 December 1999**	**23 December 1999**	**23 December 1999**
LABORATORY SAMPLE NUMBER	Matrix Spike L990227-2	Matrix Spike Duplicate L990227-2	Matrix Spike L990271-1	Matrix Spike Duplicate L990271-1
%LIPIDS	0.20	0.19	0.11	0.20
ANALYTE	PCB A1260 MDL 0.11	PCB A1260 MDL 0.11	Lindane MDL 0.009 Heptachlor MDL 0.012 Aldrin MDL 0.016 DDT MDL 0.011	Lindane MDL 0.009 Heptachlor MDL 0.012 Aldrin MDL 0.016 DDT MDL 0.011
SPIKE AMOUNT	1.14	1.14	Lindane 0.025 Heptachlor 0.025 Aldrin 0.025 DDT 0.050	Lindane 0.025 Heptachlor 0.025 Aldrin 0.025 DDT 0.050
SPIKE RECOVERED	1.08	1.07	Lindane 0.026 Heptachlor 0.024 Aldrin 0.026 DDT 0.052	Lindane 0.026 Heptachlor 0.027 Aldrin 0.028 DDT 0.060
SPIKE % RECOVERY	95	94	Lindane 104 Heptachlor 96 Aldrin 104 DDT 104	Lindane 104 Heptachlor 108 Aldrin 112 DDT 120

MDL – method detection limit

NOTE: Parker River Watershed samples were batched with others. These laboratory fortified matrix results are pertinent to Parker River Watershed samples.

Conclusion(s):

Data for fish tissue contaminants at Rock Pond and Baldpate Pond accurately represented catchable/edible fish in these lakes at the time of sampling. Data for tissue metals, PCBs and organochlorine pesticides were accepted without qualification. There was not sufficient information to require censoring of any of the data.

Although a watershed QAPP detailing specific data quality objectives (DQOs) for the Parker watershed fish contaminant monitoring was not produced, the analytical QC data generally showed lack of blank contamination, blank and matrix spike recoveries ranging from 80-128 % for all analyte groups and RPDs less than 30 % for lab duplicates. (For comparison, DWM's current, 2001 DQO's for overall precision of metal/PCB/pesticide monitoring are generally 30% RPD). The quality control acceptance limits of WES for analytical accuracy and precision were met for all samples.

Although the lab fortified blank recovery for DDT was 128% (above the typical criteria of 80-120%, specified in Section A1.2), this was deemed insufficient grounds for qualification or censoring of the DDT data.

Table A.2-4. 1999 MA DEP DWM Parker River Watershed laboratory QA/QC data for metals in fish tissue. (Data expressed in µg/g wet weight unless otherwise noted.)

		Precision			LFM Accuracy					Accuracy* (% Recovery)			
Sample ID	Analyte	Sample	Duplicate	RPD	Spike Amount (SA)	Spike Recovered (SR)	% Spike Recovery (PSR)	Sample Mean (SM)	LFM (spike + sample)	LFB	QCS	MDL	Analytical Method
L990179-10	Hg	0.52	0.53	1.9	2.0	1.7	85	0.525	2.23	85	97	0.02	EPA 245.6
L990179-24	As	<MDL	<MDL	NA	2.0	NR	91	NA	NA	95	94	0.04	EPA 200.9
L990179-24	Se	0.118	0.110	7.0	2.0	2.44	122	0.114	2.55	98	92	0.04	EPA 200.9
L990179-24	Pb	<MDL	<MDL	NA	20	NR	91	NA	NA	92	95	0.20	EPA 200.7
L990179-24	Cd	<MDL	<MDL	NA	20	NR	96	NA	NA	93	103	0.02	EPA 200.7
L990165-14	Hg	0.96	1.04	8.0	2.0	2.04	102	1.00	3.04	110	101	0.02	EPA 245.6
L990165-20	Se	0.124	0.129	4.0	2.0	1.76	88	0.127	1.89	88	90	0.04	EPA 200.9
L990165-20	As**	0.079	NR	NA	2.0	NR	NR	NA	NA	101	106	0.04	EPA 200.9
L990165-20	Pb	<MDL	<MDL	NA	20	NR	91	NA	NA	92	95	0.20	EPA 200.7
L990165-20	Cd	<MDL	<MDL	NA	20	NR	93	NA	NA	93	102	0.02	EPA 200.7

LFB - Laboratory Fortified Blank
LFM - Laboratory Fortified Matrix
MDL - Method Detection Limit
NA - Not Applicable

NR - Not Reported
QCS - Quality Control Sample
RPD - Relative Percent Difference

*see Appendix A, section A.1.2. for further details
**Method Std. additions used.

LFM Calculation: SA x PSR = SR ; SR + SM = LFM

Table A.2-5. 1999 MA DEP DWM Parker River Watershed laboratory QA/QC lab fortified blank data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors and Congeners and Organochlorine Pesticides. (Data expressed in µg/g wet weight unless otherwise noted.)

DATE ANALYZED	**2 December 1999**	**7 December 1999**	**8 December 1999**	**14 December 1999**	**16 December 1999**
LABORATORY SAMPLE NUMBER	Laboratory Fortified Blank #1	Laboratory Fortified Blank #2	Laboratory Fortified Blank #3	Laboratory Fortified Blank #4	Laboratory Fortified Blank #5
%LIPIDS	0.10	0.07	0.10	0.07	0.08
ANALYTE	PCB A1260 MDL 0.11	Chlordane MDL 0.11	PCB A1242 MDL 0.26	Toxaphene MDL 0.59	Lindane MDL 0.009 Heptachlor MDL 0.012 Aldrin MDL 0.016 DDT MDL 0.011
Spike Amount	0.96	0.98	1.0	0.96	Lindane 0.010 Heptachlor 0.010 Aldrin 0.010 DDT 0.020
Spike Recovered	0.95	1.0	0.67	0.91	Lindane 0.0098 Heptachlor 0.0115 Aldrin 0.0120 DDT 0.0255
Spike % Recovery	99	102	67	95	Lindane 98 Heptachlor 115 Aldrin 120 DDT 128

MDL – method detection limit

NOTE: Parker River Watershed samples were batched with others. These laboratory fortified matrix results are pertinent to Parker River Watershed samples.

A.3 Analytical Methods and MDLs

The analytical methods used to estimate the levels of metals, PCBs and organochlorine pesticides in tissues of largemouth bass, perch and bullhead (three fish composites of each game fish, with substitutions of similar species as necessary) are provided in Table A.3-1.

Table A3-1. Analytical Methods and MDLs for 1999 DWM Sampling

Discrete Water Sample Analytes	EPA Method*	SM Methods**	Other Methods	MDLs
Fish Tissue Analytes				**ug/g wet wt**
PCB Arochlor 1242			AOAC 983.21***	0.26 µg/g wet wt
PCB Arochlor 1254			AOAC 983.21***	0.37 µg/g wet wt
PCB Arochlor 1260			AOAC 983.21***	0.11 µg/g wet wt
Chlordane			AOAC 983.21***	0.11 µg/g wet wt
Toxaphene			AOAC 983.21***	0.59 µg/g wet wt
a-BHC			AOAC 983.21***	0.009 µg/g wet wt
b-BHC			AOAC 983.21***	0.011 µg/g wet wt
Lindane			AOAC 983.21***	0.009 µg/g wet wt
d-BHC			AOAC 983.21***	0.043 µg/g wet wt
Hexachlorocyclopentadiene			AOAC 983.21***	0.33 µg/g wet wt
Trifluralin			AOAC 983.21***	0.18 µg/g wet wt
Hexachlorobenzene			AOAC 983.21***	0.18 µg/g wet wt
Heptachlor			AOAC 983.21***	0.012 µg/g wet wt
Heptachlor Epoxide			AOAC 983.21***	0.015 µg/g wet wt
Methoxychlor			AOAC 983.21***	0.029 µg/g wet wt
DDD			AOAC 983.21***	0.011 µg/g wet wt
DDE			AOAC 983.21***	0.010 µg/g wet wt
DDT			AOAC 983.21***	0.011 µg/g wet wt
Aldrin			AOAC 983.21***	0.016 µg/g wet wt
BZ#81			AOAC 983.21***	0.0005 µg/g wet wt
BZ#77			AOAC 983.21***	0.0005 µg/g wet wt
BZ#123			AOAC 983.21***	0.0011 µg/g wet wt
BZ#118			AOAC 983.21***	0.0025 µg/g wet wt
BZ#114			AOAC 983.21***	0.0008 µg/g wet wt
BZ#105			AOAC 983.21***	0.0019 µg/g wet wt
BZ#126			AOAC 983.21***	0.0004 µg/g wet wt

Table A3-1 (Continued)

Discrete Water Sample Analytes	EPA Method*	SM Methods**	Other Methods	MDLs
BZ#156			AOAC 983.21***	0.0007 µg/g wet wt
BZ#157			AOAC 983.21***	0.0007 µg/g wet wt
BZ#180			AOAC 983.21***	0.0007 µg/g wet wt
BZ#169			AOAC 983.21***	0.0003 µg/g wet wt
BZ#170			AOAC 983.21***	0.0007 µg/g wet wt
BZ#189			AOAC 983.21***	0.0007 µg/g wet wt
Arsenic	EPA 200.9		AOAC 983.21***	0.04 µg/g wet wt
Lead	EPA 200.7		AOAC 983.21***	0.20 µg/g wet wt
Selenium	EPA 200.9		AOAC 983.21***	0.04 µg/g wet wt
Cadmium	EPA 200.7		AOAC 983.21***	0.02 µg/g wet wt
Mercury	EPA 245.6		AOAC 983.21***	0.02 µg/g wet wt
% Lipids			WES SOP	NA
In-Situ Water Quality Analytes				
Hydrolab® Multiprobe Series 3			DWM SOP (CN 4.0)	NA

***** = "Methods for Chemical Analysis of Water and Wastes", Environmental Protection Agency, Environmental Monitoring Systems Laboratory – Cincinnati (EMSL-CI), EPA-600/4-79-020, Revised March 1983 and 1979 where applicable.

****** = Standard Methods, Examination of Water and Wastewater, 20th edition

******* = PCBs and Organochlorine Pesticides in Biological Tissue, AOAC Official Methods of Analysis, 1990

NA = Not Applicable

CONCLUSION

The Parker River Watershed fish tissue and Hydrolab® data collected in 1999 were reviewed with regard to DWM data quality objectives (DQOs) and adherence to MA DEP DWM and WES Laboratory SOPs for collection and analysis. Where applicable, the primary DQO elements of precision, accuracy, representativeness, completeness and comparability (PARCC) were evaluated.

All samples collected resulted in usable data. There was insufficient evidence on which to base any conclusions to qualify or censor the data.

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APPENDIX B - 1999 MA DEP DWM PARKER RIVER WATERSHED FISH TOXICS MONITORING SURVEY RESULTS

INTRODUCTION

Fish toxics monitoring is aimed primarily at assessing human health risks associated with the consumption of freshwater fishes. The program is a cooperative effort between three MA DEP Offices/Divisions, (Watershed Management, Research and Standards [ORS], and Environmental Analysis), the Department of Fisheries and Wildlife Environmental Law Enforcement, and the Department of Public Health (MDPH). Fish tissue monitoring is typically conducted to assess the concentrations of toxic contaminants in freshwater fish, identify waterbodies where those concentrations may pose a risk to human health, and identify waters where toxic contaminants may impact fish and other aquatic life. Fish tissue analysis has been restricted to edible fillets. The fish toxics monitoring was designed to screen the edible fillets of several species of fish representing different feeding guilds (i.e., bottom dwelling omnivores, top-level predators, etc.) for the presence of heavy metals (Pb, Cd, Se, Hg, As), PCB and organochlorine pesticides. These data are then used by the Massachusetts Department of Public Health in assessing human health risks associated with the consumption of freshwater fishes (MA DEP 1999a).

As part of the ongoing fish toxics monitoring program and in support of an intensive mercury sampling program in northeastern Massachusetts designed by the MA DEP Office of Research and Standards (ORS), fish were sampled at two sites (Figure B1) in the Parker River Watershed. Baldpate Pond is a 55 acre pond located in Boxford and Rock Pond is a 49.6 acre pond located in Georgetown.

MATERIALS AND METHODS

Fish were collected by DWM staff via gill nets, trot lines, and boat mounted electrofishing gear at Baldpate Pond, Boxford on 13 May 1999 (MA DEP 1999a). Rock Pond in Georgetown was sampled by DWM staff using gill nets and boat mounted electrofishing gear on 19 May 1999. Fish were held in an onboard livewell until an appropriate sample number was reached, at which time the samples were placed in an ice filled cooler and brought back to the DWM laboratory for processing.

Protocols designed to assure accuracy and prevent cross-contamination of samples were followed for collecting, processing and shipping fish. Lengths and weights were measured and fish were visually inspected for tumors, lesions, or other anomalies. Scale or pectoral fin spine samples were obtained from each fish to determine age. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. All equipment used in the filleting process was rinsed in tap water to remove slime, scales, and other fluids such as blood, then re-rinsed in deionized water twice before (and/or after) each sample. Composite samples (single fillets from three like-sized individuals of the same species) targeted for % lipids, PCBs and organochlorine pesticide analysis were wrapped together in aluminum foil. Composite samples targeted for metals analysis were placed in VWR 32-ounce high density polyethylene (HDPE) cups with covers. Individual samples targeted for Hg analysis only were also placed in VWR 32-ounce high density polyethylene (HDPE) cups with covers. Samples were tagged and frozen for subsequent delivery to the Department’s Wall Experiment Station (WES).

Methods used at WES for metals analysis were as follows:

- mercury - cold vapor method, Perkin Elmer, FIMS (Flow Injection Mercury System) with Flow Injection Atomic Absorption Spectroscopy
- cadmium and lead - Perkin Elmer, Optima 3000 XL ICP – Optical Emission Spectrophotometer
- arsenic and selenium - Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer

PCB/organochlorine pesticide analysis was performed on a gas chromatograph equipped with an electron capture detector. Additional information on analytical techniques used at WES is available from the laboratory (MA DEP 1995).

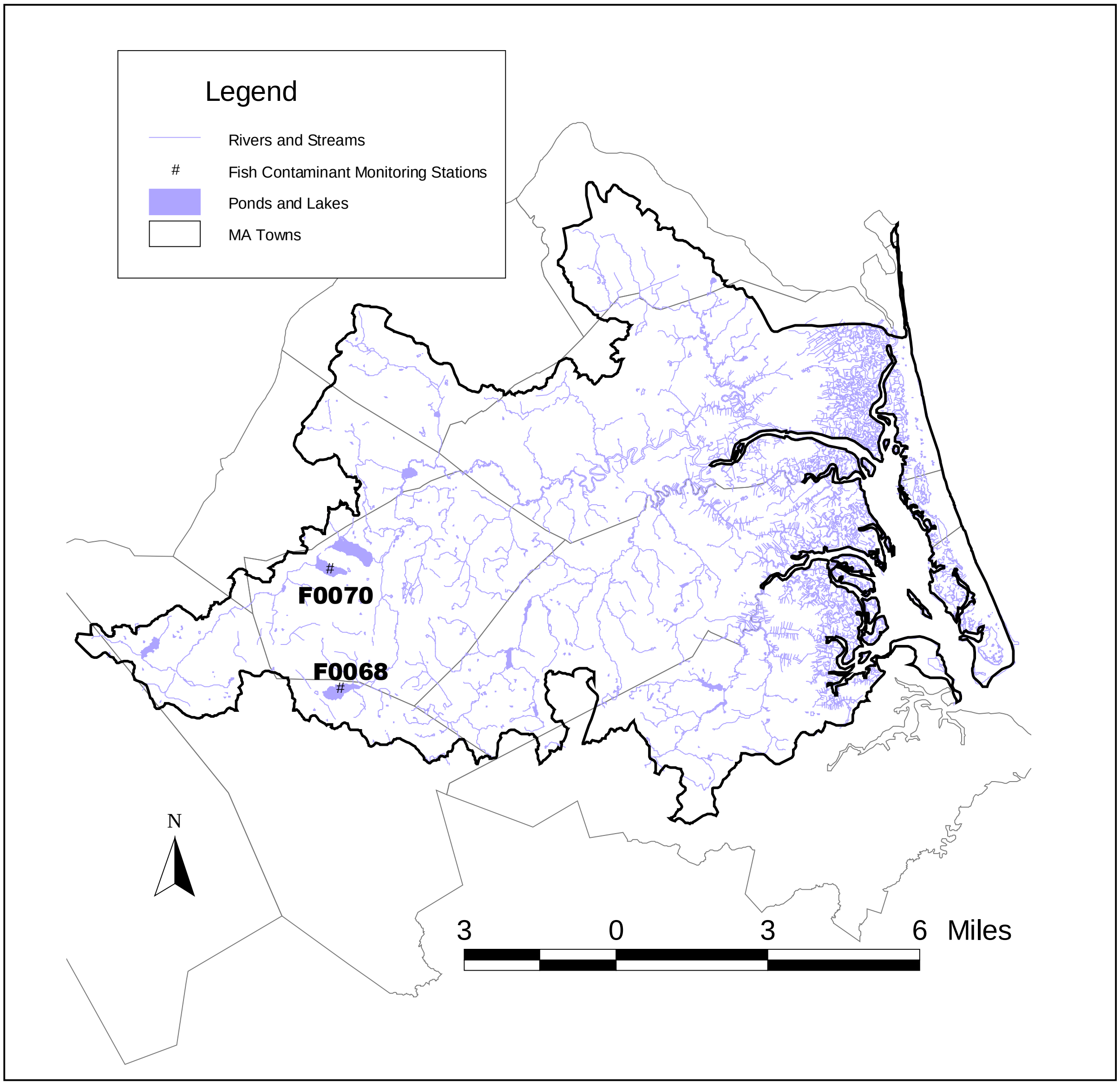

Figure B1. 1999 MA DEP DWM Parker River Watershed fish contaminant monitoring stations: Baldpate Pond, Boxford (F0068) and Rock Pond, Georgetown (F0070)

RESULTS

Survey results (MA DEP 1999c) are presented in Tables B1 and B2.

Baldpate Pond, Boxford (Table B1) (F0068)
Samples of largemouth bass, yellow perch, and brown bullhead were collected from Baldpate Pond, Boxford. Fish were processed at the DWM laboratory as individual samples or composite samples comprised of tissue from three like-sized individual fish.

Cadmium, PCB and lead were not detected in the edible fillets of any sample analyzed for these analytes from Baldpate Pond. Selenium was detected in all samples analyzed; ranging from 0.064 to 0.201 mg/kg wet weight. Arsenic was detected in all samples analyzed; ranging from 0.079 to 0.161 mg/kg wet weight. Mercury in the fish tissue from Baldpate Pond ranged from 0.37 to 1.6 mg/kg wet weight.

With the exception of the brown bullhead sample from Baldpate Pond, which contained a detectable level of dichlorodiphenyl ethylene - DDE (0.019µg/g), pesticide levels in all other samples were below detection. The % lipids content of the fish analyzed ranged between 0.06 and 0.79.

According to standard practice, all laboratory analytical results were forwarded to the Massachusetts Department of Public Health (MDPH) for review. The mercury data triggered a site-specific advisory against the consumption of fish from Baldpate Pond, Boxford (MA DPH 1999).

Rock Pond, Georgetown (Table B2) (F0070)
Samples of largemouth bass, yellow perch, and brown bullhead were collected from Rock Pond, Georgetown. Fish were sorted by type and processed at the DWM laboratory as individual samples or composite samples comprised of tissue from three like-sized individual fish.

Cadmium, lead, PCB and pesticides were not detected in the edible fillets of any sample analyzed for these analytes from Rock Pond. Selenium was detected in all samples analyzed; ranging from 0.084 to 0.178 mg/kg wet weight. In one sample analyzed arsenic was detected at 0.042 mg/kg wet weight, all other samples analyzed were below the method detection limit of 0.04 mg/kg. Mercury in the fish tissue from Rock Pond ranged from 0.39 to 1.9 mg/kg wet weight. The % lipids content of the fish analyzed ranged between 0.05 and 0.18.

According to standard practice, all laboratory analytical results were forwarded to MDPH for review. The data triggered a site-specific advisory against the consumption of fish from Rock Pond, Georgetown (MA DPH 1999).

Table B1. 1999 MA DEP DWM fish toxics monitoring data for Baldpate Pond (F0068), Boxford. Results (mg/kg wet wt.) are from fish fillets with skin off and are of individual fillets or composite samples as noted.

Sample ID	Collection Date	Species[1] Code	Length (cm)	Weight (g)	Individual Sample ID (lab sample #)	Hg	Composite Sample ID (lab sample #)	Cd	Hg	Pb	As	Se	Lipids (%)	PCB (µg/g)	Pesticides (µg/g)
BOXBP-01	5/13/99	LMB	32.1	409.6	99113 (L990165-1)	1.3									
BOXBP-02	5/13/99	LMB	29.5	308.9	99093 (L990165-2)	1.2	99111 (L990165-20)	<0.02		<0.20	0.079	0.124			
BOXBP-03	5/13/99	LMB	31.5	398.6	99094 (L990165-3)	1.3									
BOXBP-04	5/13/99	LMB	30.1	306.4	99095 (L990165-4)	1.4									
BOXBP-05	5/13/99	LMB	30.7	326.2	99096 (L990165-5)	1.1	99112 (L990165-21)						0.06	ND	ND
BOXBP-06	5/13/99	LMB	30.4	318.0	99097 (L990165-6)	1.4									
BOXBP-07	5/13/99	LMB	32.7	410.0	99098 (L990165-7)	1.2									
BOXBP-08	5/13/99	LMB	37.5	710.1	99099 (L990165-8)	1.6									
BOXBP-09	5/13/99	LMB	35.7	649.9	99100 (L990165-9)	1.5									
BOXBP-10	5/13/99	YP	27.9	227.2	99101 (L990165-10)	0.41									
BOXBP-11	5/13/99	YP	28.3	252.4	99102 (L990165-11)	0.37	99114 (L990165-22)	<0.02		<0.20	0.090	0.201			
BOXBP-12	5/13/99	YP	27.7	213.1	99103 (L990165-12)	0.39									
BOXBP-13	5/13/99	YP	29.3	262.0	99104 (L990165-13)	0.45									
BOXBP-14	5/13/99	YP	26.8	232.8	99105 (L990165-14)	1.0	99115 (L990165-23)						0.14	ND	ND
BOXBP-15	5/13/99	YP	26.4	201.7	99106 (L990165-15)	0.76									
BOXBP-16	5/13/99	YP	22.0	112.8	99107 (L990165-16)	0.62									
BOXBP-17	5/13/99	YP	25.5	186.6	99108 (L990165-17)	0.87									
BOXBP-18	5/13/99	YP	20.8	89.0	99109 (L990165-18)	0.58									
BOXBP-19	5/13/99	BB	29.7	339.0			99117 (L990165-24)	<0.02		<0.20	0.161	0.064	0.79	ND	0.019[2]
BOXBP-20	5/13/99	BB	26.9	283.4											
BOXBP-21	5/13/99	BB	26.8	235.8			99110 (L990165-19)		0.37						

[1]Species brown bullhead (BB) *Ameiurus nebulosus*
largemouth bass (LMB) *Micropterus salmoides*

[2] DDE

ND – not detected or the analytical result is at or below the method detection limit (MDL). See Appendix A for MDL.

Table B2. 1999 MA DEP DWM fish toxics monitoring data for Rock Pond (F0070), Georgetown. Results (mg/kg wet wt.) are from fish fillets with skin off and are of individual fillets or composite samples as noted.

Sample ID	Collection Date	Species[1] Code	Length (cm)	Weight (g)	Individual Sample ID (lab sample #)	Hg	Composite Sample ID (lab sample #)	Cd	Hg	Pb	As	Se	Lipids (%)	PCB (µg/g)	Pesticides (µg/g)
GTNRP-01	5/19/99	LMB	32.0	384.4	99180 (L990179-1)	1.2									
GTNRP-02	5/19/99	LMB	35.2	603.1	99181 (L990179-2)	1.9	99199 (L990179-20)	<0.02		<0.20	0.042	0.136			
GTNRP-03	5/19/99	LMB	34.1	458.8	99182 (L990179-3)	1.9									
GTNRP-04	5/19/99	LMB	34.7	604.5	99183 (L990179-4)	1.6									
GTNRP-05	5/19/99	LMB	30.3	357.1	99184 (L990179-5)	1.6	99179 (L990179-21)						0.05	ND	ND
GTNRP-06	5/19/99	LMB	34.5	614.1	99185 (L990179-6)	1.7									
GTNRP-07	5/19/99	LMB	33.4	418.6	99186 (L990179-7)	1.6									
GTNRP-08	5/19/99	LMB	30.7	299.1	99187 (L990179-8)	1.5									
GTNRP-09	5/19/99	LMB	34.4	530.6	99188 (L990179-9)	1.7									
GTNRP-10	5/19/99	YP	21.9	136.5	99189 (L990179-10)	0.52									
GTNRP-11	5/19/99	YP	21.5	131.2	99190 (L990179-11)	0.90	99178 (L990179-22)	<0.02		<0.20	<0.04	0.178			
GTNRP-12	5/19/99	YP	21.3	127.2	99191 (L990179-12)	0.70									
GTNRP-13	5/19/99	YP	23.5	171.6	99192 (L990179-13)	0.85									
GTNRP-14	5/19/99	YP	22.0	140.4	99193 (L990179-14)	1.1	99177 (L990179-23)						0.06	ND	ND
GTNRP-15	5/19/99	YP	21.8	118.3	99194 (L990179-15)	0.84									
GTNRP-16	5/19/99	YP	22.6	138.9	99195 (L990179-16)	0.83									
GTNRP-17	5/19/99	YP	21.6	131.0	99196 (L990179-17)	1.1									
GTNRP-18	5/19/99	YP	21.3	118.5	99197 (L990179-18)	0.89									
GTNRP-19	5/19/99	BB	29.5	356.9			99176 (L990179-24)	<0.02		<0.20	<0.04	0.084	0.18	ND	ND
GTNRP-20	5/19/99	BB	29.9	440.0											
GTNRP-21	5/19/99	BB	30.3	410.8			99198 (L990179-19)		0.39						

[1]Species yellow perch (YP) *Perca flavescens*
brown bullhead (BB) *Ameiurus nebulosus*

ND – not detected or the analytical result is at or below the method detection limit (MDL). See Appendix A for MDL.

largemouth bass (LMB) *Micropterus salmoides*
yellow perch (YP) *Perca flavescens*

***IN-SITU* WATER QUALITY MEASUREMENT**

In conjunction with fish toxics monitoring, Hydrolab®data were collected at Baldpate Pond, Boxford on 12 May 1999 and Rock Pond, Georgetown on 19 May 1999. The Hydrolab®*in-situ* results are provided in Table B3. MA DEP DWM water quality data is managed and maintained in the *Water Quality Access Database.*

Table B3. 1999 MA DEP DWM Parker River Watershed *in-situ* Hydrolab® data

		Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (µS/cm)	TDS (mg/L)	DO (mg/L)	SAT (%)
Baldpate Pond, Boxford (PALIS #: 91001)									
Station: Hole									
F0068	5/12/99	12:01	0.4	16.7	7.7	224	143	11.0	110
		12:20	3.1	15.6	7.8	227	145	11.6	114
		12:08	5.8	12.0	6.9	220	141	8.3	76
		12:14	9.3	8.0	6.5	206	132	5.1	42
Rock Pond, Georgetown (PALIS #: 91012)									
Station: Hole									
F0070	5/19/99	11:12	0.4	19.4	7.1	207	132	9.7	103
		11:19	3.5	14.5	6.5	204	131	5.9	56
		11:25	4.6	12.3	6.4	207	132	3.2	29

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APPENDIX C - 1999 DEP DWM BIOMONITORING TECHNICAL MEMORANDUM

Technical Memorandum (TM-91-1)

Subject: Parker Watershed 1999 Biological Assessment

Prepared by: John Fiorentino, DEP/ Division of Watershed Management, Worcester, MA

Date: 7 December 2000

INTRODUCTION

Biological monitoring is a useful means of detecting anthropogenic impacts to the aquatic community. Resident biota (e.g., benthic macroinvertebrates, fish, periphyton) in a Waterbody are natural monitors of environmental quality and can reveal the effects of episodic and cumulative pollution and habitat alteration (Barbour et al. 1999, Barbour et al. 1995). Biological surveys and assessments are the primary approaches to biomonitoring.

As part of the Massachusetts Department of Environmental Protection/ Division of Watershed Management's (MA DEP/DWM) 2000 Parker River watershed assessments, aquatic benthic macroinvertebrate biomonitoring was conducted to evaluate the biological health of various portions of the watershed. A total of eight biomonitoring stations were sampled in both the mainstem Parker River and selected tributaries to investigate the effects of various nonpoint source stressors—both historical and current—on the aquatic communities of the watershed. Some stations sampled during the 1999 biomonitoring survey were previously "unassessed" by DEP, while historical DEP biomonitoring stations—most recently assessed in 1994 (Fiorentino 1996a and 1996b)—were reevaluated to determine if water quality and habitat conditions have improved or worsened over time. Sampling locations, along with station identification numbers and sampling dates, are noted in Table 1. Sampling locations are also shown in Figure 1.

To provide information necessary for making basin-wide aquatic life use assessments required by Section 305(b) of the Federal Clean Water Act (CWA), all Parker River watershed stations were compared to a regional reference station thought to represent the "best attainable" (i.e., least-impacted) conditions in the watershed. Use of a regional reference station is particularly useful in assessing nonpoint source (NPS) pollution impacts (e.g., physical habitat degradation) at upstream control sites as well as downstream sites suspected as chemically-impacted from known point source stressors (Hughes 1989). Cart Creek, originally recommended as a reference station by the Parker River Clean Watershed Association (PRCWA), was determined by DWM to be inappropriate as the reference condition due to the extremely low base-flow observed during reconnaissance activities (i.e., site visits) in the watershed. As a result, the regional reference station was established in Fish Brook, which is located in the nearby Ipswich River watershed. As a coastal basin, the Ipswich River watershed shares many similar characteristics with the Parker River watershed with respect to hydrology, channel geomorphology, and instream habitat quality. The Fish Brook station was situated upstream from all known point sources of water pollution, and was also assumed to be relatively unimpacted by nonpoint sources. Additional, site-specific bioassessments were conducted at two stations (PR00 and PR02) in the mainstem Parker River, with comparisons made to an upstream control at PR01B. These upstream-downstream comparisons were made to assess potential effects of nearstream groundwater withdrawals on downstream aquatic communities in the Parker River.

During "year 1" of its 5-year basin cycle, problem areas within the Parker River watershed were better defined through such processes as coordination with appropriate groups (EOEA Parker River Basin Team, EPA, PRCWA, Essex County Greenbelt Association, USGS), assessing existing data, conducting site visits, and reviewing NPDES and water withdrawal permits. Following these activities, the 1999 biomonitoring plan was more closely focused and the study objectives better defined. Table 2 includes a summary of the perceived problems/issues—both historical and current—addressed during the 1999 Parker River watershed biomonitoring survey.

The main objectives of biomonitoring in the Parker River watershed were: (a) to determine the biological health of streams within the watershed by conducting assessments based on aquatic macroinvertebrate communities; and (b) to identify problem stream segments so that efforts can be focussed on developing NPDES permits, Water Management Act permits, stormwater management, and control of other nonpoint source (NPS) pollution. Specific tasks were:

1. Conduct benthic macroinvertebrate sampling at locations throughout the Parker River watershed.

2. Based upon the macroinvertebrate data, identify river segments within the watershed with potential point/nonpoint source pollution problems; and

3. Using the benthic macroinvertebrate data and supporting water chemistry and field data, assess the types of water quality and/or water quantity problems that are present, and if possible, make recommendations for remedial actions. Provide macroinvertebrate data to DWM's Environmental Monitoring and Assessment Program to be used in making aquatic life use assessments required by Section 305(b) of the Federal Clean Water Act (CWA).

Table 1. List of macroinvertebrate biomonitoring stations sampled during the 1999 Parker River watershed survey, including station identification number, drainage area, station description, and sampling date.

Station	Drainage Area (mi^2)	Parker River Watershed Station description	Sampling Date
PR00	21.12	Parker River, upstream from Main Street, Byfield, Newbury, MA	3 August 1999
PR01B	2.90	Parker River, downstream from Route 133, Boxford, MA	4 August 1999
PR02	6.15	Parker River, at Bailey Lane, Georgetown, MA	5 August 1999
MR03	12.40	Mill River, upstream from Route 1, Rowley, MA	3 August 1999
OX03	1.81	Ox Pasture Brook, downstream from Fenno Road, Rowley, MA	4 August 1999
PB01	3.92	Penn Brook, upstream from Parsonage and North Street, Georgetown, MA	3 August 1999
JK01	0.58	Jackman Brook, downstream from Jackman Street, Georgetown, MA	5 August 1999
FB00*****	12.16	Fish Brook, upstream from Middletown Road, Boxford, MA	28 July 1999

***** located in the Ipswich River watershed

Table 2. List of perceived problems addressed during the 1999 Parker River watershed biomonitoring survey. Specific biomonitoring stations addressing each problem are also listed, as is the sampling methodology employed at each station.

Parker River Watershed Stations	Issues/Problems	Sampling method
PR00	unknown NPS, impoundments/dams	RBPIII--kick sampling
PR01B*****	groundwater withdrawals/reduced flows	RBPIII--kick sampling
PR02	groundwater withdrawals/reduced flows, unknown NPS	Qualitative--multi-habitat jabs
MR03*****	stormwater, road runoff, agriculture, septic systems	RBPIII--kick sampling
OX03*****	stormwater, road runoff, agriculture	RBPIII--kick sampling
PB01	road runoff, town dump (capped), trash, NPS inputs (e.g., yard waste) from adjacent homes	Qualitative--multi-habitat jabs
JK01*****	miscellaneous NPS (habitat degradation, stormwater/road runoff, new home construction)	RBPIII--kick sampling

***** biomonitoring conducted here by DEP in 1994

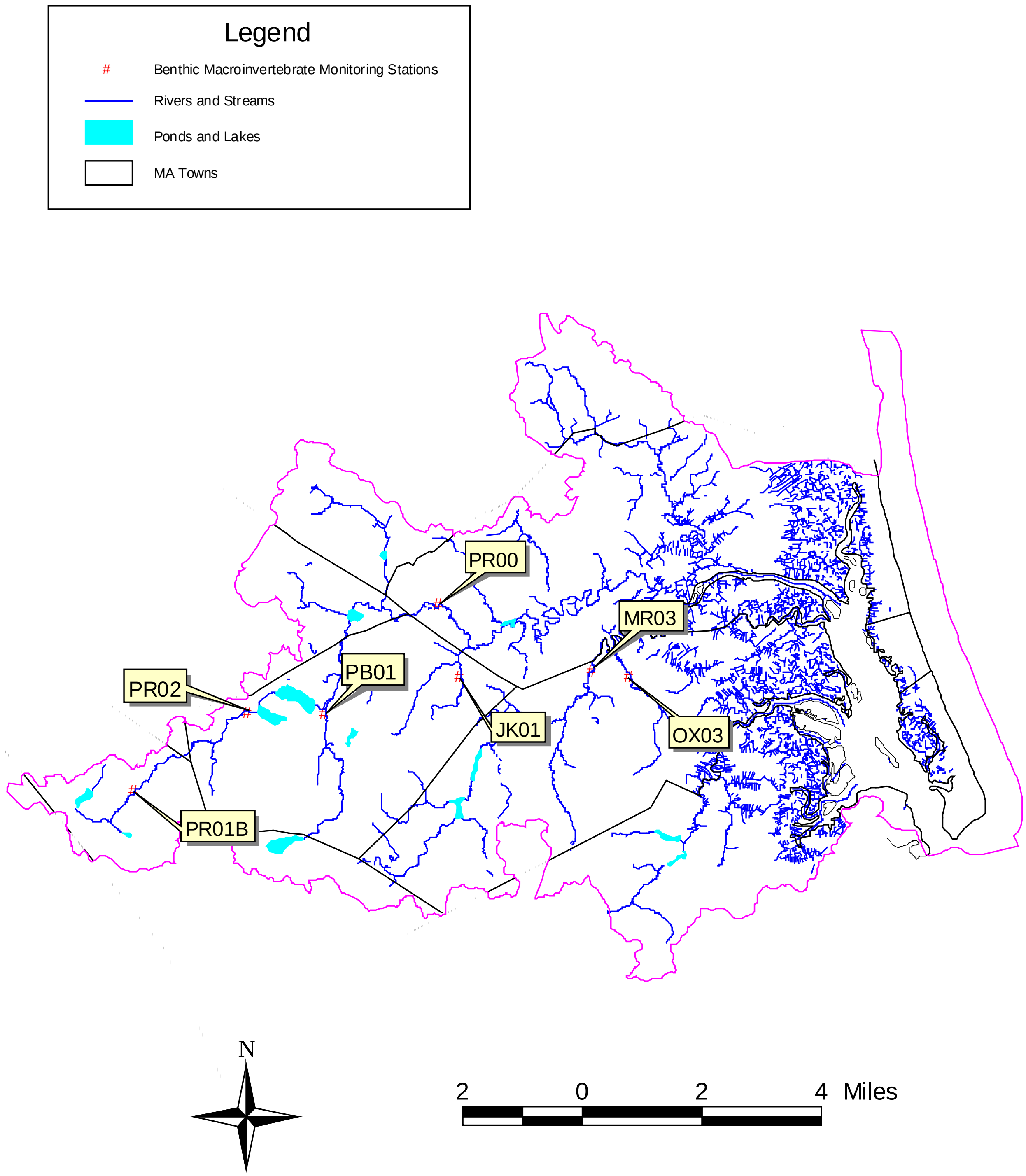

Figure 1. Location of DWM biomonitoring stations for the 1999 Parker River watershed survey.

METHODS

Macroinvertebrate Sampling -- RBPIII

The macroinvertebrate sampling and processing procedures are described in the *Water Quality Monitoring In Streams Using Aquatic Macroinvertebrates* standard operating procedures (Nuzzo 1999), and are based on US EPA Rapid Bioassessment Protocols (RBPs) (Barbour et al. 1999). Sampling was conducted by DWM biologists throughout a 100 m reach, in riffle/run areas with fast currents and cobble/gravel substrates—generally the most productive habitats, supporting the most diverse communities in the stream system. Ten kicks in squares approximately 0.46 m x 0.46 m were composited for a total sample area of about 2 m^2. Samples were preserved in the field with denatured 95% ethanol, then brought to the DEP/DWM lab for processing.

Habitat Assessments

An evaluation of physical and biological habitat quality is critical to any assessment of ecological integrity (Karr et al. 1986; Barbour et al. 1999). Habitat assessment supports understanding of the relationship between physical habitat quality and biological conditions, identifies obvious constraints on the attainable potential of a site, assists in the selection of appropriate sampling stations, and provides basic information for interpreting biosurvey results (US EPA 1995). Before leaving the sample reach during the 1999 biosurveys, habitat qualities were scored using a modification of the evaluation procedure in Barbour et al. (1999). The matrix used to assess habitat quality is based on key physical characteristics of the Waterbody and surrounding land use. Most parameters evaluated are instream physical attributes often related to overall land use and are potential sources of limitation to the aquatic biota (Barbour et al. 1999). The ten habitat parameters are as follows: instream cover, epifaunal substrate, embeddedness, sediment deposition, channel alteration, velocity/depth combinations, channel flow status, right and left (when facing downstream) bank vegetative protection, right and left bank stability, right and left bank riparian vegetative zone width. Habitat parameters are scored, totaled, and compared to a regional reference station and/or a site-specific control (upstream reference) station to provide a final habitat ranking.

Macroinvertebrate Sample Processing And Analysis

Macroinvertebrate sample processing entailed distributing a sample in pans, selecting grids within the pans at random, and sorting specimens from the other materials in the sample until approximately 100 organisms (±10%) were extracted. Specimens were identified to genus or species as allowed by available keys, specimen condition, and specimen maturity. Taxonomic data were analyzed using a modification of Rapid Bioassessment Protocol III (RBP III) metrics and scores (Barbour et al. 1999). Based on the taxonomy various community, population, and functional parameters, or “metrics”, were calculated which allow an investigator to measure important aspects of the biological integrity of the community. This integrated approach provides more assurance of a valid assessment because a variety of biological parameters are evaluated. Deficiency of any one metric should not invalidate the entire approach (Barbour et al. 1999). Metric values for each station were scored based on comparability to the reference station, and scores were totaled. The percent comparability of total metric scores for each study site to those for a selected “least-impacted” reference station (i.e., “best attainable” situation) yields an impairment score for each site. RBP III analysis separates sites into four categories: non-impacted, slightly impacted, moderately impacted, and severely impacted. Impacts to the benthic community may be indicated by the absence of generally pollution-sensitive macroinvertebrate taxa such as Ephemeroptera, Plecoptera, and Trichoptera (EPT); dominance of a particular taxon, especially the pollution-tolerant Chironomidae and Oligochaeta taxa; low taxa richness; or shifts in community composition relative to the reference station (Barbour et al. 1999). Those biological metrics calculated and used in the analysis of Parker River watershed macroinvertebrate data are listed and defined below. For a more detailed description of metrics used to evaluate benthos data see Barbour et al. (1999):

1. Taxa richness—a measure based on the number of taxa present. The lowest possible taxonomic level is assumed to be genus or species.
2. EPT Index—a count of the number of genera/species from the orders Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). As a group these are considered three of the more

sensitive aquatic insect orders. Therefore, the greater the contribution to total richness from these three orders, the healthier the community.

3. Biotic Index—Based on the Hilsenhoff Biotic Index (HBI), this is an index designed to produce a numerical value to indicate the level of organic pollution. Organisms have been assigned a value ranging from zero to ten based on their tolerance to organic pollution. A value of zero indicates the taxon is highly intolerant of pollution and is likely to be found only in pollution-free waters. A value of ten indicates the taxon is tolerant of pollution and may be found in highly polluted waters. The number of organisms and the individually assigned values are used in a mathematical formula that describes the degree of organic pollution at the study site. The formula for calculating HBI is:

$$HBI = \sum \frac{x_i t_i}{n}$$

where x_i = number of individuals within a taxon
t_i = tolerance value of a taxon
n = total number of organisms in the sample

4. Ratio of EPT and Chironomidae Abundance—The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Skewed populations having a disproportionate number of the generally tolerant Chironomidae ("midges") relative to the more sensitive insect groups may indicate environmental stress.

5. Percent Contribution Dominant Taxon—is the percent contribution of the numerically dominant taxon (genus or species) to the total numbers of organisms. A community dominated by few species indicates environmental stress. Conversely, more balance among species indicates a healthier community.

6. Ratio of Scraper and Filtering Collector Functional Feeding Groups—This ratio reflects the community food base. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source (Barbour et al. 1999). Scrapers predominate when diatoms are the dominant food resource, and decrease in abundance when filamentous algae and mosses prevail. Filtering collectors thrive where filamentous algae and mosses are prevalent and where fine particulate organic material (FPOM) levels are high.

7. Community Similarity—is a comparison of a study site community to a reference site community. Similarity is often based on indices that compare community composition. Most community similarity indices stress richness and/or richness and abundance. Generally speaking, communities will become more dissimilar as stress increases. In the case of the Parker River watershed bioassessments, an index of macroinvertebrate community composition was calculated based on similarity to the reference community, expressed as percent composition of the following organism groups: Oligochaeta, Ephemeroptera, Plecoptera, Coleoptera, Trichoptera, Chironomidae, and Other.

Macroinvertebrate Sampling -- Qualitative

Macroinvertebrate biomonitoring was conducted at two stations (Table 2) based on modifications to the RBP I protocol, a screening or reconnaissance assessment that documents specific visual observations made in the field by a trained professional. The RBP I procedure was used at these stations due to habitat and flow constraints that made the application of the RBP III methodology impractical. RBP I is used to discriminate obviously impacted and non-impacted areas from potentially affected areas. A biosurvey component focuses on qualitative sampling of benthic macroinvertebrates, supplemented by a preliminary field examination of other aquatic biota (periphyton, macrophytes, and fish). Qualitative benthic samples are collected from all available habitats using a kick net; Benthic macroinvertebrate orders/families are listed on a field data sheet. A cursory evaluation of habitat is conducted in lieu of the RBPIII habitat assessment matrix. On the basis of the observations made on habitat, water quality, physical characteristics, and the qualitative biosurvey, the investigator determines whether impairment is detected.

RESULTS AND DISCUSSION

The taxonomic list of macroinvertebrates collected at each sampling station is attached as an appendix (Table A1). Included in the taxa list are total organism counts, and the functional feeding group (FG) and tolerance value (TV) of each taxon. Table A1 also includes a listing of family level taxa observed at those stations where sampling was conducted qualitatively (presence is indicated with an “x”).

Summary tables of the RBP III data analyses, including biological metric calculations, metric scores, and impairment designations, are included in the Appendix as well. Table A2 is the summary table for all Parker River watershed stations using Fish Brook (FB00) as the regional reference station. Table A3 is a summary of the RBPIII data analyses when the mainstem Parker River station PR00 is compared to the more upstream station PR01B. Habitat assessment scores for each station are also included in the summary tables, while a more detailed summary of habitat parameters is shown in Table A4.

The 1999 biomonitoring data for this watershed generally indicate various degrees of nonpoint source-related problems in many of the mainstem and tributary stations examined. Urban runoff, habitat degradation, and other forms of NPS pollution compromise water quality and biological integrity throughout the watershed. That said, some streams examined in the Parker River watershed remain relatively non-impacted and are indicative of the “best attainable” conditions in the watershed.

Parker River Watershed

The Parker River watershed lies between the drainage basins of the Ipswich and Merrimack rivers in Northeastern Massachusetts. All or part of nine communities lie within the 60 square mile area drained by the Parker River. The watershed is generally rural-residential in nature, with only minor industrial development.

The Parker River is formed by the confluence of two unnamed streams in a wetland area of West Boxford. From this confluence, the river, which is little more than two feet wide, meanders through wetlands in a northeasterly direction which caries it into Rock Pond in Georgetown. Three small tributaries join the Parker River during its journey to Rock Pond. Stream velocity increases as the Parker nears the Rock Pond inlet; however, the river is still very narrow and shallow. The outlet of Rock Pond is located at its northern tip and is only one-tenth of a mile from the inlet. The Parker then flows one-third of a mile in a northeasterly direction to the entrance of Pentucket Pond in Georgetown. The general direction of flow in the pond is to the southeast. At the outlet of Pentucket Pond is a four-foot high dam which is the first of six dams on the Parker River. Below the dam, the river follows a southeasterly course to the confluence with Penn Brook. The river then turns abruptly northward and follows a meandering course through wetlands in Georgetown. The stream channel widens, and on two occasions the river splits into two distinct channels. The Parker continues to meander in a northerly direction and is joined by two unnamed tributaries before entering Crane Pond, which is located in the midst of extensive wetlands in Groveland.

Downstream of the outlet of Crane Pond, the Parker turns to the east and meanders to the confluence with Beaver Brook, which flows out of Ash Swamp. The river continues eastward into Byfield, where a series of low dams create several small impoundments. Downstream of the last of these impoundments is a USGS stream gage. At the Byfield Gage, the Parker River has drained an area of 21.6 square miles and has an average discharge of 31.5 cubic feet per second (cfs). From the gage, the river flows in a southeasterly direction under Interstate 95 and enters another small impoundment. The direction of the stream flow remains southeasterly until the Parker reached the confluence with Wheeler Brook in Georgetown. The river then turns and meanders in a northeasterly direction to the dam at Central Street in Newbury which marks the rise of the tide. Beyond this point, the river channel progressively widens as the Parker flows through extensive saltwater marshes to its mouth in Plum Island Sound. There are numerous tributaries to the tidal portion of the Parker River, with the most significant being the Mill River and the Little River. At its mouth, the Parker has drained a total of 60 square miles and has an estimated discharge of 97.2 cfs. From its source in West Boxford to its mouth in Plum Island Sound, the Parker River falls a total of 95 feet. Thirty-six feet of that fall are taken up by the six dams on the river.

Fish Brook

FB00—Fish Brook, mile point 3.5, upstream from Middletown Road, Boxford, MA

Habitat

The FB00 sampling reach began approximately 200 m upstream from Middletown Road, in a forested and relatively undeveloped portion of Boxford in the Ipswich River watershed. The reach consisted of a series of shallow, short riffles interspersed with deeper run areas. Rocky substrates were prevalent, including an abundance of cobble and pebble, as well as gravel and a fair amount of sand—the latter resulting in occasional small areas of deposition. Instream mosses and emergent macrophytes—most notably burreed (*Sparganium* sp.)—provided additional microhabitat for macroinvertebrates; however, epifaunal habitat was considered suboptimal. Fish habitat was suboptimal as well, with submerged logs and overhanging shrubs providing the majority of the cover. Both stream banks were well-vegetated and stabilized with an abundance of shrubby and herbaceous vegetation. A diverse assemblage of shrubs and herbaceous growth, consisting of riverbank grape (*Vitis riparia*), rose (*Rosa multiflora*), honeysuckle (*Lornicera* sp.), skunk cabbage (*Symplocarpus foetidus*), Joe-Pye weed, (*Eupatorium* sp.) and ferns, dominated the riparian zone along both banks. Farther from the stream channel riparian vegetation was dominated by a mix of evergreens and hardwoods that included white pine (*Pinus strobus*), red maple (*Acer rubrum*), ash (*Fraxinus americana*), and oak (*Quercus* sp.). Riparian vegetation extended undisturbed from the left (west) bank, while the wide wooded buffer along the right (east) bank eventually gave way to a large uncultivated pasture.

FB00 received a composite habitat score of 158/200—the highest received by a biomonitoring station during the 1999 Parker River watershed survey (Table A4). This was the designated regional reference station by virtue of its habitat evaluation, presumed good water quality, and minimal upstream/nearstream land use impacts (i.e., absence of point source inputs, lack of channelization, minimal development or agricultural activity nearby, undisturbed and well-vegetated riparian zone, minimal NPS inputs).

Benthos

This portion of Fish Brook was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community. A richness of 29, including 8 intolerant EPT taxa, was recorded—the most of any biomonitoring station in the survey—and most of the metric values were indicative of clean water and “least-impacted” conditions (Table A2). In particular, those attributes that measure components of community structure (i.e., taxa richness, biotic index, EPT index)—which display the lowest inherent variability among the RBP metrics used (Resh 1988)—scored well, further corroborating the designation as a reference station. A relatively low biotic index (4.81) and high scraper/filterer metric value (1.50) relative to other biomonitoring stations in the survey indicated the dominance of the Fish Brook benthos assemblage by pollution-sensitive taxa, and good overall trophic balance. FB00 received a total metric score of 38 (Table A2).

Jackman Brook

JB01—Jackman Brook, mile point 0.60, downstream from Jackman Street, Georgetown, MA

Habitat

The JB01 sampling reach began approximately 20 m downstream from Jackman Street and terminated at the road crossing. Due to the extremely limited benthos habitat here, the reach was considerably shorter than the 100 m called for in the biomonitoring SOP. Most of the kick sampling was confined to the few very shallow riffle areas near the Jackman Street crossing. While those riffle areas present contained cobble and gravel substrates, the majority of the reach consisted of sand and silt not conducive to macroinvertebrate colonization. Snags, fallen trees, and undercut banks—generally considered good fish habitat if submerged—were left exposed and unavailable as fish cover due to channel flow status at the time of sampling (only 50% of channel contained water). As a result of the habitat constraints caused by seasonal low base-flow, both epifaunal and fish habitat were considered marginal. In addition, instream deposits of organic and inorganic materials resulted in shifting, unstable bars and substrate embeddedness that further compromised fish and macroinvertebrate habitat. The Jackman Street crossing was the most likely source of sediment inputs to the JK01 sampling reach; however, recent housing construction and/or agricultural activities upstream were potential sources of NPS pollution as well. Land-use in the immediate area of the sampling reach consisted of undeveloped hardwood forest. Both stream banks were well-vegetated and stabilized with mosses and root masses. Riparian vegetation extended undisturbed from each bank, with a thin herbaceous/shrub layer of ferns, mosses, grasses, skunk cabbage (*Symplocarpus foetidus*), and elderberry (*Sambucus canadensis*) giving way to red maple (*Acer rubrum*) and oak (*Quercus* sp.). JK01 received a total habitat assessment score of 126/200 (Table A4).

Benthos

JK01 received a total metric score of 38, representing 100% comparability to reference conditions at FB00 (Table A2). The resulting "non-impacted" bioassessment is somewhat surprising, given the low habitat evaluation here relative to other biomonitoring stations in the 1999 survey. The JK01 benthos assemblage was dominated by pollution-sensitive macroinvertebrates, including an abundance of the highly intolerant (tolerance value= 0) stonefly, *Leuctra* sp. (Table A1), and resulting in the lowest biotic index of all the Parker River watershed biomonitoring stations (Table A2). Richness was second only to the reference station in terms of number of taxa present, and an EPT index of 11 was actually higher than at FB00 or anywhere else sampled during the 1999 survey. The high scoring (score= 6) community similarity metric further supports that community composition at JK01 was indicative of the "best attainable" conditions in the watershed.

It appears, then, that habitat constraints resulting from reduced base-flow and sediment deposition do not cause any appreciable impact to resident biota at JK01, as was perceived following the 1994 biosurvey which found a "slightly impacted" community here (Fiorentino 1996a). It is unclear whether improved metric performance at JK01 in 1999 is a result of improved water quality conditions or simply due to new sampling methodologies that may be more efficient (i.e., more rigorous) than those employed during the 1994 survey. Regardless, potential NPS inputs from Jackman Street and other upstream sources threaten biological integrity here and should be minimized as much as possible. Effects from sediment deposition, in particular, may be exacerbated by low base-flow and the shallow nature of this small tributary.

Mill River

MR03—Mill River, mile point 6.40, upstream from Route 1 (downstream from Hillside Street/Mill Street), near Jewel Mill, Rowley, MA

Habitat

The MR03 sampling reach began approximately 100 m downstream from Mill Street/Hillside Street and ended at the road crossing. This portion of Mill River is extremely straight—the result of historical channelization probably related to the activities of the now-defunct Jewel Mill. Despite the lack of meander, the abundance of large rocky substrates (boulder and cobble) subjected to well-developed riffle and runs provided macroinvertebrates with excellent epifaunal habitat. Fish habitat was only marginal, however, due to shallow water (channel only about 50% full) and limited cover. Aquatic vegetation, mostly in the form of mosses, covered about 10% of the reach. Filamentous forms of green algae were observed on cobble substrates, but were fairly minimal. The lack of a well-established algal community here was quite different than conditions observed during the 1994 biosurvey, when the presence of large balls of the blue-green alga, *Nostoc* sp., suggested elevated nutrient levels in this portion of Mill River—a problem documented by the Massachusetts Department of Environmental Management (MA DEM) and the Massachusetts Audubon Society (Cooper 1993). The suppressed algal community observed at MR03 during the 1999 biosurvey may in fact reflect the effects of reductions in nutrient loadings to Mill River—possibly the result of the efforts of the Massachusetts Audubon Society, who has been working with landowners in this subwatershed to control NPS pollution through a 319 Nonpoint Source Grant Program study entitled *The Mill River Watershed Nonpoint Source Reduction Implementation Project* (Cooper 1995). The Hillside/Mill Street crossing was a potential source of localized NPS inputs to the MR03 sampling reach; however, there were no obvious signs (e.g., sediment deposition, substrate embeddedness) of road runoff during the time of sampling.

Both stream banks were well-vegetated and stabilized by an established layer of shrubby and herbaceous growth. The dense layer of riverbank grape (*Vitis riparia*), rose (*Rosa* sp.), jewelweed (*Impatiens capensis*), and purple loosestrife (*Lythrum salicaria*) along the right (east) bank gave way to a wide riparian zone dominated by a mix of hardwoods—most notably ash (*Fraxinus americana*), elm (*Ulmus rubra*), red maple (*Acer rubrum*), and willow (*Salix* sp.). Similar types of herbaceous and shrubby growth provided only a minimal riparian buffer along the left (west) bank, however, due to the close proximity of a road along the entire length of the sampling reach. MR03 received a total habitat assessment score of 146/200 (Table A4).

Benthos

The benthos assemblage at MR03 received a total metric score of 28, representing 74% comparability to the reference community at FB00 and resulting in a “slightly impacted” assessment of biological condition (Table A2). The low scoring community similarity metric (score= 0) inferred that community composition was highly dissimilar to the reference community at FB00. In addition, taxa richness and EPT index were lower than at FB00 (Table A2). Interestingly, both total taxa richness and EPT richness were higher at MR03 in 1994—when they were 26 and 8 respectively—than during the 1999 bioassessment (Fiorentino 1996a); however, this discrepancy may simply be the result of temporal variability or differing sampling procedures.

The numerous filter-feeding caddisflies (*Cheumatopsyche* sp., *Hydropsyche betteni* gr., and *Chimarra* sp.) found at MR03 suggest that an abundance of fine particulate organic material (FPOM) provides an important food resource in this portion of the river. Much of this FPOM probably originates from the impoundments (Upper and Lower Mill ponds) immediately upstream from MR03. Typically, in lentic systems such as ponds and impoundments, the primary source of organic matter is autochthonous (produced within the system), with secondary inputs of allochthonous (transported into the system from someplace else) materials from shoreline vegetation and fluvial inputs (Wetzel 1975, Merritt et al. 1984). Phytoplankton production—and to a lesser extent, littoral vascular plant production—and associated dissolved organic matter (DOM), are the primary source of autochthonous matter (Wetzel 1975). It is the physical-chemical flocculation (nonbiological) of this DOM and/or other biological processes that leads to the formation of FPOM, the primary nutrition resource utilized by filter-feeders (Wetzel 1975). While FPOM production in lotic systems is primarily a result of the processing of course particulate organic material (CPOM) contributed by aquatic shredders, the high concentration of FPOM in stream systems immediately below pond and reservoir outlets has mainly lentic origins. If these lentic systems are subjected to increasingly eutrophic conditions the resulting effects of enrichment (i.e., increased algal, plant, and DOM production) can be seen not only in the lentic fauna, but also in the lotic aquatic communities immediately downstream. Nutrient/organic loadings originating from various nonpoint sources in the Mill River sub-basin, such as inadequate septic systems or agricultural runoff, probably contribute to the productive conditions that supply the abundant FPOM food resource to the MR03 aquatic community. Indeed, elevated nutrient levels were documented by DEP at multiple locations in Mill River during the 1994 Parker River watershed assessment (MA DEP, unpublished data, 1994). In addition, the proliferation of noxious aquatic vegetation—specifically the water chestnut, *Trapa natans*—was documented by DEP in both the Upper and Lower Mill ponds during the 1994 survey, corroborating the productive nature of this portion of Mill River (MA DEP 1999).

Trophic structure at MR03 did not grossly favor a FPOM-based benthos assemblage, however, as indicated by the high scoring (score= 6) scraper/filterer metric (Table A2). Indeed a periphyton-based community, comprised of algal grazers such as the elmid and psephenid beetles, was well represented (Table A1). Nevertheless, every effort should be made to minimize nutrient loads and other NPS inputs to Mill River, as further loads may contribute to additional reductions in taxa richness as well as a lack of trophic balance among the MR03 community.

Ox Pasture Brook

OX03—Ox Pasture Brook, mile point 0.70, downstream from Fenno Road, Rowley, MA

Habitat

The OX03 sampling reach began approximately 1.0 km downstream from Fenno Road and was located within the densely forested Mill Creek Wildlife Management Area. Although DWM conducted macroinvertebrate biomonitoring at Fenno Road (OX02) during the 1994 biosurvey, habitat constraints—most notably in the form of shallow, stagnant water and unproductive mucky substrates—precluded the ability to apply current DWM sampling protocols and produce useful benthos data here during the 1999 survey. Because the 1999 biosurvey of Ox Pasture Brook was conducted considerably farther downstream from OX02 and in a portion of the stream with far superior habitat, it is impossible to determine if water quality and habitat quality have improved at OX02 since the 1994 survey. However, findings of the 1999 benthic macroinvertebrate survey at OX03 should still provide DWM with the necessary information needed to make aquatic life use assessment decisions for this stream.

The OX03 sampling reach contained an abundance of cobble, boulder, and woody material subjected to swift current velocity; however, extremely low base-flow (channel only 50% full) resulted in much exposed substrate and unusable fish cover. As a result, epifaunal benthos habitat and fish habitat were considered marginal and poor respectively. Bank and riparian habitat parameters scored well. Banks were well-vegetated and stabilized with boulders and root masses. Riparian vegetation was dominated by red maple (*Acer rubrum*), red oak (*Quercus rubra)*, ash, (*Fraxinus americana*) and some conifers (white pine, *Pinus strobus*) and extended undisturbed from the moss-covered banks. There was no evidence of instream sediment deposition or other NPS-related habitat degradation, as was the case farther upstream at OX02 during the 1994 biosurvey. OX03 received a total habitat assessment score of 148/200 (Table A4).

Benthos

The benthic community at OX03 received a total metric score of 30, representing 79% comparability to FB00 and placing it just outside the “non-impacted” biological condition category (Table A2). Despite point reductions in the richness (taxa richness; EPT index) metric scores, a biotic index of 3.94 was actually lower than that for the reference community at FB00 (Table A2). Contributing most to the low biotic index was the pollution-sensitive mayfly, *Stenonema* sp, as well as the elmid beetles—a relatively intolerant insect family whose plastron respiration requires well-oxygenated instream conditions (Peckarsky et al. 1990). In addition, the abundance of these algal scrapers indicates the importance of periphyton as a food resource at OX03 and is corroborated by the high scoring (score= 6) scraper/filterer metric (Table A2).

Based on the balance in trophic structure and presence of numerous pollution-sensitive taxa among the OX03 macroinvertebrate community, it appears that habitat constraints rather than water quality are probably most limiting to biological potential in this portion of Ox Pasture Brook. In particular, naturally occurring base-flow reductions and the resulting effects (e.g., exposed substrates) on epifaunal sustrate availability may most shape community composition at OX03; yet, impacts to the resident biota currently appear minimal at most, as reflected in the “non/slightly impacted” bioassessment. Road and stormwater runoff originating in downtown Rowley—believed to compromise both habitat and water quality at the OX02 biomonitoring station during the 1994 survey (Fiorentino 1996a)—does not appear to impact biological integrity in the OX03 sampling reach. It is possible that BMP implementation (e.g., Stormtreat™ installation near Rowley center) resulting from findings of the 1994 bioassessment of Ox Pasture Brook has helped to minimize the effects of NPS pollution here.

Penn Brook

PB01—Penn Brook, mile point 0.10, upstream from Parsonage and North streets, Georgetown, MA

Habitat

Sampling at PB01 commenced immediately upstream from Parsonage Street and extended for approximately 20 m. This heavily developed portion (housing subdivisions) of Penn Brook is located downstream from the recently capped town dump serving Georgetown. Flow constraints, as well as degraded riparian and instream habitat quality in Penn Brook, precluded valid benthos comparisons to the regional reference station (FB00). Nevertheless, a qualitative bioassessment was conducted in attempt to discern the effects of gross impairment to the resident biota. The collection procedure consisted of numerous “jabs” in beds of the rooted emergent macrophyte, *Sparganium* sp. (burreed), as well as “kicks” in the limited hard substrates (snags, gravel/cobble) available immediately upstream from Parsonage Road. Although some riffle areas did exist in the PB01 sampling reach, they were extremely shallow and usually in areas with soft substrates. Flow regimes were predominantly comprised of isolated mud-bottom pools with no perceptible current velocity. NPS inputs in the form of trash, grass clippings, and other yard waste were observed along much of the stream, especially where the vegetative buffer from encroaching yards was minimal. In addition, sediment deposition was evident throughout the sampling reach, presumably the result of runoff from nearby yards and the adjacent road (North Street) along the minimally buffered left (west) bank. The effects of runoff and severe bank erosion along the left bank were probably exacerbated by the extremely thin riparian zone here, consisting of a few trees (red maple, *Acer rubrum*; ash, *Fraxinus americana*) and beds of poison ivy (*Rhus radicans*). Much of the riparian vegetation along the right (east) bank consisted of the invasive purple loosestrife (*Lythrum salicaria*). Turbid instream conditions, and heavy deposits of FPOM on substrates and accumulating in pools, suggested water quality problems possibly related to organic enrichment associated with NPS pollution.

Benthos

The qualitative nature of the macroinvertebrate sampling efforts at PB01 precludes the generation of an assessment score for biological condition here; however, the benthos assemblage observed suggests the absence of gross levels of organic pollution. Despite the extremely limited benthos habitat throughout the PB01 sampling reach, a total of 15 taxa were observed, including 4 EPT families and representing every major trophic guild (Table A1). Other fairly sensitive taxa observed here include the Elmidae, Sialidae, and Aeshnidae.

Although an upstream landfill is a perceived threat to biological integrity in this portion of Penn Brook, more localized NPS pollution may compromise biological potential most here. One major threat to the resident benthic community at PB01 is instream sedimentation. Sand and other fine sediments drastically reduce macroinvertebrate microhabitat by filling the intersticial spaces of epifaunal substrates. In addition, the filling of pools with sediment reduces fish cover and may be detrimental to fish egg incubation.

Removal and/or disturbance of riparian vegetation may exacerbate the effects of NPS pollution related to road runoff and yard waste originating from adjacent residences. Outreach efforts are recommended to educate residents on how improper yard waste disposal impacts aquatic life “in their own back yard,” as well as the importance of maintaining a riparian buffer zone. In addition, local clean-up efforts to remove instream trash and debris should be encouraged.

Parker River

PR01B—Parker River, mile point 19.60, downstream from Route 133, Boxford, MA

Habitat

The PR01B sampling reach began approximately 600 m downstream from Route 133, in a predominantly forested portion of Boxford. Upstream from several groundwater wells serving the town of Georgetown, it was anticipated that PR01B would serve as an upstream control for biological comparisons with downstream monitoring stations that may be impacted by flow reductions associated with these water withdrawals. While DWM established baseline biological "control" conditions a short distance farther downstream near Pine Plain Road (PR01A) during the 1994 biomonitoring survey, the effects of beaver activity (i.e., dams) made it impossible to sample the now-flooded wetland encountered there during the 1999 biomonitoring survey.

The fully shaded PR01B stream reach meandered through a dense forest of hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), red oak (*Quercus rubra*), and red maple (*Acer rubrum*) with an abundance of fern along the stream banks and understory. The reach consisted of isolated, short riffle areas interspersed with slow runs and pockets of standing water before gradually giving way to "flat" water farther downstream that was more typical of this portion of the subwatershed. The top of the reach was delineated by an enormous (approximately 40 m wide) beaver dam responsible for extensive flooding of the river upstream and altered (i.e., sluggish) flow downstream. Fish habitat was adequate, with snags and submerged logs providing ample cover in some of the deeper pools present. Epifaunal habitat for macroinvertebrates was only marginal due to limited riffle areas and a preponderance of soft (sand and silt) substrates and FPOM deposits probably originating from the wetland upstream and/or beaver activity. Snags submerged in shallow riffles provided some productive benthos habitat in addition to occasional gravel beds and undercut banks. Instream vegetation consisted of small amounts of free-floating duckweed (*Lemna* sp.) and a thin film of surface algae. Both stream banks were well-vegetated with ferns and mosses, and root masses and the remnants of an old stone wall provided good bank stability. Riparian vegetation, consisting of a woodland forest with an even mix of deciduous and evergreen trees, extended undisturbed in both directions. There were no obvious sources of NPS pollution; however, slight sediment deposition was noted in portions of the sampling reach. PR01B received a total habitat assessment score of 134/200 (Table A4).

Benthos

The macroinvertebrate assemblage at PR01B received a total metric score of 26, representing 68% comparability to the FB00 assemblage. Reductions in total taxa richness, as well as EPT richness, contributed to the "slightly impacted" bioassessment (Table A2). An abundance of filter-feeding organisms (e.g., Hydropsychidae and Chironomidae), along with gathering collectors such as the gammarid amphipods, indicated that suspended and deposited forms of organic matter are the primary food resources in this portion of the river. In addition, the biotic index for the PR01B benthos assemblage was highest of all the Parker River watershed biomonitoring stations, corroborating the effects of mild organic enrichment here. Contributing greatly to the high biotic index value was the abundant midge, *Rheotanytarsus exiguus* gr., a tolerant taxon that has been found to be an indicator of high levels of suspended organic particulate matter (Bode and Novak 1998). The absence of a periphyton-based trophic guild (i.e., algal grazers) was evidenced by the conspicuous lack of scrapers (scraper/filterer metric score= 0) in the PR01B macroinvertebrate assemblage (Tables A1 and A2).

In lieu of anthropogenic perturbations in this mostly undeveloped portion of the Parker River, instream organic loads here may be naturally occurring—the result of extensive upstream wetland areas that may offer substantial organic inputs in the form of allochthonous materials. Recent beaver activity may also compound the effects (e.g., possible low dissolved oxygen levels, FPOM deposits, slight turbidity) of organic enrichment at PR01B. In addition, beaver activity may remove or adversely affect productive benthos habitat as a result of altered flow regimes due to dams.

Parker River

PR02—Parker River, mile point 17.4, at Bailey Lane, Georgetown, MA

Habitat

The PR02 sampling reach, which during the 1994 biosurvey contained at least some productive lotic habitat for macroinvertebrates in the form of short riffle areas with cobble/gravel substrates, displayed virtually no perceptible current velocity during the 1999 survey. A beaver dam constructed immediately upstream from the Bailey Lane crossing now results in slow/deep, lentic habitat with a primarily muddy bottom and flooded wetland margins throughout this portion of the Parker River. Due to flow constraints and substrates dissimilar to either the upstream or regional reference station, and not suitable for the RBPIII sampling methodologies, only a qualitative assessment of biological conditions at PR02 could be made during the 1999 survey. Instream vegetation provided virtually all the productive habitat for macroinvertebrates here during the 1999 survey. Rooted submergent burreed (*Sparganium* sp.) and Arrow Arum (*Peltandra virginica*) were the most common macrophytes observed, with floating duckweed (*Lemna* sp.) abundant as well. Channel margins were dominated by purple loosestrife (*Lythrum salicaria*) and various wetland shrubs (dogwood, *Cornus* sp.; buttonbush, *Cephalanthus occidentalis*) before giving way to forested areas of red oak *(Quercus rubra*) and red maple (*Acer rubrum*). Localized NPS pollution in the form of sediment deposition was observed immediately downstream from Bailey Lane, most likely originating from the road crossing via a paved "swale" along the right (south) bank or from the road itself.

Benthos

Despite the limited epifaunal habitat encountered here during the 1994 biosurvey, an abundance of relatively pollution-sensitive taxa contributed to overall high taxa richness. And while several of the insect orders present (e.g., Hemiptera and Odonata) during the 1994 survey were more typical of lentic wetland-dominated systems, lotic forms were well represented also (Fiorentino 1996b). This contrasts markedly with the benthos sample taken during the 1999 biosurvey at PR02, which yielded only 8 taxa—most of which were non-insect forms (e.g., Viviparidae, Gammaridae, and Asellidae) typical of lentic habitats (Table A1). The discrepancy in community composition between the 1994 and 1999 benthos samples may be related to changes in flow regimes here, as recent beaver activity (i.e., dams) has dramatically altered hydrology in this portion of the river since the 1994 biosurvey when riffle areas were still present. Biological sampling efforts at PR02 in 1999 found a deep, pool-dominated wetland channel with no appreciable current velocity. At this time it is unclear whether nearby groundwater withdrawals have affected discharge and flow regimes at PR02; however, the ability to discern these potential impacts will no doubt be confounded by the hydrological effects of beaver activity in this portion of the Parker River.

Parker River

PR00—Parker River, mile point 10.90, upstream from Main Street, Byfield, Newbury, MA

Habitat

The PR00 sampling reach began approximately 10 m upstream from Main Street, in the Byfield section of Newbury, and extended 100 m upstream to the base of a small dam which marked the top of the reach. A fish ladder extending from near the bottom of the reach to the impoundment just upstream, and a stone wall along much of the left (north) bank, were evidence of the historical mill activity in this portion of the river. Some deposition of FPOM was observed on the rocky substrates and pool areas of the PR00 reach—probably a result of its location downstream from the impoundment. Nevertheless, well-developed riffle areas with an abundance of moss-covered cobble and boulder substrates dominated the reach, providing some of the best fish and macroinvertebrate habitat observed during the 1999 Parker River watershed survey. Bank stability along the left bank was good, with boulders and the adjacent wall providing reinforcement. A wide and undisturbed riparian zone consisting of red maple (*Acer rubrum*), ash (*Fraxinus americana*), and elm (*Ulnus rubra*) extended from the well-vegetated left bank as well. Bank stability was slightly less than optimal along the right bank, with erosion effects probably exacerbated by the removal of bank and riparian vegetation in the vicinity of an adjacent residential property and nearby road (Main Street). The close proximity of the road resulted in only a narrow riparian zone to buffer the effects of potential NPS inputs in the form of runoff. PR00 received a total habitat assessment score of 155/200 (Table A4).

Benthos

Despite the excellent epifaunal habitat found at PR00, the benthos assemblage received a total metric score of only 26, representing 68% comparability to the regional reference station (Table A2). Between the hydropsychids and another net-spinning caddisfly, Philopotamidae, filter-feeding Tricopterans comprised more than half of the benthos sample, indicating an unbalanced community responding to a preponderance of suspended FPOM in this portion of the Parker River. The low scoring (score= 0) scraper/filterer metric further supports that filter-feeders have displaced periphyton grazers as the dominant trophic guild (Table A2). Upstream impoundments probably deliver an abundance of organic particulates to the PR00 community. As previously discussed, deposits of FPOM were indeed observed on much of the epifaunal substrate in the PR00 sampling reach.

It appears, then, that water quality rather than habitat quality is most limiting to biological potential at PR00, with the impounded nature of this portion of the river having a pronounced effect on community composition and trophic structure, and resulting in a “slightly impacted” bioassessment of the PR00 aquatic community (Table A2).

When compared to the more upstream mainstem station PR01B, the PR00 benthic community received a total metric score of 38, representing 90% comparability. Several metrics at PR00—including EPT index, biotic index, and EPT/Chironomidae—performed better than for the PR01B assemblage, resulting in a “non-impacted” bioassessment (Table A3). However, the impairment detected at PR01B (“slightly impacted” when compared to the FB00 regional reference station) may render it inappropriate as a control station and undermine the utility of these upstream-downstream comparisons.

SUMMARY/RECOMMENDATIONS

Jackman Brook (JK01)—The macroinvertebrate community at JK01 was dominated by highly sensitive taxa, reflecting overall excellent biological integrity and good water quality in this portion of Jackman Brook. Every effort should be made to maintain the diverse benthic community encountered here—maintaining current base-flow as well as instream and riparian habitat is essential. Instream deposition probably threatens biological potential most here. Sediment inputs—which can be detrimental to trout spawning habitat and epifaunal benthos habitat, and that most likely originate from the Jackman Street crossing—should be minimized. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP Parker River watershed survey in 2004.

Mill River (MR03)—Despite the efforts of both the Massachusetts Audubon Society and landowners to control NPS pollution in this subwatershed, the MR03 benthic communty continues to reflect the effects of organic enrichment—most likely the result of nutrient loadings to Upper and Lower Mill ponds or elsewhere along Mill River. Nutrient/organic loadings originating from inadequate septic systems, or various forms of runoff (e.g., agriculture, lawns, stormwater), probably contribute to the productive conditions of the upstream impoundments that supply an abundant FPOM food resource to the MR03 aquatic community. Outreach on septic system maintenance in concert with investigation of septic systems in this subwatershed should be conducted. Outreach on NPS pollution associated with agricultural practices is warranted as well. Biomonitoring (macroinvertebrates and fish) is strongly recommended here during the next DEP watershed survey in 2004, allowing DEP to document any improvements made as a result of the 319 grant entitled *The Mill River Watershed Nonpoint Source Reduction Implementation Project*. In addition, water quality monitoring throughout the Mill River subwatershed—especially bacteria and nutrient sampling—may help to isolated sources of anthropogenic impacts. That algal cover was not as prolific here compared to the 1994 biosurvey is somewhat encouraging.

Ox Pasture Brook (OX03)—While water quality may be suspect in the upper portions of this subwatershed, it appears that habitat constraints are probably most limiting to biological potential in this segment of Ox Pasture Brook. In particular, naturally occurring base-flow reduction and the resulting effects (e.g., exposed substrates) on epifaunal substrate availability may most shape community composition at OX03. Every effort should be made to maintain current base-flow here, as numerous pollution-sensitive taxa were encountered during the biosurvey. Additional fish community and macroinvertebrate sampling should be conducted here during the next “year 2” phase of the basin cycle for the Parker River watershed. Monitoring physico-chemical parameters such as dissolved oxygen and pH may aid in the interpretation of future biomonitoing data collected here.

Penn Brook (PB01)—Habitat degradation poses a serious threat to biological integrity in this portion of Penn Brook. In particular, removal and/or disturbance of riparian vegetation may exacerbate the effects of NPS pollution related to yard waste originating from adjacent residences and runoff from North Street (upstream road crossings may contribute sediment loads as well). Outreach efforts are recommended to educate residents on how improper yard waste disposal impacts aquatic life “in their own back yard,” as well as the importance of maintaining a riparian buffer zone. In addition, local clean-up efforts to remove instream trash and debris should be encouraged. Biomonitoring should be conducted here again during the 2004 DEP watershed survey in this basin. If possible, more intensive (i.e., RBPIII) macroinvertebrate sampling should be conducted, coupled with water quality monitoring.

Parker River (PR01B; PR02; PR00)—Both the PR01B and PR00 stations were characterized by a benthos assemblage structured in response to mild organic enrichment. The preponderance of FPOM—both deposited and suspended—provides an important food resource to high densities of filter feeders and gathering collectors at PR01B and PR00 respectively. The organic loads that appear to shape community composition and trophic structure at both these stations may originate from naturally productive wetland systems and/or FPOM-rich impoundments located upstream. In addition, upstream beaver activity may result in the delivery of particulate organic materials to the benthos at PR01B and PR02, while at the same time altering channel morphology and instream flow regimes. While habitat constraints made it impossible for DWM to effectively assess the potential impacts of groundwater withdrawals on the aquatic community in this portion of the Parker River, efforts should be made to address this again during the 2004 biosurveys here—possibly after further development by DWM of macroinvertebrate sampling methodologies that accurately assess biological condition in low gradient, wetland-dominated stream systems. An investigation of land-use and possible NPS pollution along the mainstem Parker River upstream from PR00 (especially in the vicinity of the impoundments in Byfield) may be warranted. Biomonitoring is recommended here again as part of the 2004 monitoring efforts for the Parker River watershed. Diurnal dissolved oxygen monitoring, nutrient sampling, and chlorophyll *a* sampling may help to better understand primary productivity in this portion of the Parker River.

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APPENDIX

Macroinveretebrate taxa list, RBPIII analyses, and Habitat evaluations

Table A1. Species-level taxa list and counts, functional feeding groups (FG), and tolerance values (TV) for macroinvertebrates collected during the Parker River watershed survey between 28 July and 5 August 1999. An "x" indicates taxon presence at those stations sampled qualitatively. Refer to Table 1 for a complete listing and description of sampling stations.

TAXON	FG[1]	TV[2]	FB00	JK01	MR03	OX03	PB01	PR00	PR01B	PR02
Hydrobiidae	SC	8			1		x			x
Viviparidae	SC	6								x
Laevapex fuscus	SC	7			1					
Pisidiidae	FC	6	5	1	3	8	x	8	2	x
Nais elinguis	GC	10		1						
Tubificidae (immature w/o capilliform chaetae)	GC	10					x			
Lumbriculus sp.	GC	8	3	4		1		1	4	
Asellidae	GC	8					x			x
Caecidotea communis	GC	8			1			2	2	
Gammaridae	GC	6					x			x
Gammarus sp.	GC	6	33	23		1		2	21	
Baetidae	GC	4			3			1		
Baetidae (subequal terminal filaments)	GC	6			1	1				
Eurylophella sp.	GC	2		1						
Heptageniidae	SC	4					x			
Stenonema sp.	SC	3	2		3	28			1	
Leptophlebiidae	GC	2		1					4	
Paraleptophlebia sp.	GC	1				2				
Aeschnidae	PR	3					x			
Calopterygidae	PR	5					x			
Coenagrionidae	PR	9				1				x
Acroneuria sp.	PR	0						2		
Hansonoperla sp.	PR	1	2							
Leuctra sp.	SH	0	7	24					1	
Neoperla sp.	PR	3						2		
Perlesta sp.	PR	5	1							
Hemiptera	PR	5					x			
Corydalidae	PR	5					x			
Nigronia sp.	PR	0				5		1	1	
Sialidae	PR	4					x			
Sialis sp.	PR	4		2						
Brachycentrus sp.	FC	1						1		
Glossosoma sp.	SC	0		2						
Philopotamidae	FC	3					x			
Chimarra sp.	FC	4			8	19		32		

[1] Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: **SH**-Shredder; **GC**-Gathering Collector; **FC**-Filtering Collector; **SC**-Scraper; **PR**-Predator. [2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms which are very tolerant.

Table A1. (Continued)

TAXON	FG[1]	TV[2]	FB00	JK01	MR03	OX03	PB01	PR00	PR01B	PR02
Dolophilodes sp.	FC	0		1						
Cheumatopsyche sp.	FC	5		5	16	2		3	19	
Hydropsyche sp.	FC	4	1					5	1	
Hydropsyche betteni gr.	FC	6		2	21	8		17		
Lepidostoma sp.	SH	1		3	7					
Leucotrichia sp.	SC	6		1						
Uenoidae	SC						x			
Neophylax sp.	SC	3	1							
Oecetis sp.	PR	5	1							
Psilotreta sp.	SC	0	1							
Limnephilidae	SH	4					x			
Pycnopsyche sp.	SH	4		1					1	
Rhyacophila sp.	PR	1		2						
Elmidae	SC	4					x			
Microcylloepus sp.	GC	3	2		4					
Microcylloepus pusillus	GC	3				1		1		
Optioservus sp.	SC	4	5	2	2	8				
Optioservus ovalis	SC	4				2				
Oulimnius latiusculus	SC	4		1	5	2		1		
Promoresia sp.	SC	2			1					
Promoresia tardella	SC	2	6			6				
Psephenidae	SC	4					x			
Psephenus herricki	SC	4	1		12	2		1		
Stenelmis sp.	SC	5	1		11	6		8	4	
Stenelmis crenata	SC	5			2					
Chironomidae	GC	6					x			x
Conchapelopia sp.	PR	6	1		2			1	7	
Krenopelopia sp.	PR	7		1						
Procladius sp.	PR	9							1	
Thienemannimyia sp.	PR	6	1							
Corynoneura sp.	GC	4		1						
Micropsectra sp.	GC	7	8		2	2			11	
Microtendipes pedellus gr.	FC	6	3						2	
Microtendipes rydalensis gr.	FC	6	1							
Parametriocnemus sp.	GC	5	1			1				
Phaenopsectra sp.	SC	7	1							
Polypedilum aviceps	SH	4		8		3				
Polypedilum fallax	SH	6	1							
Polypedilum flavum	SH	6						17	1	
Polypedilum tritum	SH	6	1						3	
Rheotanytarsus distinctissimus gr.	FC	6							3	
Rheotanytarsus exiguus gr.	FC	6							18	

[1] Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: **SH**-Shredder; **GC**-Gathering Collector; **FC**-Filtering Collector; **SC**-Scraper; **PR**-Predator. [2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms which are very tolerant.

Table A1. (Continued)

TAXON	FG[1]	TV[2]	FB00	JK01	MR03	OX03	PB01	PR00	PR01B	PR02
Stempellinella sp.	GC	2	2							
Tanytarsus sp.	FC	6	2						1	
Tvetenia bavarica gr.	GC	5	1	8		2				
Culicidae	FC	na								x
Chelifera sp.	PR	6		1						
Simulium sp.	FC	5		1						
Tipulidae	SH	5					x			
Dicranota sp.	PR	3	2			2				
Paradelphomyia sp.	PR	5		2						
TOTAL			97	99	106	113	QUALITATIVE	106	108	QUALITATIVE

[1] Functional Feeding Group (FG) lists the primary feeding habit of each species and follows the abbreviations: **SH**-Shredder; **GC**-Gathering Collector; **FC**-Filtering Collector; **SC**-Scraper; **PR**-Predator. [2] Tolerance Value (TV) is an assigned value used in the calculation of the biotic index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms which are very tolerant.

Table A2. Summary of RBP III data analysis for macroinvertebrate communities sampled during the Parker River watershed survey between 28 July and 5 August 1999. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (FB00), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION #	FB00		JK01		MR03		OX03		PR01B		PR00	
STREAM	Fish Brook		Jackman Brook		Mill River		Ox Pasture Brook		Parker River		Parker River	
HABITAT SCORE	158		126		146		148		134		155	
TAXA RICHNESS	29	*6*	25	*6*	18	*4*	22	*4*	21	*4*	18	*4*
BIOTIC INDEX	4.81	*6*	3.70	*6*	4.66	*6*	3.94	*6*	5.70	*4*	4.90	*6*
EPT INDEX	8	*6*	11	*6*	6	*2*	6	*2*	6	*2*	7	*4*
EPT/CHIRONOMIDAE	0.70	*6*	2.39	*6*	14.75	*6*	7.50	*6*	0.57	*6*	3.50	*6*
SCRAPERS/FILTERERS	1.50	*6*	0.60	*4*	0.79	*6*	1.46	*6*	0.11	*0*	0.15	*0*
COMMUNITY SIMILARITY	100%	*6*	71%	*6*	31%	*0*	45%	*2*	62%	*4*	49%	*2*
% DOMINANT TAXON	34%	*2*	24%	*4*	20%	*4*	25%	*4*	19%	*6*	30%	*4*
TOTAL METRIC SCORE	*38*		*38*		*28*		*30*		*26*		*26*	
% COMPARABILITY TO REFERENCE STATION			100%		74%		79%		68%		68%	
BIOLOGICAL CONDITION-DEGREE IMPAIRMENT	**REFERENCE**		**NON-IMPACTED**		**SLIGHTLY IMPACTED**		**NON/ SLIGHTLY IMPACTED**		**SLIGHTLY IMPACTED**		**SLIGHTLY IMPACTED**	

Table A3. Summary of RBP III data analysis for macroinvertebrate communities sampled at stations in the Parker River on 4 and 5 August 1999. Shown are the calculated metric values, metric scores (in italics) based on comparability to the upstream reference station (PR01B), and the corresponding assessment designation for the PR00 biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

STATION #	**PR01B**		**PR00**	
STREAM	Parker River		Parker River	
HABITAT SCORE	134		155	
TAXA RICHNESS	21	*6*	18	*6*
BIOTIC INDEX	5.70	*6*	4.90	*6*
EPT INDEX	6	*6*	7	*6*
EPT/CHIRONOMIDAE	0.57	*6*	3.50	*6*
SCRAPERS/FILTERERS	0.11	*6*	0.15	*6*
COMMUNITY SIMILARITY	100%	*6*	55%	*4*
% DOMINANT TAXON	19%	*6*	30%	*4*
TOTAL METRIC SCORE	*42*		*38*	
% COMPARABILITY TO REFERENCE STATION			90%	
BIOLOGICAL CONDITION-DEGREE IMPAIRMENT	**REFERENCE**		**NON-IMPACTED**	

Table A4. Habitat assessment summary for macroinvertebrate biomonitoring stations sampled during the 1999 Parker River watershed survey. For primary parameters, scores ranging from 16-20 = optimal; 11-15 = suboptimal; 6-10 = marginal; 0-5 = poor. For secondary parameters, scores ranging from 9-10 = optimal; 6-8 = suboptimal; 3-5 = marginal; 0-2 = poor. Refer to Table 1 for a complete listing and description of sampling stations.

STATION	**FB00**	**JK01**	**MR03**	**OX03**	**PR00**	**PR01B**
PRIMARY PARAMETERS (range is 0-20)						
INSTREAM COVER	15	8	7	5	18	11
EPIFAUNAL SUBSTRATE	13	8	17	10	18	7
EMBEDDEDNESS	15	11	19	19	19	14
CHANNEL ALTERATION	16	19	15	20	15	14
SEDIMENT DEPOSITION	15	6	18	20	15	16
VELOCITY-DEPTH COMBINATIONS	10	6	13	6	14	7
CHANNEL FLOW STATUS	16	8	9	8	11	6
SECONDARY PARAMETERS (range is 0-10 for each bank)						
BANK VEGETATIVE PROTECTION	10 10	10 10	9 10	10 10	10 6	10 10
BANK STABILITY	10 8	10 10	8 10	10 10	10 8	10 10
RIPARIAN VEGETATIVE ZONE WIDTH	10 10	10 10	1 10	10 10	10 1	9 10
TOTAL SCORE	**158**	**126**	**146**	**148**	**155**	**134**
%COMPARABILITY TO REFERENCE (FB00)		**80%**	**92%**	**94%**	**98%**	**85%**

APPENDIX D - MA DEP GRANT AND LOAN PROGRAMS

Excerpted from the MA DEP DWM World Wide Web site, http://www.state.ma.us/dep/brp/wm/wmpubs.htm#other '1999 Grant and Loan Programs - Opportunities for Watershed Planning and Implementation'.

604(b) WATER QUALITY MANAGEMENT PLANNING GRANT PROGRAM
This grant program is authorized under the federal Clean Water Act, Section 604(b); for water quality assessment and management planning. Section 604(b) projects in the Parker River Watershed include:

- 98-02/604 *Little River NonPoint Source Assessment.* This project will comprehensively inventory, map, and assess nonpoint sources of pollution in the Little River subwatershed of the Parker River Basin.

104(b)(3) WETLANDS AND WATER QUALITY GRANT PROGRAM
This grant program is authorized under Section 104(b)(3) of the federal Clean Water Act. The water quality proposals received by MA DEP under this National Environmental Performance Partnership Agreement (NEPPA) with the U.S. Environmental Protection Agency is a results-oriented approach that will focus attention on environmental protection goals and the efforts to achieve them. The goals of the NEPPA are to: 1) achieve clean air, 2) achieve clean water, 3) protect wetlands, 4) reduce waste generation, and 5) clean up waste sites. Section 104(b)(3) projects include:

- 99-07/104 *Identifying Sources of Microbiology Contaminants of Freshwater Beaches.* Numerous beaches in the Commonwealth are closed to swimming periodically due to microbiological contamination. This project would field test a cooperative approach involving MA DEP, local officials and local basin watershed associations to identify sources of bacterial contamination at freshwater beaches by sampling dry and wet weather discharges from stormwater outfalls. It will also involve using techniques such as comparing microbiological contamination from illicit sewage connections versus contamination from street runoff.

319 NONPOINT SOURCE GRANT PROGRAM
This grant program is authorized under Section 319 of the CWA for implementation projects that address the prevention, control, and abatement of nonpoint source (NPS) pollution. In order to be considered eligible for funding projects must: implement measures that address the prevention, control, and abatement of NPS pollution; target the major source(s) of nonpoint source pollution within a watershed/subwatershed; have a 40 percent non-federal match of the total project cost (match funds must meet the same eligibility criteria as the federal funds); contain an appropriate method for evaluating the project results; and address activities that are identified in the Massachusetts NPS Management Program Plan.

RESEARCH AND DEMONSTRATION GRANT PROGRAM
The Research and Demonstration (R&D) Program is authorized by Section 38 of Chapter 21 of the Massachusetts General Laws and is funded by proceeds from the sale of Massachusetts bonds. Specifically, the R&D Program was established to enable the Department to conduct a program of study and research and demonstration relating to water pollution control and other scientific and engineering studies "...so as to insure cleaner waters in the coastal waters, rivers, streams, lakes and ponds of the Commonwealth."

SOURCE WATER AND TECHNICAL ASSISTANCE/LAND MANAGEMENT GRANT PROGRAM
The Source Water Protection Technical Assistance/Land Management Grant Program provides funds to *third party* technical assistance organizations that assist public water suppliers in protecting local and regional ground and surface drinking water supplies.

MASSACHUSETTS WATERSHED INITIATIVE PROJECTS

Each year EOEA Watershed Team Leaders, in conjunction with State and Federal agencies, municipal governments and regional planning agencies, universities, local watershed associations, businesses and other groups, develop work plans that identify the most important goals for each watershed and the specific projects and programs which are needed to meet those goals.

- 00-03MWI *Development of Watershed Management Plans for Rock and Pentucket Ponds.* The purpose of this project is to prepare action-oriented, watershed management plans for both Rock and Pentucket ponds in the Parker River watershed. This project will compile and summarize existing data, inventory and map key watershed characteristics, assess point and nonpoint source pollution, develop comprehensive management recommendations to enhance water quality, and conduct public outreach.

WELLHEAD PROTECTION GRANT PROGRAM

The Wellhead Protection Grant Program provides funds to assist public water suppliers in addressing wellhead protection through local projects and education.

CLEAN WATER STATE REVOLVING LOAN FUND (SRF) PROGRAM

The Massachusetts State Revolving Loan Fund for water pollution abatement projects was established to provide a low-cost funding mechanism to assist municipalities seeking to comply with federal and state wateer quality requirements. The SRF Program is jointly administered by the Division of Municipal Services of the Department of Environmental Protection and the Massachusetts Water Pollution Abatement Trust. Each year the Department solicits projects from Massachusetts municipalities and wastewater districts to be considered for subsidized loans , which are currently offered at 50%grant equivalency (approximates a no interest loan). In recent years the program has operated at an annual capacity of $150 to $200 million per year, representing the financing of 40 to 50 projects annually. The SRF Program now provides increased emphasis on watershed management priorities. A major goal of the SRF Program is to provide incentives to communities to undertake projects with meaningful water quality and public health benefits and which address the needs of the communities and the watershed.

- In the Parker River Watershed, The town of Newburyport was awarded an SRF Grant in 2000 for improvements to the wastewater treatment facility and collection systems.

COMMUNITY SEPTIC MANAGEMENT PROGRAM

The enactment of the Open Space Bond Bill in March of 1996 provided new opportunities and stimulated new initiatives to assist homeowners with failing septic systems. The law appropriated $30 million to the MA DEP to assist homeowners. The DEP will use the appropriation to fund loans through the Massachusetts Water Pollution Abatement Trust. The fund will provide a permanent state/local administered revolving fund to assist income-eligible homeowners in financing necessary Title 5 repairs. Working together, the MA DEP and the Trust have created the Community Septic Management Program to help Massachusetts' communities protect threatened ground and surface waters while making it easier to comply with Title 5. This loan program offers three options from which a local governmental unit can choose.

- Between 1998 and 2000, the towns of Georgetown, Rowley, and West Newbury were awarded funding under the Community Septic Management Program.

APPENDIX E - DMF SHELLFISH DATA, PARKER RIVER/PLUM ISLAND SOUND COASTAL DRAINAGE AREA

It is the mission of the Division of Marine Fisheries (DMF) to manage, develop, and protect the Commonwealth's renewable living marine resources to provide the greatest public benefit. DMF fosters protection of the marine environment by cooperating with other state and federal agencies on pollution abatement, coastal wetlands protection and other programs concerning coastal waters and marine life. DMF monitors coastal contaminant levels in fish and shellfish, operates a shellfish depuration facility, and evaluates the impacts of coastal development on marine fish and their habitats. DMF provides assistance to local shellfish officers on matters affecting the management of shellfish, and provides expertise on anadromous fish and construction assistance on fishways. Other DMF programs assist commercial and recreational fishermen and educate the public on marine resource issues and values.

The DMF Shellfish Management Program manages shellfish growing areas in compliance with the National Shellfish Sanitation Program (NSSP). The NSSP is a federal/state cooperative program recognized by the U.S. Food and Drug Administration (FDA) and the Interstate Shellfish Sanitation Conference (ISSC). One goal of this program is the sanitary control of shellfish harvested and sold for human consumption. Growing areas are managed with respect to shellfish harvest for direct human consumption and comprise at least one or more classification areas. The classification areas are the management units, and range from being approved to prohibited (six different classification types in all) with respect to shellfish harvest (Tables E1, E2 and E3).

Table E1. DMF Shellfish Management Program Managed Shellfish Growing Area Classifications.

Classification Type	Definition
Approved	Open for harvest of shellfish for direct human consumption.
Conditionally Approved	During the time the area is approved, it is open for harvest of shellfish for direct human consumption subject to local rules and state regulations.
Conditionally Restricted	During the time the area is restricted, it is only open for the harvest of shellfish with depuration subject to local rules and state regulations.
Restricted	Open for harvest of shellfish with depuration subject to local rules and state regulations for the relay of shellfish.
Management Closure	Closed for the harvest of shellfish. Not enough testing has been done in the area to determine whether it is fit for shellfish harvest or not.
Prohibited	Closed for the harvest of shellfish.

Classification area codes and town names identify each DMF shellfish area. The Parker River/ Plum Island Sound Coastal Drainage Area 1999 Water Quality Assessment Report describes each shellfishing area by its classification area code and the assessed region is defined in square miles within the DEP/DWM water body system segment. As of October 2000 DMF classified a total of 11,137.968 acres in the Parker River/ Plum Island Sound Coastal Drainage Area (Table E2).

Table E2. Summary Shellfish Classification Area Information as of October 2000.

Classification Type	Area (acres)
Approved	7106.453
Conditionally Approved	3494.853
Prohibited	536.662

Table E3. DMF - Shellfish Project Classification Area Information as of October 2000.

Town	Classification Area Code	Classification Type	Area (Acres)
Ipswich	N3.0	Approved	997.216
Ipswich	N4.0	Conditionally Approved	1620.143
Ipswich	N4.1	Conditionally Approved	274.464
Ipswich	N4.2	Conditionally Approved	23.021
Ipswich	N5.2	Prohibited	0.023
Ipswich	N6.0	Approved	425.862
Ipswich	N6.1	Prohibited	32.473
Newbury	N2.0	Prohibited	58.259
Newbury	N3.0	Approved	1430.912
Newbury	N4.0	Conditionally Approved	640.801
Newbury	N4.3	Prohibited	160.868
Newbury	N4.4	Prohibited	159.468
Newbury	N3.0	Approved	2590.512
Newburyport	N1.0	Prohibited	0.006
Newburyport	N2.0	Prohibited	10.666
Newburyport	N3.0	Approved	135.445
Newburyport	N3.0	Approved	338.444
Rowley	N3.0	Approved	402.639
Rowley	N4.0	Conditionally Approved	920.102
Rowley	N4.2	Conditionally Approved	6.322
Rowley	N4.4	Prohibited	29.131
Rowley	N3.0	Approved	785.423
Salisbury	N1.0	Prohibited	61.23
Salisbury	N2.0	Prohibited	24.538