APPENDIX A –DEP DWM QA/QC

Introduction

Quality Assurance/Quality Control (QA/QC) activities were conducted as part of the DEP DWM Ten Mile River Basin Monitoring Survey in 1997. This QA/QC review was conducted to ensure that the collection and analysis of the monitoring data was of high quality. The 1997monitoring data subjected to this QA/QC review includes the following: discrete water samples, fish tissue samples and *in-situ* water quality measurements. All discrete water sample and fish tissue monitoring data were reviewed independently by the Wall Experiment Station's (WES) Quality Assurance Program and the Division of Watershed Management's (DWM) Quality Assurance Officer and Assessment Coordinator. All *in-situ* water quality measurements were reviewed independently by DWM's Hydrolab® Instrument Coordinator and Database Manager. Data that fell outside established QA/QC acceptance criteria were investigated and may have been subject to censoring. This Quality Assurance/Quality Control appendix is divided into three sections: A.1 field and laboratory data objectives; A.2 QA/QC data; A.3 analytical methods.

A.1 Field and Laboratory QA/QC Objectives

Data collected by DWM in the 1997 Ten Mile River Basin survey was subject to field and laboratory data quality objectives. Section A.1.1 outlines the field collection objectives and laboratory quality control for discrete water samples. Section A.1.2 includes fish tissue laboratory quality control methods and Section A.1.3 includes Hydrolab QA/QC procedures.

A.1.1 Discrete Water Sample Data

FIELD

The collection of discrete water sample analytes followed DWM Standard Operating Procedures [1,2]. Four field collection quality control criteria were applied to the Ten Mile River Basin 1997 discrete water sample data:

1.0 Sampling/Analysis Holding Time: Each analyte has a standard holding time that has been established to ensure sample/analysis integrity. Refer to DWM Standard Operating Procedure Table 1.0 CN# 1.1 [2] for a complete listing. If the standard holding time was exceeded, this objective is violated.

2.0 Quality Control Sample Frequency: At a minimum, one field blank and one replicate must be collected for every ten samples by any given sampling crew on any given date. If less than one quality control sample per 10 field samples was collected, this objective is violated.

3.0 Field Blank: Field blanks were prepared at the DWM Worcester Office. Reagent grade water was transported into the field where it was transferred into a sample container and fixed using the same method as its corresponding field sample. All blanks were submitted to WES laboratory "blind". If the field blanks were significantly different (>2 standard deviations [9]) from the detection limit, this data quality objective is violated.

4.0 Field Replicate: Two independent samples were collected from the same location and as close as possible to the same time in the field. Both samples were submitted to WES laboratory "blind". In order for this data quality objective to be met, the results must be:

<20% Relative Percent Difference (RPD) for method detection limits >1mg/L
<30% RPD for method detection limits <1mg/L

A detailed QA/QC summary of the four data quality objectives and additional DWM quality assurance observations for the 1997 Ten Mile River Basin data can be found in the 1997 Watershed QA/QC Assessment Report [8].

LABORATORY

Discrete water sample analysis followed EPA-approved laboratory QA/QC methodologies in accordance with WES Standard Operating Procedures [3]. The quality of data generated at WES was determined by analyzing the results of a variety of quality control procedures including but not limited to:

Low Calibration Standards – Checks the stability of the instrument's calibration curve. Analyzes the accuracy of an instrument's calibration within a 5% range.

Reference Standards – Generally, a second source standard (a standard different from the calibration stock standard) that analyzes the accuracy of an instrument's calibration within a 5% range.

Laboratory Reagent Blank/Method Blank (LRB) – Reagent grade water (de-ionized) extracted with every sample set to ensure that the system is free of target analytes (< MDL).

Duplicate Sample – Measures the precision (% Relative Percent Difference) of the extraction and analytical process. The acceptable laboratory %RPD range is typically ≤ 25%.

Spike Sample (Laboratory Fortified Blank - LFB, Laboratory Fortified Matrix - LFM)– Measures the accuracy (% Recovery) of an analytical method. The acceptable laboratory % recovery range is typically between 80 – 120% for LFB samples and 70 –130% for LFM discrete water samples.

The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. The frequency of the laboratory's quality control procedure was at times inconsistent with their Quality Assurance Plan [3]. In these circumstances additional quality assurance procedures were used. Refer to WES's Quality Assurance Plan [3] for specific laboratory analytical QA/QC criteria. WES laboratory releases discrete water sample data when their established QA/QC criteria are met or the data are labeled as outside of these criteria.

A.1.2 Fish Tissue Data

Fish were collected and processed according to DWM's Quality Assurance Project Plan [4]. Tissue preparation and analysis strictly adhered to EPA-approved laboratory QA/QC methodologies in accordance with WES Standard Operating Procedures [6,7]. The quality of tissue data generated at WES was determined by incorporating a variety of quality control samples:

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).

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%.

Laboratory Fortified Matrix (LFM) – Tissue matrix spiked with a low concentration of a target compound. LFM 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.

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%.

The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. The frequency of the laboratory's quality control procedure was at times inconsistent with their Quality Assurance Plan [3]. In these circumstances additional quality assurance procedures were used. Refer to WES's Quality Assurance Plan [3] for specific laboratory analytical QA/QC criteria. WES laboratory releases tissue data when their established QA/QC criteria are met or the data are labeled as outside of these criteria.

A.1.3 *In-situ* Water Quality Analysis

Trained DWM staff members conducted *in-situ* measurements using a Hydrolab® Multiprobe Series 3 analyzer. The Hydrolab® Multiprobe Series 3 analyzer measures dissolved oxygen, temperature, pH, conductivity, depth and turbidity and calculates total dissolved solids and % saturation of oxygen. To ensure the quality of the *in-situ* data, the following QA/QC steps were taken:

1.0 Pre-Calibration: After each analytical probe on the Hydrolab® analyzer was calibrated, a pre-calibration check was conducted. A low ionic standard was first analyzed to check the accuracy of the instrument. Then an instrument check consisting of de-ionized water was analyzed to check the instrument for contamination. The instrument check criteria is based on de-ionized water that that had been stored and vented to the air for at least three days. If the pre-calibration check achieved the criteria in Table HL-1 then the instrument was ready for field analysis but if the pre-calibration check failed to achieve the low ionic standard criteria than the instrument was re-calibrated and a second low ionic and instrument check was analyzed. If the instrument failed to meet the established low ionic standard criteria a second time the Hydrolab® instrument could not be used to collect data and maintenance was scheduled. Refer to the DWM Hydrolab® Standard Operating Procedure [5].

2.0 Post Survey Check: Once the Hydrolab® was returned from field sampling, a post survey check was performed to ensure that no malfunction or damage had occurred to any of the Hydrolab® probes. The low ionic standard and the instrument check were re-analyzed. If the post survey check achieved the established criteria in Table HL-1, the data was deemed acceptable and was ready for the data reduction QA/QC step. If, however, the post calibration failed to meet the criteria, the Hydrolab® Coordinator investigated the cause and recommended censoring of affected data to the Database Manager.

3.0 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 was investigated and may have been recommended for censoring. The Database Manager electronically tagged all data recommended for censoring in the database.

Table A.1-1. Hydrolab® Multiprobe Series 3 analyzer pre and post calibration specifications.

Hydrolab® Analyte	Low-Ionic Standard	Instrument Check *
Dissolved Oxygen	Saturation Chart (dependant on temperature & barometric pressure)	
pH	6.90 ±1%	5.6 ±0.2 units
Specific Conductance	74 ±1%	1.0 ±1%
Turbidity	0.0 ±5%	0.0 ±5%
Temperature	Ambient ±0.15°C**	Ambient ±0.15°C**
Depth	Field Calibrated ±0.45m	Field Calibrated ±0.45m
Salinity	Not Applicable	0.0 ±0.2ppt
Redox	Not Applicable	0.0±20mV

* Based on Division of Watershed Management's filtered de-ionized water
** Compared to the DWM laboratory's wall thermometer

REFERENCES

(1) MA DEP. 1999. CN 1.0 Grab Collection Techniques for DWM Water Quality Sampling *1999.* Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

(2) MA DEP. 1999. CN 1.1 Sampling Analytes Table 1.0, *1999*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

(3) MA DEP. 1995. Laboratory Quality Assurance Plan and Standard Operating Procedures, Appendix B and C. January *1995.* Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Senator William X. Wall Experiment Station. Lawrence MA.

(4) MA DEP. 1999. CN 13.0 Fish Contaminant Monitoring Program Quality Assurance Project Plan, *1999*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

(5) MA DEP. 1999. CN 4.0 Hydrolab® Multiprobe Series 3 and Appendixes CN 4.1 – 4.5, *1999*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

(6) MA DEP. 1995. Laboratory Quality Assurance and Standard Operating Procedures, "Wet Tissue Digestion for Metals Analysis by Atomic Absorption Spectroscopy and/or ICP Emission Spectroscopy (Fish, Clams, Mussels, Etc.)", January *1995*. Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Senator William X. Wall Experiment Station. Lawrence MA.

(7) MA DEP. 1995. Laboratory Quality Assurance and Standard Operating Procedures, AOAC Method 983.21 "PCBs and Organochlorine Pesticides in Biological Tissue", January *1995*. Massachusetts Department of Environmental Protection, Division of Environmental Analysis, Senator William X. Wall Experiment Station. Lawrence MA.

(8) MA DEP. 1999. CN 9.0 1997/98 Watershed QA/QC Assessment Report , *1999*. Massachusetts Department of Environmental Protection, Division of Watershed Management. Worcester, MA.

(9) Clesceri, L.S., A.E. Greenberg, and A.D. Eaton, (editors). Standard Methods for the Examination of Water and Wastewater, 20th Edition, American Public Health Association, Washington. Section 1010B "Statistics", pg. 1-2 and 1-3.

A.2 QA/QC DATA

Field blank and replicate sampling results for the discrete bacteriological water quality sampling are provided in Tables A.2-1 and A.2-2. Tables A.2-3 and A.2-4 contain laboratory QA/QC data for organics in tissue analyses and metals in tissue analyses, respectively.

Table A.2-1. 1997 DEP DWM Ten Mile River Basin instream bacteriological QA/QC field blank data. (Units expressed in colonies/100ml.)

			Time (24hr)	FECAL	E-COLI	ENTEROCOCCUS	AEROMONAS
Field Blank Sample							
52-0010	BLANK	07/01/97	6:32	<20	<20	<20	<100
52-0021	BLANK	07/01/97	6:55	<20	<20	<20	<100
52-0049	BLANK	08/05/97	**	**	--	--	--
52-0060	BLANK	08/05/97	**	**	--	--	--
52-0091	BLANK	09/03/97	**	<20	<20	--	--
52-0102	BLANK	09/03/97	**	<20	<20	--	--

Table A.2-2. 1997 DEP DWM Ten Mile River Basin instream bacteriological QA/QC field replicate data. (Units expressed in colonies/100ml,.data log10 transformed).

			Time (24hr)	FECAL	E-COLI	ENTEROCOCCUS	AEROMONAS
TEN MILE RIVER, Station: TM06							
52-0004	52-0005	07/01/97	5:07	2.204	2.000	2.447	6.079
52-0005	52-0004	07/01/97	5:07	2.255	1.778	2.342	5.079
Relative Percent Difference (RPD):				*2.3%*	*11.7%*	*4.4%*	*17.9%*
52-0043	52-0044	08/05/97	5:13	**	--	--	--
52-0044	52-0043	08/05/97	5:13	**	--	--	--
Relative Percent Difference (RPD):							
52-0085	52-0086	09/03/97	5:10	1.778	1.903	--	--
52-0086	52-0085	09/03/97	5:10	1.778	1.778	--	--
Relative Percent Difference (RPD):				*0.0%*	*6.8%*		
TEN MILE RIVER, Station: TM13							
52-0013	52-0014	07/01/97	4:53	2.380	2.079	2.380	6.176
52-0014	52-0013	07/01/97	4:53	2.380	2.000	1.903	6.000
Relative Percent Difference (RPD):				*0.0%*	*3.9%*	*22.3%*	*2.9%*
52-0052	52-0053	08/05/97	4:40	**	--	--	--
52-0053	52-0052	08/05/97	4:40	**	--	--	--
Relative Percent Difference (RPD):							
52-0094	52-0095	09/03/97	5:07	2.380	2.079	--	--
52-0095	52-0094	09/03/97	5:07	2.380	2.000	--	--
Relative Percent Difference (RPD):				*0.0%*	*3.9%*		

* = interference ** = missing/censored data -- = no data

Table A.2-3. 1997 Ten Mile River Basin Survey laboratory blank QA/QC data for organics in fish tissue analyses. The reporting units are µg/g wet weight.

ANALYTE	ACCURACY	MINIMUM DETECTION LIMIT
	Blank #1 (5/26 - 9/29/98)	
% Lipid	0.51	Not Applicable
PCB A1242	ND	0.06
PCB A1254	ND	0.17
PCB A1260	ND	0.16
Chlordane	ND	0.11
Toxaphene	ND	0.11
a-BHC	ND	0.0062
b-BHC	ND	0.0019
Lindane	ND	0.0059
d-BHC	ND	0.020
Hexachlorocyclopentadiene	ND	0.0077
Trifluralin	ND	0.0062
Hexachlorobenzene	ND	0.0091
Heptachlor	ND	0.012
Heptachlor Epoxide	ND	0.030
Methoxychlor	ND	1.07
DDD	ND	0.0052
DDE	ND	0.015
DDT	ND	0.0083
Aldrin	ND	0.0075

ND - not detected or the analytical result is at or below the established minimum detection limit (MDL)
REMARKS: The samples were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCBs and Organochlorine Pesticides.

Table A.2-4. 1997 Ten Mile River Basin Survey laboratory QA/QC data for metals in tissue analyses. (Data expressed in mg/kg wet weight unless otherwise noted.)

Sample ID	Analyte	Precision			Accuracy			Accuracy* (% Recovery)		MDL	Analytical Method
		Sample	Duplicate	RPD	LFM	Spike Amount	Recovery (%)	LFB	QCS		
97-3232	As	<MDL	<MDL	NA	17.9	19.68	91	88	76	0.040	EPA 200.9
97-3232	Pb	<MDL	<MDL	NA	18.9	19.68	96	98	100	0.140	EPA 200.7
97-3232	Se	0.147	0.125	16.2%	19.1	19.68	97	94	84	0.040	EPA 200.9
97-3232	Cd	<MDL	<MDL	NA	18.7	19.68	95	91	100	0.020	EPA 200.7
97-3234	Hg	0.150	0.140	6.9%	1.12	1.25	90	97	88	0.020	EPA 245.6

LFB - Laboratory Fortified Blank
LFM - Laboratory Fortified Matrix
MDL - Minimum Detection Limit
NA - Not Applicable
QCS - Quality Control Sample
RPD - Relative Percent Difference
*see Appendix A section A.1.2. for further details

A.3 ANALYTICAL METHODS

Discrete Water Sample Analytes	EPA Method*	SM Methods**	Other Methods
Fecal Coliform		SM 9222D	
E. Coli, MTEC		SM 9213D	
Enterococcus		SM 9230C	
Aeromonas Hydrophilia		SM 9260L	
Fish Tissue Analytes			
PCB Arochlor 1242			AOAC 983.21***
PCB Arochlor 1254			"
PCB Arochlor 1260			"
Chlordane			"
Toxaphene			"
a-BHC			"
b-BHC			"
Lindane			"
d-BHC			"
Hexachlorocyclopentadiene			"
Trifluralin			"
Hexachlorobenzene			"
Heptachlor			"
Heptachlor Epoxide			"
Methoxychlor			"
DDD			"
DDE			"
DDT			"
Aldrin			"
Arsenic (STGFAA)	EPA 200.9	SM 3113	
Lead (ICP)	EPA 200.7	SM 3120B	
Selenium (STGFAA)	EPA 200.9	SM 3113	
Cadmium (ICP)	EPA 200.7	SM 3120B	
Mercury (cold vapor)	EPA 245.1	SM 3112B	

* = "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

APPENDIX B WATER RESOURCE MONITORING

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MATERIALS AND METHODS

The DWM sampling began in July 1997 and continued through October 1997. The DWM sampling matrix is summarized in Table B1. Sampling components at river stations included: *in situ* Hydrolab® measurements, fecal coliform bacteria sampling, biological community (benthic macroinvertebrate, fish and periphyton) sampling, and toxics in fish flesh. Synoptic surveys of lakes were conducted during August 1997 to coincide with the maximum extent of macrophyte growth. Each sampling component is described in the sections that follow.

Table B1. 1997 Ten Mile River Basin Surveys DEP-DWM sampling matrix.

STATION	1997 July	1997 August	1997 September	1997 October
TM01	H, B	H, B	H, B, M	
TM02			M, F	
TM04	H, B	H, B	H, B, M	
TM05				F
F0044 (Falls Pond)			F2	
TM06	H, B	H, B	H, B, M, F	
TM06A			M, F	
TM07	H, B	H, B	H, B	
TM08A	H, B	H, B	H, B	
TM11	H, B	H, B	H, B, M	
TM12	H ,B	H, B	H, B	F
TM13	H, B	H, B	H, B	
TM14	H, B	H, B	H, B, M	
SM00	H, B	H, B	H, B, M, F	
SM01	H. B	H, B	H, B	
SM02				F
BG01	H, B	H, B	H, B	
BG02	H, B	H, B	H, B	
SW01	H, B	H, B	H, B	
SW01M			M	
FM01	H, B	H, B	H, B, QM	
CB01	H, B	H	H, B	
SB01		H, B		

B= Bacteria (fecal coliform, E. coli); H= Hydrolab® multiprobe meter (pH, temperature, dissolved oxygen, conductivity, total dissolved solids); M= Macroinvertebrate kick sampling and habitat analysis (RBP III) and periphyton sampling; QM= Qualitative macroinvertebrate sampling, F = Fish population sampling via electrofishing, F2 = Toxics in fish tissue (Cd, Pb, Hg, As, Se, % lipids, organochlorine pesticides).

SURVEY CONDITIONS

Conditions prior to each synoptic survey were characterized by analyzing precipitation and streamflow data. One weather station precipitation gage was used to determine precipitation and weather conditions for five days prior to and on the sampling dates: West Street, Attleboro Station #801: data for this station was provided by the DEM Office of Water Resources (MA DEM 1998). Discharge (hereinafter referred to as streamflow) and duration data was obtained from the only continuous USGS stream gage in the basin (Figure B1), Ten Mile River at Pawtucket Avenue at East Providence, RI (01109403). The data from this gage was used to calculate streamflow characteristics for the period of record. These statistical analyses can be found in *Water Resources Data Massachusetts and Rhode Island, Water Year 1997* (Socolow *et al.* 1998), and the *Gazetteer of Hydrologic Characteristics of Streams in Massachusetts—Taunton and Ten Mile River Basins and Coastal River Basins of Mount Hope Bay, Narragansett Bay, and Rhode Island Sound* (Wandle and Keezer 1984). The period of record for the Ten Mile River gage is from October 1986 to present. The provisional 7-day, 10-year (7Q10) low flow was provided by USGS (1998).

Bahls (1993), which assigns categories from rare to very abundant for the algae based on the numbers of cells per field.

With the exception of the designations C and VC being combined and referred to as C, the scheme developed by Bahls for determining abundance is as follows:

R (rare)	fewer than one cell per field of view at 200x, on the average;
C (common)	at least one, but fewer than five cells per field of view;
VC (very common)	between 5 and 25 cells per field;
A (abundant)	more than 25 cells per field, but countable;
VA (very abundant)	number of cells per field too numerous to count.

FISH POPULATION

DEP DWM biologists conducted fish population surveys in the Ten Mile River Basin during September and October 1997. Five stations were located along the mainstem Ten Mile River and one station was located on the Sevenmile River. Surveys were conducted using techniques similar to Rapid Bioassessment Protocols V (fish) as described by Plafkin (1989). Surveys also included a habitat assessment component.

Fish populations were sampled by electroshocking using a Smith Root Model 12 battery powered backpack electrofisher. A reach of approximately 100m was sampled by passing a pole mounted anode ring, side to side through the stream channel and in and around likely fish holding cover. All fish shocked were netted and held in buckets. Sampling proceeded from an obstruction or constriction, upstream to an endpoint at another obstruction or constriction such as a waterfall or shallow riffle. Following completion of a sampling run, all fish were identified to species, counted, and released. Methods used to evaluate the fish data collected during this survey were similar to those outlined in Protocol V (Plafkin *et al.* 1989).

FISH TOXICS

Uniform protocols, designed to assure accuracy and prevent cross-contamination of samples, were followed for collecting, processing and shipping fish collected for fish toxics monitoring from the north basin of Falls Pond. Fish were collected from the north basin of Falls Pond, North Attleborough on 9 September 1997 using a Coffelt® electrofishing boat (Figure B2). Fish were collected as the boat was maneuvered through the littoral habitat in the north basin of Falls Pond and were placed in a live well filled with site water. Fish included in the sample were removed from the live well, placed in an ice-filled cooler and brought back to the laboratory for sample processing. The remaining fish were released.

Lengths and weights were measured and fish were visually inspected for tumors, lesions, or other indications of stress or disease. Fish were then filleted on glass cutting boards, the skin was removed, and samples were prepared for freezing. All equipment used in the filleting process was rinsed in tap water to remove slime, scales, and blood, then re-rinsed twice in de-ionized water before and/or after each individual fish or composite. Fillets targeted for metals analyses were placed in VWR 32 ounce high-density polyethylene cups with covers. The opposite fillets were wrapped in aluminum foil for % lipids, PCB and organochlorine pesticide analysis. In the case of composite samples, three fillets from like-sized individuals of the same species were wrapped together in aluminum foil or stored in a single sample container. Samples were tagged and frozen for subsequent delivery to WES.

Methods used at WES for metals analysis include the cold vapor method using a VGA hydride generator for mercury and Varian 1475 flame atomic absorption for all remaining metals (MA DEP 1994). 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.

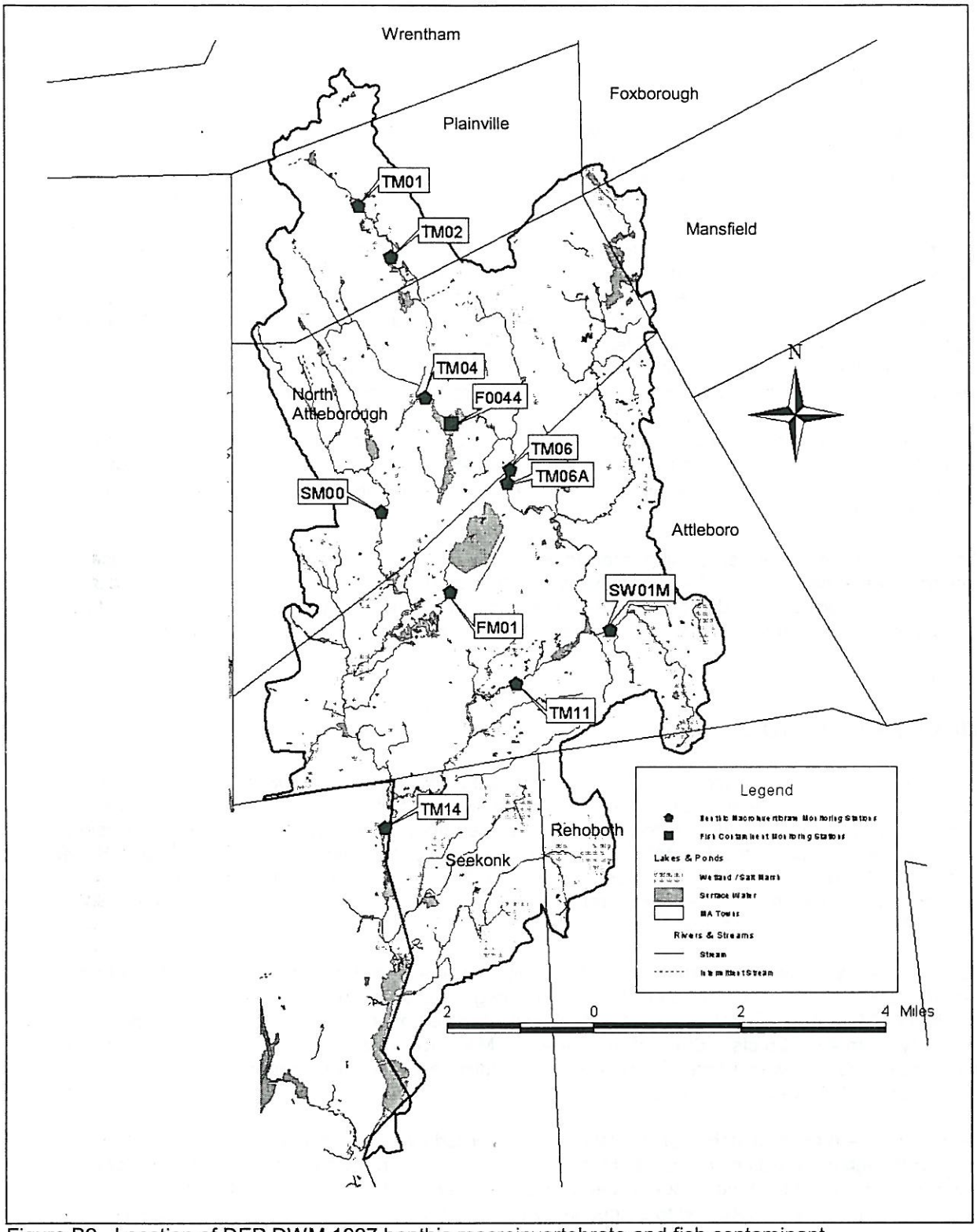

Figure B2. Location of DEP DWM 1997 benthic macroinvertebrate and fish contaminant monitoring stations in the Ten Mile River Basin.

LAKES/PONDS

Synoptic surveys of 22 lakes, ponds, reservoirs were conducted during July and September 1997. Synoptic surveys consist of taking observations from at least one access point on each lake (multiple access points on larger lakes). At each lake, an attempt was made to observe the entire surface area to determine the extent of areal macrophyte cover.

At each observation site the general water quality was noted and all aquatic macrophyteand wetland plant species were recorded along with their general abundance and an estimate of the total percent areal coverage of all species. Qualitative macrophyte observations were aided by conducting several hauls with a plant "rake," which was constructed by bolting two garden rakes back-to-back, the handles cut to about half length, and then attached to about a 50' length of rope. Each time the rake was thrown to its maximum extension and then retrieved along the lake bottom. The rake was thrown into the water several times in different directions from the observation site to provide more thorough coverage.

Where possible (e.g., dam or dock), transparency was measured using a standard 20-centimeter diameter Secchi disc attached to a rope with metric calibrations. When Secchi disc measurements were not feasible, transparency was estimated as being above or below 1.2 meters (based on the 4 foot Secchi disc bathing beach standard).

All observations were recorded on standardized field sheets. Assessments of trophic status and use impairment were made on site. Later, the assessments and supporting information will be entered into the US EPA Water Body System database. Data on the presence of non-native plants were entered into a separate database intended for linking to the Massachusetts Geographic Information System (MassGIS).

RESULTS

SURVEY CONDITIONS

To fulfill the assessment guidance, information on precipitation (MA DEM 1998) and stream discharge (Socolow *et al.* 1998) were analyzed to determine hydrologic conditions during the water quality sampling events. This review was conducted to determine the streamflow condition in relation to the provisional 7Q10 low flow of 13 cfs at the Ten Mile River USGS gage at East Providence (01109403) (USGS 1998). Additionally, this review was used to determine whether the fecal coliform bacteria data were representative of "wet" or "dry weather" sampling conditions. Survey conditions are described below for each DWM sampling event reviewed for the assessment.

1 July 1997—Just under a tenth of an inch of precipitation was recorded five days prior to the sampling event (MA DEM 1998). The daily mean stream discharge of the Ten Mile River USGS gage at East Providence (01109403) (Socolow *et al.* 1998) steadily declined over the five-day antecedent period prior to the survey (from 42 to 26 cfs). Streamflow of the Ten Mile River was approximately two times higher than the estimated 7Q10 flow of 13 cfs. Data from this sampling event will be interpreted as being representative of dry weather conditions.

5 August 1997—A tenth of inch of precipitation was recorded five days prior to the survey (MA DEM 1998). Although there was no measurable rainfall during the four days prior to the survey, the daily mean discharge of the Ten Mile River USGS gage at East Providence (01109403) (Socolow *et al.* 1998) increased from 16 cfs on 3 August to 21 cfs on 5 August. The reason for this increase is unknown. Streamflow of the Ten Mile River was 1.6 times higher than the estimated 7Q10 flow of 13 cfs. Data from this survey will be interpreted as dry weather conditions.

3 September 1997—Just over a half inch (0.52) of precipitation was measured three days prior to the survey, while 0.15 inches of rain were measured the following day (MA DEM 1998). Discharge in theTen Mile River responded to the storm event, increasing from baseflow conditions (approximately 22-24 cfs prior to precipitation) to 53 cfs, followed by a decrease in discharge to 34 cfs on the day of sampling (Socolow *et al.* 1998). Streamflow of the Ten Mile River was approximately 2.6 times higher than the

estimated 7Q10 flow of 13 cfs. Data from this survey will be interpreted as representative of wet weather conditions.

STREAM WATER QUALITY MONITORING

All DEP water quality data is managed and maintained in an Access Database (Dallaire, 2000). The Hydrolab in-situ results are provided in Table B2. Bacterial data are provided in Table B3.

Table B2. 1997 DEP DWM Ten Mile River Basin *in-situ* Hydrolab data.

		Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
TEN MILE RIVER										
Station: TM01, Mile Point: 22.1										
Description: downstream at Fuller Street, Plainville.										
52-0001	07/01/97	04:21	<0.3	22.1	6.6	265	0.2	6.5	74	--
52-0022	07/01/97	14:21	<0.3	24.1	6.8	259	0.2	7.7	90	6
52-0040	08/05/97	04:19	<0.3	21.4	6.8	209	0.1	5.9	66	--
52-0061	08/05/97	14:25	<0.3	20.8	6.9	208	0.1	6.7	74	2
52-0082	09/03/97	04:26	<0.3	21.0	6.7	196	0.1	5.0	54	--
52-0103	09/03/97	14:29	<0.3	20.8	6.7	205	0.1	5.5	61	4
TEN MILE RIVER										
Station: TM04, Mile Point: 18.5										
Description: upstream at Route 1 (west of inlet to Falls Pond), North Attleborough.										
52-0003	07/01/97	04:46	<0.3	22.1	6.9	262	0.2	5.8	65	--
52-0024	07/01/97	14:40	<0.3	25.2	7.1	256	0.2	7.0	83	**
52-0042	08/05/97	04:56	<0.3	19.7	**	108	0.07	6.2	67	--
52-0063	08/05/97	14:47	<0.3	21.2	7.0	148	0.10	8.8	98	6
52-0084	09/03/97	04:50	<0.3	22.4	7.3	242	0.2	7.7	86	--
52-0105	09/03/97	15:00	<0.3	21.4	7.5	254	0.2	8.6	95	**
TEN MILE RIVER										
Station: TM06, Mile Point: 16.5										
Description: immediately upstream of Cedar Road, North Attleborough.										
52-0004	07/01/97	05:07	<0.3	21.5	6.7	239	0.2	5.8	64	--
52-0025	07/01/97	14:58	<0.3	24.8	6.8	239	0.2	6.3	75	7
52-0043	08/05/97	05:13	<0.3	18.1	**	236	0.2	6.9	72	--
52-0064	08/05/97	15:15	<0.3	19.3	6.8	241	0.2	7.8	83	9
52-0085	09/03/97	05:10	<0.3	21.7	6.9	234	0.1	5.8	64	--
52-0106	09/03/97	15:20	<0.3	21.1	7.0	234	0.1	6.9	76	17
TEN MILE RIVER										
Station: TM07, Mile Point: 15.8										
Description: 200 yards downstream of Route 95 (off Woodcock Lane), Attleboro.										
52-0006	07/01/97	05:24	<0.3	18.9	6.4	459	0.3	5.2	55	--
52-0026	07/01/97	15:17	<0.3	21.8	6.8	547	0.3	9.6	107	6
52-0045	08/05/97	05:28	<0.3	18.5	**	645	0.4	5.5	58	--
52-0066	08/05/97	15:34	**	**	**	**	**	**	**	**
52-0087	09/03/97	05:27	0.6	20.8	6.8	462	0.3	5.4	59	--
52-0107	09/03/97	15:43	0.5	20.7	7.1	535	0.3	8.8	97	**
TEN MILE RIVER										
Station: TM08A, Mile Point: 13.6										
Description: approximately 20 yards upstream of Olive Street, Attleboro.										
52-0007	07/01/97	05:46	<0.3	23.0	6.6	438	0.3	4.8	55	--
52-0027	07/01/97	15:37	<0.3	24.0	6.7	441	0.3	6.0	70	29*
52-0046	08/05/97	05:43	<0.3	20.9	**	**	**	5.3	58	--
52-0067	08/05/97	15:54	**	**	**	**	**	**	**	**
52-0088	09/03/97	05:46	0.5	22.3	6.8	407	0.3	5.3	60	--
52-0108	09/03/97	16:45	0.3	21.4	6.8	416	0.3	6.6	74	7

* = outside calibrated range, ** = censored data, -- = no data

Table B2 (continued). 1997 DEP DWM Ten Mile River Basin *in-situ* Hydrolab data.

		Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
TEN MILE RIVER										
Station: TM11, Mile Point: 11.5										
Description: off the upstream side of the Tiffany Street bridge, Attleboro.										
52-0017	07/01/97	05:58	<0.3	23.9	7.0	401	0.3	6.0	70	9
52-0035	07/01/97	15:26	<0.3	25.9	7.0	403	0.3	6.8	82	--
52-0056	08/05/97	05:27	<0.3	22.8	7.0	474	0.3	5.7	65	3
52-0077	08/05/97	15:23	0.4	23.4	7.0	483	0.3	7.3	85	--
52-0098	09/03/97	06:11	<0.3	22.4	7.0	424	0.3	6.1	69	4
52-0116	09/03/97	15:26	0.4	22.4	7.2	418	0.3	7.3	83	--
TEN MILE RIVER										
Station: TM12, Mile Point: 6.6										
Description: 200 yards downstream of Bridge Street (between Old Mill apartment - upstream of railroad - southeast of Read Street), Attleboro.										
52-0016	07/01/97	05:37	<0.3	24.1	6.8	359	0.2	6.9	80	18
52-0034	07/01/97	15:14	<0.3	24.7	6.8	369	0.2	7.0	83	--
52-0055	08/05/97	05:14	<0.3	21.7	6.9	412	0.3	6.9	77	2
52-0076	08/05/97	15:10	0.3	22.2	6.8	411	0.3	8.0	91	--
52-0097	09/03/97	05:51	<0.3	22.6	7.0	402	0.3	7.0	79	6
52-0115	09/03/97	15:14	0.4	22.8	7.2	408	0.3	7.5	86	--
TEN MILE RIVER										
Station: TM13, Mile Point: 5.8										
Description: off the downstream side of the Pond Street bridge, Seekonk.										
52-0013	07/01/97	04:53	<0.3	23.6	6.7	366	0.2	4.8	55	12
52-0032	07/01/97	14:51	0.3	27.4	7.0	371	0.2	8.5	106	--
52-0052	08/05/97	04:45	<0.3	21.8	6.8	423	0.3	5.5	61	4
52-0073	08/05/97	14:45	0.4	22.8	6.8	424	0.3	7.5	86	--
52-0094	09/03/97	05:07	0.3	21.7	6.8	399	0.3	5.0	56	3
52-0113	09/03/97	14:52	0.6	22.6	7.0	396	0.3	7.4	84	--
TEN MILE RIVER										
Station: TM14, Mile Point: 4.3										
Description: off the upstream side of the Central Avenue bridge, Pawtucket, Rhode Island.										
52-0012	07/01/97	04:19	<0.3	21.9	6.8	542	0.3	5.7	63	4
52-0031	07/01/97	14:41	<0.3	25.0	7.1	583	0.4	8.8	105	--
52-0051	08/05/97	04:33	<0.3	21.1	6.9	671	0.4	5.4	60	3
52-0072	08/05/97	14:31	0.5	21.1	7.0	756	0.5	9.2	102	--
52-0093	09/03/97	04:51	<0.3	21.1	6.8	538	0.3	5.6	62	9
52-0112	09/03/97	14:41	0.4	21.6	7.1	599	0.4	8.5	95	--
COLES BROOK										
Station: CB01, Mile Point: 0.3										
Description: upstream/east at Route 152, Seekonk.										
52-0011	07/01/97	**	**	**	**	**	**	**	**	**
52-0030	07/01/97	**	**	**	**	**	**	**	**	**
52-0050	08/05/97	--	---------- *Not enough flow to take sample*----------					--	--	--
52-0071	08/05/97	--	---------- *Not enough flow to take sample*----------					--	--	--
52-0092	09/03/97	04:32	<0.3	21.9	6.6	94	0.06	5.4	60	9
52-0111	09/03/97	14:27	0.4	21.6	6.7	97	0.06	5.5	62	--
SEVENMILE RIVER										
Station: SM00, Mile Point: 5.6										
Description: off the downstream/south side of the Draper Avenue bridge, North Attleborough.										
52-0019	07/01/97	07:01	<0.3	18.2	6.6	537	0.3	5.8	60	**
52-0037	07/01/97	15:53	<0.3	22.0	6.6	529	0.3	6.7	75	--
52-0058	08/05/97	05:53	<0.3	17.6	6.5	235	0.2	5.7	59	**
52-0079	08/05/97	15:46	<0.3	19.0	6.4	418	0.3	6.2	66	--
52-0100	09/03/97	06:56	<0.3	22.1	6.6	106	0.07	7.3	82	16
52-0118	09/03/97	15:49	0.3	22.3	6.8	104	0.07	7.9	89	--

* = outside calibrated range, ** = censored data, -- = no data

Table B2 (continued). 1997 DEP DWM Ten Mile River Basin *in-situ* Hydrolab data.

		Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
SEVENMILE RIVER										
Station: SM01, Mile Point: 0.5										
Description: upstream/northwest of County Street, Attleboro.										
52-0015	07/01/97	05:16	<0.3	18.0	6.4	321	0.2	6.3	65	18
52-0033	07/01/97	15:03	0.3	19.0	6.4	321	0.2	6.9	73	--
52-0054	08/05/97	05:01	<0.3	17.6	6.4	299	0.2	6.0	62	7
52-0075	08/05/97	14:57	0.4	17.9	6.3	269	0.2	6.5	68	--
52-0096	09/03/97	05:28	<0.3	18.4	6.5	332	0.2	6.6	68	5
52-0114	09/03/97	15:03	0.3	18.0	6.5	333	0.2	7.0	72	--
FOURMILE BROOK										
Station: FM01, Mile Point: 0.4										
Description: downstream/south at West Street, Attleboro.										
52-0018	07/01/97	06:38	<0.3	14.5	6.7	202	0.1	7.7	74	10
52-0036	07/01/97	15:41	<0.3	19.3	7.0	203	0.1	8.8	94	--
52-0057	08/05/97	05:41	<0.3	23.4	7.0	204	0.1	7.4	85	3
52-0078	08/05/97	15:34	<0.3	23.8	6.9	206	0.1	7.6	89	--
52-0099	09/03/97	06:38	<0.3	22.6	7.0	201	0.1	7.5	85	9
52-0117	09/03/97	15:38	<0.3	21.5	6.7	221	0.1	6.3	70	--
SPEEDWAY BROOK										
Station: SW01, Mile Point: 0.01										
Description: off the upstream/east side of the Route 152 bridge, Attleboro.										
52-0020	07/01/97	06:17	<0.3	18.3	6.7	395	0.3	4.6	48	72*
52-0038	07/01/97	16:10	<0.3	22.2	6.8	397	0.3	6.1	69	--
52-0059	08/05/97	06:12	<0.3	20.9	6.6	172	0.1	4.9	54	8
52-0080	08/05/97	16:05	<0.3	20.4	6.5	139	0.09	6.2	68	--
52-0101	09/03/97	07:22	<0.3	20.9	7.0	426	0.3	5.3	58	**
52-0119	09/03/97	16:08	<0.3	20.3	7.1	424	0.3	5.7	62	--
BUNGAY RIVER										
Station: BG01, Mile Point: 4.7										
Description: approximately 100 feet downstream/south of West Street (Bungay Road), North Attleborough (Two feet above fish hatchery outfall).										
52-0008	07/01/97	06:10	<0.3	19.3	6.4	**	**	4.5	47	--
52-0028	07/01/97	16:01	<0.3	21.4	6.5	**	**	7.3	81	10
52-0047	08/05/97	06:06	<0.3	18.0	**	225	0.1	4.6	48	--
52-0068	08/05/97	16:14	<0.3	21.6	6.7	227	0.1	8.5	95	5
52-0089	09/03/97	06:09	<0.3	18.3	6.4	233	0.1	4.7	48	--
52-0109	09/03/97	16:18	<0.3	19.9	6.7	233	0.1	8.3	90	16
Pipe/Discharge to BUNGAY RIVER										
Station: MA0005398, Mile Point: 4.69										
Description: outlet of North Attleborough National Fish Hatchery discharge pipe, North Attleborough (Two feet below Station BG01).										
52-0126	09/03/97	06:19	<0.3	12.8	6.3	288	0.2	8.7	81	--
52-0127	09/03/97	16:26	**	**	**	**	**	**	**	**
BUNGAY RIVER										
Station: BG02, Mile Point: 1.2										
Description: upstream/north at Holden Street, Attleboro.										
52-0009	07/01/97	06:31	<0.3	24.0	6.5	274	0.2	5.2	60	--
52-0029	07/01/97	16:20	<0.3	26.1	7.0	271	0.2	11.3	137	11
52-0048	08/05/97	06:27	<0.3	22.8	**	265	0.2	5.8	66	--
52-0069	08/05/97	16:33	<0.3	24.7	6.9	262	0.2	8.0	94	6
52-0090	09/03/97	06:35	0.4	22.1	6.7	270	0.2	6.7	75	--
52-0110	09/03/97	16:01	<0.3	22.3	7.0	273	0.2	9.2	104	10

* = outside calibrated range, ** = censored data, -- = no data

Table B2 (continued). 1997 DEP DWM Ten Mile River Basin *in-situ* Hydrolab data.

		Time (24hr)	Measurement Depth (m)	Temp (°C)	pH (SU)	Cond (uS/cm)	TDS (g/l)	DO (mg/l)	SAT (%)	Turb (NTU)
SCOTTS BROOK										
Station: SB01, Mile Point: 0.4										
Description: off the upstream/west side of the Broadway bridge, North Attleborough.										
52-0002	07/01/97	--	---------- *Not enough flow to take sample*----------					--	--	--
52-0023	07/01/97	--	---------- *Not enough flow to take sample*----------					--	--	--
52-0062	08/05/97	--	---------- *Not enough flow to take sample*----------					--	--	--
52-0041	08/05/97	04:42	<0.3	19.3	**	41	0.03	7.8	83	--
52-0083	09/03/97	--	---------- *Not enough flow to take sample*----------					--	--	--
52-0104	09/03/97	--	---------- *Not enough flow to take sample*----------					--	--	--

* = outside calibrated range, ** = censored data, -- = no data

Table B3. 1997 DEP DWM Ten Mile River Basin bacteria data. Units in colonies/100 ml.

			Time (24hr)	FECAL	E-COLI	ENTEROCOCCUS	AEROMONAS
TEN MILE RIVER							
Station: TM01, Mile Point: 22.1							
Description: downstream at Fuller Street, Plainville.							
52-0001		07/01/97	4:21	40	20	40	1,100,000
52-0040		08/05/97	4:19	**	--	--	--
52-0082		09/03/97	4:26	<20	<20	--	--
TEN MILE RIVER							
Station: TM04, Mile Point: 18.5							
Description: upstream at Route 1 (west of inlet to Falls Pond), North Attleborough.							
52-0003		07/01/97	4:46	440	440	740	1,200,000
52-0042		08/05/97	4:56	**	--	--	--
52-0084		09/03/97	4:50	1,200	480	--	--
TEN MILE RIVER							
Station: TM06, Mile Point: 16.5							
Description: immediately upstream of Cedar Road, North Attleborough.							
52-0004	52-0005	07/01/97	5:07	160	100	280	1,200,000
52-0005	52-0004	07/01/97	5:07	180	60	220	120,000
52-0043	52-0044	08/05/97	5:13	**	--	--	--
52-0044	52-0043	08/05/97	5:13	**	--	--	--
52-0085	52-0086	09/03/97	5:10	60	80	--	--
52-0086	52-0085	09/03/97	5:10	60	60	--	--
TEN MILE RIVER							
Station: TM07, Mile Point: 15.8							
Description: 200 yards downstream of Route 95 (off Woodcock Lane), Attleboro.							
52-0006		07/01/97	5:24	100	40	140	1,700,000
52-0045		08/05/97	5:28	**	--	--	--
52-0087		09/03/97	5:27	360	220	--	--

* = interference ** = missing/censored data -- = no data

Table B3 (continued). 1997 DEP DWM Ten Mile River Basin bacteria data. Units in colonies/100 ml.

			Time (24hr)	FECAL	E-COLI	ENTEROCOCCUS	AEROMONAS
TEN MILE RIVER							
Station: TM08A, Mile Point: 13.6							
Description: approximately 20 yards upstream of Olive Street, Attleboro.							
52-0007		07/01/97	5:46	320	160	220	800,000
52-0046		08/05/97	5:43	**	--	--	--
52-0088		09/03/97	5:46	320	280	--	--
TEN MILE RIVER							
Station: TM11, Mile Point: 11.5							
Description: off the upstream side of the Tiffany Street bridge, Attleboro.							
52-0017		07/01/97	5:58	80	40	80	1,700,000
52-0056		08/05/97	5:22	**	--	--	--
52-0098		09/03/97	6:11	20	20	--	--
TEN MILE RIVER							
Station: TM12, Mile Point: 6.6							
Description: 200 yards downstream of Bridge Street (between Old Mill apartment - upstream of railroad - southeast of Read Street), Attleboro.							
52-0016		07/01/97	5:37	120	100	100	1,500,000
52-0055		08/05/97	5:12	**	--	--	--
52-0097		09/03/97	5:49	160	120	--	--
TEN MILE RIVER							
Station: TM13, Mile Point: 5.8							
Description: off the downstream side of the Pond Street bridge, Seekonk.							
52-0013	52-0014	07/01/97	4:53	240	120	240	1,500,000
52-0014	52-0013	07/01/97	4:53	240	100	80	1,000,000
52-0052	52-0053	08/05/97	4:40	**	--	--	--
52-0053	52-0052	08/05/97	4:40	**	--	--	--
52-0094	52-0095	09/03/97	5:07	240	120	--	--
52-0095	52-0094	09/03/97	5:07	240	100	--	--
TEN MILE RIVER							
Station: TM14, Mile Point: 4.3							
Description: off the upstream side of the Central Avenue bridge, Pawtucket, Rhode Island.							
52-0012		07/01/97	4:19	360	200	160	1,200,000
52-0051		08/05/97	4:30	**	--	--	--
52-0093		09/03/97	4:51	400	240	--	--
COLES BROOK							
Station: CB01, Mile Point: 0.3							
Description: upstream/east at Route 152, Seekonk.							
52-0011		07/01/97	3:51	180	80	10,000	1,000,000
52-0050		08/05/97		---------- *Not enough flow to take sample*----------			**
52-0071		08/05/97		---------- *Not enough flow to take sample*----------			**
52-0092		09/03/97	4:32	1,000	1,000	--	--

* = interference ** = missing/censored data -- = no data

Table B3 (continued). 1997 DEP DWM Ten Mile River Basin bacteria data. Units in colonies/100 ml.

		Time (24hr)	FECAL	E-COLI	ENTEROCOCCUS	AEROMONAS
SEVENMILE RIVER						
Station: SM00, Mile Point: 5.6						
Description: off the downstream/south side of the Draper Avenue bridge, North Attleborough.						
52-0019	07/01/97	7:01	100	120	280	300,000
52-0058	08/05/97	5:50	**	--	--	--
52-0100	09/03/97	6:56	520	400	--	--
SEVENMILE RIVER						
Station: SM01, Mile Point: 0.5						
Description: upstream/northwest of County Street, Attleboro.						
52-0015	07/01/97	5:16	700	400	160	600,000
52-0054	08/05/97	5:00	**	--	--	--
52-0096	09/03/97	5:28	360	300	--	--
FOURMILE BROOK						
Station: FM01, Mile Point: 0.4						
Description: downstream/south at West Street, Attleboro.						
52-0018	07/01/97	6:38	40	20	180	700,000
52-0057	08/05/97	5:36	**	--	--	--
52-0099	09/03/97	6:38	40	80	--	--
SPEEDWAY BROOK						
Station: SW01, Mile Point: 0.01						
Description: off the upstream/east side of the Route 152 bridge, Attleboro.						
52-0020	07/01/97	6:17	520	280	460	1,300,000
52-0059	08/05/97	6:10	**	--	--	--
52-0101	09/03/97	7:22	720	420	--	--
BUNGAY RIVER						
Station: BG01, Mile Point: 4.7						
Description: approximately 100 feet downstream/south of West Street (Bungay Road), North Attleborough (two feet above fish hatchery outfall).						
52-0008	07/01/97	6:10	260	200	220	690,000
52-0047	08/05/97	6:06	**	--	--	--
52-0089	09/03/97	6:09	240	80	--	--
BUNGAY RIVER						
Station: BG02, Mile Point: 1.2						
Description: upstream/north at Holden Street, Attleboro.						
52-0009	07/01/97	6:31	60	40	20	750,000
52-0048	08/05/97	6:27	**	--	--	--
52-0090	09/03/97	6:35	100	40	--	--
SCOTTS BROOK						
Station: SB01, Mile Point: 0.4						
Description: off the upstream/west side of the Broadway bridge, North Attleborough.						
52-0002	07/01/97		---------- *Not enough flow to take sample*----------			**
52-0023	07/01/97		---------- *Not enough flow to take sample*----------			**
52-0062	08/05/97		---------- *Not enough flow to take sample*----------			**
52-0041	08/05/97	4:42	**	--	--	--
52-0083	09/03/97		---------- *Not enough flow to take sample*----------			**
52-0104	09/03/97		---------- *Not enough flow to take sample*----------			**

* = interference ** = missing/censored data -- = no data