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# BOSTON HARBOR

## LIST OF APPENDICES

### APPENDIX A – DATA VALIDATION REPORT FOR 1999 DEP/DWM BOSTON HARBOR WATERSHED MONITORING DATA



### APPENDIX B - 1999 DEP DWM BOSTON HARBOR WATERSHED SURVEY DATA



### APPENDIX C - TECHNICAL MEMORANDUM (*(TM-71-1)* BOSTON HARBOR WATERSHED 1999 BIOLOGICAL ASSESSMENT

# APPENDIX A – DATA VALIDATION REPORT FOR 1999 DEP/DWM BOSTON HARBOR WATERSHED MONITORING DATA

**PREFACE:**
The objective of DWM's data validation process is to ensure that the quality of monitoring data meets defined criteria for acceptability as "final", usable data. This is accomplished by thoroughly reviewing and evaluating all draft data and associated field and laboratory quality control information. This report includes evaluation of all 1999 data, as well as 1994 fish toxics data, collected in the Boston Harbor watershed.

The 1999 Data Validation Report (MADEP 2000a) summarizing 1999 DWM monitoring QA/QC results is also available as a separate evaluation of all 1999 DWM data.

This Appendix is divided into seven sections as follows:
- A1. Introduction
- A2. Data Validation Process for 1999 DWM Data
- A3. 1999 QAPPs/SOPs Used in Boston Harbor Watershed Monitoring
- A4. 1999 QA/QC Acceptance Criteria for Boston Harbor Watershed Data
- A5. QC Sample Data and Validation Decisions for 1999 (and 1994 fish toxics) Boston Harbor Watershed Data
- A6. 1999 Analytical Methods and MDLs
- A7. Conclusions

## A1. INTRODUCTION
The following data were collected in 1999 as part of the DEP/DWM Boston Harbor Watershed assessment:
- Discrete water quality data and Hydrolab® readings at seven lakes and one tributary inlet,
- Benthic macroinvertebrates and aquatic habitat assessment at a total of fourteen stream stations,
- Fish tissue toxics at two lake locations (Upper and Lower Mystic Lakes), and
- Fish population assessment at nine stream sites

For specific monitoring locations, parameters, and dates, see Table B1 in Appendix B.

## A2. THE DATA VALIDATION PROCESS FOR 1999 DWM DATA
The procedures used to accept, accept with qualification or censor data were based on the draft DWM Standard Operating Procedure (SOP) for data validation (MADEP 2002). These procedures are supplemental to separate data quality assurance activities and laboratory validation performed by the analytical laboratory, Wall Experiment Station (WES).

The data validation SOP outlines specific criteria by which to evaluate data quality and acceptability. These criteria pertain to the following elements:

- <u>Conformance to DWM-project and DWM-programmatic Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs)</u>

- <u>Precision</u> (review of overall precision, including field precision and lab precision)

- <u>Accuracy</u> (review of lab quality control data regarding analysis of blind performance evaluation samples, internal check standards, blanks and matrix spike samples)

- <u>Representativeness</u> (review of field data sheets and field SOPs used to collect the data for the evidence of the potential for non-representative conditions at the time of sampling)

- <u>Holding Times</u> and <u>Preservation</u> (review for conformance to method holding times and preservation requirements for samples)

- Frequency of Field QC samples (review for conformance to standard DWM requirements for the number of field blank and split/duplicate samples taken per total number of samples taken)

- Contamination of Field Blanks (review of blank analyses for detectable analyte concentrations)

- Completeness (review of the amount of usable data in comparison to that intended to be collected)

- Chain-of-Custody (review of sample handling and transfer records)

Data that fell outside QA/QC acceptance criteria were investigated and may have been subject to censoring or qualification. Specific symbols and qualifiers used to censor and qualify data are provided in Table A1.

Completion of 1999 data validation for the Boston Harbor Watershed data resulted in the entry of the "final" data into the DWM water quality database, and its use for assessment purposes.

**Table A1.** 1999 Data Symbols and Qualifiers

| Symbol/ Qualifier | Data Source | Definition |
|---|---|---|
| ** | All | Censored or missing data |
| -- | All | No data |
| <mdl | All | Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (eg. <0.2). |
| c | Hydrolab® | Greater than **c**alibration range for conductivity (>718, 1413, 2760, 6668 or 12,900 uS/cm) or turbidity (> 10, 20 or 40 NTUs), depending on calibration standard used, or outside acceptable range about calibration standard. Also used for calculated TDS and Salinity readings that are based on qualified conductivity readings. |
| i | Hydrolab® | **i**naccurate readings from Hydrolab® multiprobe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, or lack of calibration of the depth sensor prior to use. |
| m | Hydrolab® | **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, i.e., operator error (e.g., less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented. |
| s | Hydrolab® | Field **s**heet recorded data were used to accept data, not data electronically recorded in the Hydrolab® surveyor unit, due to operator error or equipment failure. |
| u | Hydrolab® | **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. |
| ? | Hydrolab® | Light interference on Turbidity sensor (Hydrolab® error message). Data is typically censored. |
| a | Discrete samples | **a**ccuracy as estimated at WES Lab via matrix spikes, PT sample recoveries, internal check standards and lab-fortified blanks did not meet project data quality objectives identified for program or in QAPP. |
| b | Discrete samples | **b**lank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives). |
| d | Discrete samples | Precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. |
| f | Discrete samples | **f**requency of quality control duplicates did not meet data quality objectives identified for program or in QAPP. |
| h | Discrete samples | **h**olding time violation (usually indicating possible bias low) |
| j | Discrete samples | 'estimated' value; used for lab-related issues where certain lab QC criteria are not met and re-testing is not possible (as identified by the WES lab only). Also used by WES to report sample data where the sample concentration is less than the 'reporting' limit or RDL and greater than the method detection limit or MDL (mdl< *x* <rdl). |
| m | Discrete samples | **m**ethod SOP not followed or fully implemented, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), or additional steps taken by the lab to deal with matrix complications. |
| p | Discrete samples | Samples not **p**reserved per SOP or analytical method requirements. |
| r | Discrete samples | Samples collected not **r**epresentative of actual field conditions. |

## A3. 1999 QAPPS/SOPS USED IN BOSTON HARBOR WATERSHED MONITORING

Quality assurance and quality control (QA/QC) planning/process documents in place and activities performed before, during and/or after 1999 Boston Harbor Watershed monitoring included:

- Production of a draft 1999 Quality Assurance Project Plan (QAPP) for fish contaminant monitoring (MA DEP. 1999c; now CN 13.0)
- Production of a 1999 QAPP for benthic macroinvertebrate collection (MA DEP 1999e; CN 7.0)
- Production of a 1999 QAPP for Lakes Baseline TMDL assessments (MA DEP 1999a; CN 22.0)
- Production of a draft SOP for apparent color determination (MA DEP 1999g; now CN 2.0)
- Production of a draft SOP for chlorophyll *a* collection (MA DEP 1999h; now CN 3.0)
- Production of an SOP for grab sample collection (MA DEP 1999b; CN 1.0). This included the use of bucket samplers (this technique has been discontinued).
- Implementation of field and lab quality control standard operating procedures, including that for Hydrolab® multiprobe use (MA DEP 1999d; CN 4.0) and fish collection/preparation for fish tissue analysis (MA DEP 1999f; now CN 40.0)
- On-going coordination with the WES laboratory regarding sample delivery, analysis and reporting
- Post-monitoring data review and validation
- Production of a draft 1999-2000 QAPP for DEP/CERO SMART monitoring (MA DEP 2000b; now CN 12.0). The objectives, procedures and site-specific information contained in this draft QAPP were used in 1999.

The majority of analytical methods used by WES in 1999 were based on those contained in Standard Methods (Clesceri et al. 1998).

## A4. 1999 QA/QC ACCEPTANCE CRITERIA FOR BOSTON HARBOR WATERSHED DATA

### A4.1 <u>QA/QC Objectives and Criteria for 1999 *In-Situ* Hydrolab® Multiprobe Data</u>

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/salinity, and % saturation of oxygen.

To ensure the quality of the Boston Harbor data, the following QA/QC steps were taken:

<u>- Pre- Survey Calibration and Check:</u> Standard pre-survey calibration of the Hydrolab® unit was conducted in accordance with the DWM 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.

<u>- Post Survey Check:</u> 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 error and aberrant trends.  If any of these conditions were detected, the data were further investigated and may have been recommended for qualification or censoring.  Measured data are specifically evaluated for the following:

• Consistency with the Hydrolab® SOP (specifically, the requirement for three (minimum)-five (preferred) 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.

• Representativeness of data (review of field sheets and notes for any information that might indicate non-representativeness; e.g. not taken at the deep hole).

• Check for "outliers" or unreasonable data, based on best professional judgment.   Outliers are identified and flagged for scrutiny.  For lake depth profiles, it is recognized that thermal stratification can cause rapid changes in Hydrolab® parameters within the thermocline, often resulting in unstable readings (typically qualified with "u").

• In lieu of verifying in the electronic record that the Hydrolab® was depth-calibrated prior to use, both general and specific criteria are used to accept, qualify or censor of Hydrolab® Depth readings, as follows:  General Depth Criteria:  Apply to each OWMID#; For negative and zero depth readings: Censor (i), (likely in error); for 0.1 m depth readings:  Qualify (i), (potentially in error); and for 0.2 and greater depth readings:  Accept without qualification, (likely accurate).  Specific Depth Criteria:  Apply to entirety of depth data for survey date.  If zero and/or negative depth readings occur more than once per survey date, censor all negative/zero depth data, and qualify all other depth data for that survey (indicates that erroneous depth readings were not recognized in the field and that corrective action (field calibration of the depth sensor) was not taken, i.e., that all positive readings may be in error.).

• The criterion used for 1998-99 data to accept, qualify or censor Conductivity (and the dependent, calculated estimates for TDS and Salinity) readings was based on exceedance of the calibration standard concentration.  For exceedances greater than two times the standard, the conductivity reading was typically censored.  Readings were qualified for exceedances less than two times the calibration standard.  Note:  In cases where readings fell far below the calibration standard concentration (e.g. measured value of 100 uS/cm using 6668 calibration standard), no censoring or qualification was imposed.   Turbidity data with respect to the calibration standard concentration was evaluated on a case-by-case basis without any set criteria.

• For D.O. values less than 0.2 mg/l, 1999 data were accepted without qualification and reported as "<0.2".   Similarly, percent DO saturation was reported as "<2%" when DO values were <0.2 mg/l.

• Total dissolved solids (TDS) values were calculated from conductivity readings using a multiplier of 0.64.    Percent oxygen saturation values were calculated by comparing ambient D.O. readings to saturation values.

### A4.2 QA/QC Objectives and Criteria for 1999 Discrete Water Sample Data

The collection and analysis of discrete water samples from the Boston Harbor watershed followed the DWM Standard Operating Procedure for grab sampling (CN# 1.0) and analyte-specific WES SOPs. Using the following criteria, as well as other considerations and input from data reviewers, individual datum were accepted, accepted with qualification or censored. In cases where poor quality control (e.g. blank/cross contamination) affected batched analyses or entire surveys, censoring/qualification decisions were applied to groups of samples (e.g. a specific crew's samples, a specific survey's samples or all samples from a specific batch analysis).

- 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 CN# 1.1 for a complete listing. If the standard holding time was exceeded, this criterion is violated and the data may be censored, depending on the extent of exceedance. For very minor exceedances (e.g. < than 10% of the holding time), the data is typically qualified ("H" for minor holding time violation).

- 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 10% blanks and/or replicates were collected, the data may be censored or qualified, based on a review of crew member experience, training and history, as well as other factors relevant to the specific survey.

- Field Blanks: Field blanks were prepared at the DWM Worcester Laboratory. Reagent grade water was transported into the field in a sample container where it was transferred into a different sample container and fixed where necessary using the same method as its corresponding field sample. All blanks were submitted to the WES laboratory "blind". If the field blank results were greater than the MDL, the data may be censored or qualified, depending on extent and other factors.

- Field Replicates: In 1999, field replicate samples were taken as "split" samples, where two independent samples were created from a larger volume sample (not sequential duplicates or co-located duplicates). Both samples were submitted to WES laboratory "blind". In order for this data quality criterion to be met, the results must generally be:

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

or meet more specific criteria contained in a 1999 QAPP. If the criteria are not met, the data may be censored or qualified, depending on extent of exceedance and other factors. In most cases, poor precision of field split samples reflects potential poor reproducibility for entire surveys and/or analytical batch runs, and may lead to the censoring/qualification of same.

- Laboratory assessment of analytical precision and accuracy**:** The WES Laboratory is solely responsible for the administration of its Quality Assurance Program and Standard Operating Procedures. WES staff release discrete water sample data when their established QA/QC criteria have been met. When the following criteria cannot be met, data are qualified as "estimated" (using a "J" value) if appropriate, or no data ("ND") is reported:

- 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 method *accuracy.*

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

- Duplicate Sample – Measures the *precision* (as Relative Percent Difference or RPD) of the 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.

• Range of Logs (bacteria data) – Acceptance limits established by WES for range of log-transformed duplicate data.

A4.3 QA/QC Objectives and Criteria for 1999 (and 1994) Fish Tissue Contaminant Data

Fish collected (and prepared for analysis) from the Boston Harbor Watershed in 1994 and 1999 followed procedures contained in the DWM 1999 Standard Operating Procedure (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:

• 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.

• 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 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.

• 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%.

• 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%.

A4.4 QA/QC Objectives of 1999 Data for Benthic Macroinvertebrates, Aquatic Habitat and Miscellaneous Biological Monitoring (periphyton, aquatic macrophytes, phytoplankton, etc.)

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 US EPA Rapid Bioassessment Protocols (RBP III). The QAPP for 1999 biomonitoring outlined general QC steps that included:

• Thorough rinsing of sampling equipment between stations to prevent inter-station cross-contamination.
• Duplication and checking (for transcription errors) of documentation and database entries.
• In-house spot-checking (among two DWM biologists) of taxa identifications for accuracy.

A4.5 QA/QC Objectives and Criteria for Use of 1999 Data from External Sources

In performing assessment of individual segments in the Boston Harbor watershed, DWM used information and data from the following external sources in this report (discussed in detail in the "Sources of Information" section of the main report).

• Federal agencies (USGS, ACOE and USEPA)
• Municipal POTWs
• Municipal and industrial NPDES permitees
• State agencies (MWRA, MDPH, DFWELE, DMF and DEM)
• Local agencies and non-profit groups (Boston Harbor Association), and

- Volunteer monitoring groups and citizens (Neponset River Watershed Association, Mystic River Watershed Association, Weir River Watershed Association, Fore River Watershed Association, Alewife/Mystic River Advocates, Friends of the Mystic River, Alewife Brook Stream Team, misc. individuals)

In general, the pre-requisites for use of these sources are: 1) a QAPP was prepared (and followed), 2) a State-certified laboratory was used, 3) documentation was prepared for data management QA/QC, and 4) a citable report was produced. Some data, however, are used that do not meet all of these criteria (with appropriate text qualification).

No specific criteria were used in evaluating the data quality from these sources. The level of quality control review for individual data sources was variable, and due to staff resource limitations, most information was accepted at "face value", with appropriate context given to potentially suspect data (e.g. lacking any QC documentation).

### A5. QC SAMPLE DATA AND VALIDATION DECISIONS FOR 1999 (AND 1994 FISH TOXICS) BOSTON HARBOR WATERSHED DATA

Data validation procedures, as now outlined in DWM's draft Data Validation SOP (draft, 2001; CN 56.0) were applied to in-situ Hydrolab®, discrete water quality and fish tissue data (1994 and 1999) for the Boston Harbor watershed (see Table A2). The 1999 Data Validation Report (MADEP 2000a) summarizing 1999 DWM monitoring QA/QC results is also available as a separate evaluation of all 1999 data.

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

**Table A2**. 1999 Boston Harbor Censored/Qualified Hydrolab® Data

| Waterbody | Survey Date(s) | OWMID# | Censored/ Qualified Hydrolab® Parameters | Censored/ Qualified | Reason and/or Clarification |
|---|---|---|---|---|---|
| Turners Pond | 7/27/99 | LB-0046 | PH at 2.5 m depth | Qualify (u) | Unstable readings |
| Winter Pond | 8/10/99 | LB-0159 | D.O. and %SAT at 0.5 m | Qualify (u) | Unstable readings |
| Winter Pond | 8/10/99 | LB-0161 | Temp and pH at 0.5 m<br>PH at 1.0 m | Qualify (u)<br>Qualify (u) | Unstable readings |
| Cobbs Pond | 8/12/99 | LB-0180 | D.O. and % SAT at 0.5, 1.2 and 1.5 m | Qualify (i)(u) | Unstable readings (potential stirrer malfunction) |
| Turners Pond | 8/24/99 | LB-0194 | Temp at 4.4 m | Qualify (u) | Unstable readings |
| Lower Mystic Lake | 8/24/99 | LB-0199 | D.O., % SAT, temp, cond and pH at 4.5 m<br>Temp at 5.5 m<br>Cond. At 12 and 14 m<br><br>All readings at 15 m, and all readings at 15.9 m, except conductivity<br><br>Conductivity at 15.9m | Qualify (u)<br><br>Qualify (u)<br>Qualify (c)<br><br>Qualify (m) (c)<br><br>**Censor (m) (c)** | Unstable readings<br><br>Unstable readings<br>> calibration range (718)<br><br>Only 1 reading (intentional to protect D.O. probe)<br><br>Only one reading and very high cond. close to bottom |
| Cobbs Pond | 9/13/99 | LB-0336 | Temp at 0.5 m<br>D.O. and % SAT at 0.5 and 1.5 m | Qualify (u)<br>Qualify (u) | Unstable readings |
| Lower Mystic Lake | 8/5/99 | LB-0422 | Temp at 4.0 m<br>D.O. and % SAT at 3.3 m<br>All parameters at 15.7 m | Qualify (u)<br>Qualify (u)<br>Qualify (m) | Unstable readings<br><br>Only 1 reading at bottom |
| Lower Mystic Lake | 8/5/99 | LB-0423 | Temp, D.O. and % SAT at 0.5 m and 4.0 m<br>All parameters at 16.1 m, except conductivity<br>Conductivity at 16.1m | Qualify (u)<br><br>Qualify (m) (c)<br>**Censor (m) (c)** | Unstable readings<br><br>Only 1 reading at bottom (intentional)<br>Cond. >>> calibration range, 718 |
| Lower Mystic Lake | 8/24/99 | LB-0429 | Temp at 5.5 m<br>All parameters at 10.0 m<br><br>All parameters at 15.5 m | Qualify (u)<br>Qualify (m)<br><br>Qualify (m) | Unstable readings<br>Very short equilibration time for 3 readings (67 sec.)<br>Only 1 reading at bottom (intentional) |
| Lower Mystic Lake | 9/21/99 | LB-0448 | D.O. and % SAT at 7.0 m<br>Conductivity At 10, 11, 11.9 and 13.4 m | Qualify (u)<br>Qualify (c) | Unstable readings<br>> calibration range (718) |
| Lower Mystic Lake | 9/21/99 | LB-0504 | D.O. and % SAT at 7.0 m<br>Conductivity At 9, 10, 11, 13.5<br>Conductivity at 16.0 m | Qualify (u)<br>Qualify (c)<br><br>**Censor (c)** | Unstable readings<br>> calibration range (718)<br>>>> calibration range (718) |

## A5.2 Discrete Sample Data Validation

### A5.2.1 Quality Control Sample Results

Field blank and field replicate sampling results for all discrete water quality sample data taken in 1999 are provided in Table A3 and Table A4. Quality control sample data are stored and maintained in the *Water Quality Data (WQD)* Access Database.

*Note:* ***<u>All 1999 lake QC samples are listed for quality control review purposes.</u>*** *For multiple-lake surveys, certain lakes may not have had any QC samples (taken at another lake for same day survey). The relevant survey dates for Boston Harbor lake sampling are 7/15, 7/27, 8/5, 8/10, 8/12, 8/24, 9/7, 9/13 and 9/21.*

**Table A3.** 1999 DEP DWM inlake physico-chemical QA/QC field blank data. (All units expressed in mg/L unless otherwise specified.)

| Date | OWMID | OWMID QA/QC | Alkalinity (mg/L) | Color (PCU) | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|
| **Field Blank Sample** | | | | | |
| 08/03/99 | LB-0078 | BLANK | <2.0 | <15 | <0.005 |
| 09/29/99 | LB-0229 | BLANK | -- | -- | <0.005 |
| 08/05/99 | LB-0105 | BLANK | <2.0 | <15 | <0.005 |
| 09/28/99 | LB-0405 | BLANK | <2.0 | <15 | <0.005 |
| 08/31/99 | LB-0380 | BLANK | <2.0 | <15 | <0.005 |
| 09/29/99 | LB-0234 | BLANK | <2.0 | -- | -- |
| 07/29/99 | LB-0053 | BLANK | <1.0 | <15 | <0.005 |
| 08/25/99 | LB-0203 | BLANK | <2.0 | <15 | <0.005 |
| 09/23/99 | LB-0354 | BLANK | <2.0 | <15 | <0.005 |
| 08/04/99 | LB-0096 | BLANK | <2.0 | <15 | <0.005 |
| 09/01/99 | LB-0241 | BLANK | <2.0 | <15 | <0.005 |
| 10/05/99 | LB-0390 | BLANK | <2.0 | <15 | <0.005 |
| 09/02/99 | LB-0256 | BLANK | <2.0 | <15 | <0.005 |
| 07/28/99 | LB-0065 | BLANK | <1.0 | <15 | <0.005 |
| 08/26/99 | LB-0216 | BLANK | <2.0 | <15 | <0.005 |
| 09/22/99 | LB-0365 | BLANK | <2.0 | <15 | <0.005 |
| 08/05/99 | LB-0415 | BLANK | <2.0 | <15 | <0.005 |
| 08/12/99 | LB-0187 | BLANK | -- | -- | <0.005 |
| 07/15/99 | LB-0029 | BLANK | <2.0 | <15 | <0.005 |
| 08/12/99 | LB-0183 | BLANK | -- | -- | <0.005 |
| 09/13/99 | LB-0329 | BLANK | <2.0 | <15 | <0.005 |
| 07/27/99 | LB-0041 | BLANK | <1.0 | <15 | <0.005 |
| 08/24/99 | LB-0191 | BLANK | <2.0 | <15 | <0.005 |
| 09/21/99 | LB-0341 | BLANK | <2.0 | <15 | <0.005 |
| 07/14/99 | LB-0023 | BLANK | <2.0 | <15 | <0.005 |
| 08/11/99 | LB-0171 | BLANK | <1.0 | <15 | <0.005 |
| 09/09/99 | LB-0316 | BLANK | <2.0 | -- | <0.005 |
| 07/13/99 | LB-0003 | BLANK | 2.0 | ** | <0.005 |
| 08/10/99 | LB-0153 | BLANK | <1.0 | <15 | <0.005 |
| 09/07/99 | LB-0304 | BLANK | <2.0 | -- | <0.005 |
| 09/13/99 | LB-0281 | BLANK | <2.0 | <15 | <0.005 |
| 08/11/99 | LB-0120 | BLANK | -- | -- | <0.005 |
| 09/15/99 | LB-0267 | BLANK | <2.0 | -- | <0.005 |

**" ** "** = Censored or missing data **" -- "** = No data
" **<mdl** " = Less than method detection limit (MDL). Denotes a sample result that went undetected using a specific analytical method. The actual, numeric MDL is typically specified (e.g. <0.2).

**Table A4.** 1999 DEP DWM inlake physico-chemical QA/QC field replicate data. (All units expressed in mg/L unless otherwise specified.)

| Date | OWMID | OWMID QA/QC | Alkalinity (mg/L) | Color (PCU) | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|
| **Mill Road Pond (Palis: 41032)** | | | | | |
| **Station: A** | Description: deep hole, near dam at eastern end of pond, Brimfield. | | | | |
| 8/3/1999 | LB-0076 | LB-0077 | 18 | 55 | 0.023 |
| 8/3/1999 | LB-0077 | LB-0076 | 20 | 60 | 0.020 |
| ***Relative Percent Difference (RPD):*** | | | *10.5%* | *8.7%* | *14.0%* |
| 9/29/1999 | LB-0226 | LB-0227 | 13 | -- | 0.025 |
| 9/29/1999 | LB-0227 | LB-0226 | 11 | -- | 0.026 |
| ***Relative Percent Difference (RPD):*** | | | *16.7%* | | *3.9%* |
| **Morse Pond (Palis: 41033)** | | | | | |
| **Station: A** | Description: deep hole near outlet at southern end, Southbridge. | | | | |
| 8/5/1999 | LB-0103 | LB-0104 | 15 | 50 | 0.12 |
| 8/5/1999 | LB-0104 | LB-0103 | 15 | 46 | 0.14 |
| ***Relative Percent Difference (RPD):*** | | | *0.0%* | *8.3%* | *15.4%* |
| 9/28/1999 | LB-0403 | LB-0404 | 9.0 | 41 | 0.017 |
| 9/28/1999 | LB-0404 | LB-0403 | 9.0 | 44 | 0.018 |
| ***Relative Percent Difference (RPD):*** | | | *0.0%* | *7.1%* | *5.7%* |
| **Sherman Pond (Palis: 41046)** | | | | | |
| **Station: A** | Description: deep hole in northeast quadrant of pond, Brimfield. | | | | |
| 8/31/1999 | LB-0378 | LB-0379 | **m | 38 | 0.022 |
| 8/31/1999 | LB-0379 | LB-0378 | 12 | 29 | 0.021 |
| ***Relative Percent Difference (RPD):*** | | | | *26.9%* | *4.7%* |
| **Sibley Pond (Palis: 41047)** | | | | | |
| **Station: A** | Description: North Basin, deep hole at southern end, Charlton. | | | | |
| 7/29/1999 | LB-0051 | LB-0052 | 25**d** | 17**d** | 0.030 |
| 7/29/1999 | LB-0052 | LB-0051 | 15**d** | 31**d** | 0.030 |
| ***Relative Percent Difference (RPD):*** | | | *50.0%* | *58.3%* | *0.0%* |
| 8/25/1999 | LB-0201 | LB-0202 | 20 | 44**d** | 0.050 |
| 8/25/1999 | LB-0202 | LB-0201 | 19 | 25**d** | 0.048 |
| ***Relative Percent Difference (RPD):*** | | | *5.1%* | *55.1%* | *4.1%* |
| **Sibley Pond (Palis: 41048)** | | | | | |
| **Station: A** | Description: South Basin, deep hole close to center of pond, Charlton. | | | | |
| 9/23/1999 | LB-0353 | LB-0352 | 19 | 75 | 0.084 |
| 9/23/1999 | LB-0352 | LB-0353 | 18 | 70 | 0.088 |
| ***Relative Percent Difference (RPD):*** | | | *5.4%* | *6.9%* | *4.7%* |
| **Pierpont Meadow Pond (Palis: 42043)** | | | | | |
| **Station: A** | Description: deep hole south of Charlton/Dudley border, Dudley. | | | | |
| 8/4/1999 | LB-0094 | LB-0095 | 12 | 17 | ****d** |
| 8/4/1999 | LB-0095 | LB-0094 | 10 | 17 | ****d** |
| ***Relative Percent Difference (RPD):*** | | | *18.2%* | *0.0%* | |
| 9/1/1999 | LB-0238 | LB-0239 | 11 | 29 | 0.022 |
| 9/1/1999 | LB-0239 | LB-0238 | 12 | 29 | 0.019 |
| ***Relative Percent Difference (RPD):*** | | | *8.7%* | *0.0%* | *14.6%* |
| 10/5/1999 | LB-0388 | LB-0389 | 11 | 23 | 0.027**d** |
| 10/5/1999 | LB-0389 | LB-0388 | 11 | 22 | 0.016**d** |
| ***Relative Percent Difference (RPD):*** | | | *0.0%* | *4.4%* | *51.2%* |
| **Rochdale Pond (Palis: 42048)** | | | | | |
| **Station: A** | Description: deep hole in southeastern quadrant near outlet, Leicester. | | | | |
| 9/2/1999 | LB-0254 | LB-0255 | 14 | 46 | 0.028 |
| 9/2/1999 | LB-0255 | LB-0254 | 13 | -- | 0.028 |
| ***Relative Percent Difference (RPD):*** | | | *7.4%* | | *0.0%* |

**** = censored data; **--** = no data (no sample collected);
QUALIFIERS: **d** = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected; **m** = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.

**Table A4. Continued.** 1999 DEP DWM inlake physico-chemical QA/QC field replicate data. (All units expressed in mg/L unless otherwise specified.)

| Date | OWMID | OWMID QA/QC | Alkalinity (mg/L) | Color (PCU) | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|
| **Wallis Pond (Palis: 42062)** | | | | | |
| **Station: A** | Description: deep hole, southern central lobe near dam, Dudley. | | | | |
| 7/28/1999 | LB-0063 | LB-0064 | 20 | 46**d** | 0.021 |
| 7/28/1999 | LB-0064 | LB-0063 | 21 | 60**d** | 0.022 |
| | ***Relative Percent Difference (RPD):*** | | *4.9%* | *26.4%* | *4.7%* |
| 8/26/1999 | LB-0214 | LB-0215 | 30 | 43 | 0.028 |
| 8/26/1999 | LB-0215 | LB-0214 | 31 | 31 | 0.028 |
| | ***Relative Percent Difference (RPD):*** | | *3.3%* | *32.4%* | *0.0%* |
| 9/22/1999 | LB-0363 | LB-0364 | 12 | 49 | 0.025 |
| 9/22/1999 | LB-0364 | LB-0363 | 14 | 60 | 0.025 |
| | ***Relative Percent Difference (RPD):*** | | *15.4%* | *20.2%* | *0.0%* |
| **Lower Mystic Lake (Palis: 71027)** | | | | | |
| **Station: B** | Description: northwest quadrant of pond, Arlington/Medford. | | | | |
| 8/5/1999 | LB-0416 | LB-0417 | 54 | <15 | **d |
| 8/5/1999 | LB-0417 | LB-0416 | 56 | -- | **d |
| | ***Relative Percent Difference (RPD):*** | | *3.6%* | | |
| **Ganawatte Farm Pond (Palis: 73037)** | | | | | |
| **Station: A** | Description: deep hole, northern lobe of pond, Walpole | | | | |
| 7/15/1999 | LB-0027 | LB-0028 | 12 | 230**d** | 0.030**d** |
| 7/15/1999 | LB-0028 | LB-0027 | 13 | 120**d** | 0.041**d** |
| | ***Relative Percent Difference (RPD):*** | | *8.0%* | *62.9%* | *31.0%* |
| 8/12/1999 | LB-0181 | LB-0182 | 12 | 120**d** | ****m** |
| 8/12/1999 | LB-0182 | LB-0181 | 14 | 70**d** | ****m** |
| | ***Relative Percent Difference (RPD):*** | | *15.4%* | *52.6%* | |
| 9/13/1999 | LB-0327 | LB-0328 | 12 | 110**d** | 0.034 |
| 9/13/1999 | LB-0328 | LB-0327 | 12 | 70**d** | 0.035 |
| | ***Relative Percent Difference (RPD):*** | | *0.0%* | *44.4%* | *2.9%* |
| **Turners Pond (Palis: 73059)** | | | | | |
| **Station: A** | Description: deep hole in southeastern quadrant, Milton. | | | | |
| 7/27/1999 | LB-0039 | LB-0040 | 20 | 44 | 0.054 |
| 7/27/1999 | LB-0040 | LB-0039 | 21 | 40 | 0.053 |
| | ***Relative Percent Difference (RPD):*** | | *4.9%* | *9.5%* | *1.9%* |
| 8/24/1999 | LB-0189 | LB-0190 | 23 | <15**d** | 0.038 |
| 8/24/1999 | LB-0190 | LB-0189 | 22 | 26**d** | 0.037 |
| | ***Relative Percent Difference (RPD):*** | | *4.4%* | *53.7%* | *2.7%* |
| 9/21/1999 | LB-0339 | LB-0340 | 19 | 29 | 0.048 |
| 9/21/1999 | LB-0340 | LB-0339 | 18 | 31 | 0.048 |
| | ***Relative Percent Difference (RPD):*** | | *5.4%* | *6.7%* | *0.0%* |
| **Flint Pond (Palis: 84012)** | | | | | |
| **Station: A** | Description: deep hole, center of eastern lobe, Tyngsborough. | | | | |
| 7/14/1999 | LB-0020 | LB-0022 | 28 | 50 | 0.025 |
| 7/14/1999 | LB-0022 | LB-0020 | 25 | 65 | 0.025 |
| | ***Relative Percent Difference (RPD):*** | | *11.3%* | *26.1%* | *0.0%* |
| 8/11/1999 | LB-0169 | LB-0170 | 33 | 28**d** | 0.021 |
| 8/11/1999 | LB-0170 | LB-0169 | 35 | 35**d** | 0.021 |
| | ***Relative Percent Difference (RPD):*** | | *5.9%* | *22.2%* | *0.0%* |
| 9/9/1999 | LB-0314 | LB-0315 | 36 | -- | 0.017 |
| 9/9/1999 | LB-0315 | LB-0314 | 37 | -- | 0.016 |
| | ***Relative Percent Difference (RPD):*** | | *2.7%* | | *6.1%* |

****** = censored data; **--** = no data (no sample collected); QUALIFIERS: **d** = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected; **m** = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.

**Table A4. Continued.** 1999 DEP DWM inlake physico-chemical QA/QC field replicate data. (All units expressed in mg/L unless otherwise specified.)

| Date | OWMID | OWMID QA/QC | Alkalinity (mg/L) | Color (PCU) | Total Phosphorus (mg/L) |
|---|---|---|---|---|---|
| **Newfield Pond (Palis: 84046)** | | | | | |
| **Station: A** | Description: deep hole in southeastern quadrant near outlet, Chelmsford. | | | | |
| 7/13/1999 | LB-0001 | LB-0002 | 26 | <15**m** | 0.022 |
| 7/13/1999 | LB-0002 | LB-0001 | 26 | 17**m** | 0.022 |
| ***Relative Percent Difference (RPD):*** | | | *0.0%* | *12.5%* | *0.0%* |
| 8/10/1999 | LB-0151 | LB-0152 | 26 | 23 | 0.024 |
| 8/10/1999 | LB-0152 | LB-0151 | 27 | 23 | 0.024 |
| ***Relative Percent Difference (RPD):*** | | | *3.8%* | *0.0%* | *0.0%* |
| 9/7/1999 | LB-0302 | LB-0303 | 27 | -- | 0.020 |
| 9/7/1999 | LB-0303 | LB-0302 | 29 | -- | 0.018 |
| ***Relative Percent Difference (RPD):*** | | | *7.1%* | | *10.5%* |
| **Ryder Pond (Palis: 96268)** | | | | | |
| **Station: A** | Description: deep hole in northwest quadrant of pond, Truro. | | | | |
| 9/13/1999 | LB-0279 | LB-0280 | <2.0 | <15 | 0.008 |
| 9/13/1999 | LB-0280 | LB-0279 | <2.0 | <15 | 0.008 |
| ***Relative Percent Difference (RPD):*** | | | *0.0%* | *0.0%* | *0.0%* |
| **Walkers Pond (Palis: 96331)** | | | | | |
| **Station: A** | Description: deep hole, mid pond, Brewster. | | | | |
| 8/11/1999 | LB-0118 | LB-0119 | -- | -- | 0.074 |
| 8/11/1999 | LB-0119 | LB-0118 | -- | -- | 0.074 |
| ***Relative Percent Difference (RPD):*** | | | | | *0.0%* |
| 9/15/1999 | LB-0265 | LB-0266 | 6.0 | -- | 0.054 |
| 9/15/1999 | LB-0266 | LB-0265 | 8.0 | -- | 0.054 |
| ***Relative Percent Difference (RPD):*** | | | *28.6%* | | *0.0%* |

****** = censored data; **--** = no data (no sample collected);

QUALIFIERS: **d** = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP. Batched samples may also be affected; **m** = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.

### A5.2.2 Censored/Qualified 1999 Boston Harbor Discrete Water Sample Data

Data censored, qualified or accepted without qualification are summarized in Table A5 below. All other data were accepted.

**Table A5.** 1999 DEP DWM Censored/Qualified Boston Harbor Data.

| Watershed/ water body | Sample Date | OWMID #s | Analyte | Censored/ Qualified | Reason |
|---|---|---|---|---|---|
| Ganawatte Pond | 7/15 | LB-0027, 28 | TP | Qualify (d) | Split rpd's = 31% (minor exceedance of DQO) |
| Lower Mystic Lake | 8/5 | LB-0416, 417 | TP | **Censor (d)** | Split rpd = 142% (major exceedance of DQO) |
| Lower Mystic Lake | 8/5 | LB-0418, 419, 420 and 425 | TP | Qualify (d) | Split rpd = 142% indicates very poor reproducibility for survey samples |
| Ganawatte Pond | 8/12 | LB-0181, 182, 185 | TP | **Censor (m)** | Sample filtered after digestion, due to iron floc problem (current recommendation for this type of sample is not to filter) |
| Turners Pond | 9/21 | LB-0343 | TP | **Censor (m)** | Not analyzed; broken bottle indicated on field sheet |
| Turners Pond | 8/24 | LB-0189, 190,191 and 193 | TP | Accept without qualification | Very minor exceedance of analytical holding time (29/28); not enough justification to discard or qualify data) |

**Table A5. Continued.** 1999 DEP DWM Censored/Qualified Boston Harbor Data.

| | | | | | |
|---|---|---|---|---|---|
| Lower Mystic Lake | 8/24 | LB-0195, 196, 198, 200, 427, 428 | TP | Accept without qualification | Very minor exceedance of analytical holding time (29/28); not enough justification to discard or qualify data) |
| Ganawatte Farm Pond (primary; other lakes' samples in batch run affected) | 9/13 | LB-0327, 328; also 0280, 282, 279, 281, 285, 286, 334, 328, 333, 330, and 329 | Color | Qualify (d) | Field Split rpd = 46% (major exceedance of DQO; not enough justification to discard data, but batch run qualified |
| Turners Pond (primary; other lakes' samples in batch run affected) | 8/24 | LB-0189, 190; also 191, 193, 195 and 196 | Color | Qualify (d) | Field Split rpd = 54% (major exceedance of DQO; not enough justification to discard data, but batch run qualified |
| Ganawatte Farm Pond (primary; other lakes' samples in batch run affected) | 8/11, 8/12 | LB-0181, 182; also 0163, 164, 169, 170, 177, 179, and 185 | Color | Qualify (d) | Field Split rpd = 53% (major exceedance of DQO; not enough justification to discard data, but batch run qualified |
| Ganawatte Farm Pond (primary; other lakes' samples in batch run affected) | 7/15 | LB-0027, 0028; also 0029, 0030, 0033, and 0034 | Color | Qualify (d) | Field Split rpd = 62% (major exceedance of DQO; not enough justification to discard data, but batch run qualified |
| Newfield Pond | 7/13 | LB-0003 | Color | **Censor (m)** | Ambient field blank taken (LB-0003), but not analyzed or reported. |
| Newfield Pond (primary; other lakes' samples in batch run affected) | 7/13 | LB-0001, 0002, and 0005 | Color | Qualify (m) | Ambient field blank taken (LB-0003), but not analyzed or reported; survey run qualified |
| Winter Pond (primary; other lakes' samples in batch run affected) | 7/13 | LB-0008 and 0010 | Color | Qualify (m) | Ambient field blank taken, but not analyzed or reported; survey run qualified |
| Lower Mystic Lake | 8/5 | LB-0425 | Alkalinity | **Censor (m)** | Sample deliberately discarded |
| Winter Pond | 7/13 | LB-0009 | Chlorophyll a | Qualify (b) | Blank contamination |
| Ganawatte Farm Pond | 7/15 | LB-0031 | Chlorophyll a | **Censor (m)** | Cross contamination; unreasonably high bias |
| Cobbs Pond | 7/15 | LB-0035 | Chlorophyll a | **Censor (m)** | Cross contamination; unreasonably high bias |
| Turners Pond | 7/27 | LB-0042 | Chlorophyll a | Qualify (b) | Blank contamination |
| Turners Pond | 8/26 | LB-0192 | Chlorophyll a | **Censor (h)** | Hold Time exceeded |
| Lower Mystic Lake | 8/24 | LB-0197 | Chlorophyll a | **Censor (h)** | Hold Time exceeded |
| Lower Mystic Lake | 9/22 | LB-0441 | Chlorophyll a | **Censor (p)** | Sample froze in fridge prior to filtering/extraction |
| Winter Pond | 9/7 | LB-309 | Chlorophyll a | **Censor (m)** | Sample not analyzed at lab; not reported |

## A5.3 1999 Benthic Macroinvertebrate, Habitat Assessment and Fish Population Data

Based on review of the Boston Harbor 1999 Biological Assessment (Appendix C) and discussions with DWM biologists, there was no reason found to censor or qualify any of the information gathered as part of the 1999 benthic/habitat/fish population surveys.

## A5.4 Fish Toxics Data (1999 and 1994)

All fish tissue data from the Boston Harbor basins gathered in 1999 and 1994 are acceptable and usable. The results and conclusions contained in DWM's 1999 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys report are valid.

### A5.4.1 1999 Boston Harbor Fish Toxics Data

Relevant QC information for 1999 fish toxics data are provided in the Tables A6 through A10 below.

All fish tissue data passed QC acceptance limits of the WES laboratory and lab-validated data were reported by WES without qualification (i.e., the quality control acceptance limits of WES for analytical accuracy and precision were met for all samples). Sample holding times prior to analysis and extract holding times prior to GC injection were met for all samples. Although detailed data quality objectives (DQOs) for the 1999 Boston Harbor fish contaminant monitoring were not developed, the analytical QC data showed lack of blank contamination; quality control sample, fortified blank and matrix spike recoveries ranging from 67-120 % for all analyte groups; and RPDs less than 30 % for all lab duplicates, with the notable exception of a 49.2 % RPD for mercury.

Lab duplicate precision estimates for metals (Hg, Pb, Cd, As and Se) ranged from 0-49%. 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-specie, 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 Boston Harbor samples. 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 fish tissue data unusable. The 49 % RPD for mercury is greater than a typical tissue metals DQO for precision of 30 %, and indicates potential significant problems with repeatability for mercury quantitation for that specific WES batch run. Although no mercury data has been qualified, review and use of mercury data from that batch run should take this into account.

Lab accuracy estimates for metals using fortified blanks, matrix spikes and QC samples ranged from 78 to 113 % recovery for all analytes. These values meet acceptance criteria.

Lab accuracy estimates for organic contaminants using lab-fortified blanks ranged from 67-102 % recovery for all analytes tested. Lab-fortified matrix (LFM) samples using PCB arochlors and selected pesticides ranged from 94-120 %. All lab organics blanks showed non-detectable concentrations. These values meet acceptance criteria.

Lab duplicate data for DDT and the congenor BZ#118 were acceptable (15.4 and 10.5, respectively). Lab fortified matrix samples showed good recoveries, ranging from 94-120 % for LFM and LFM duplicates.

**Table A6.** 1999 DEP DWM laboratory QA/QC 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 | 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 A6).

NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC blank data for organics in fish tissue are pertinent to Boston Harbor samples.

**Table A7.** 1999 DEP DWM Boston Harbor Watershed laboratory QA/QC data for metals in fish tissue. (Data expressed in mg/Kg wet weight unless otherwise noted.)

| | | Precision | | | Accuracy | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sample ID** | **Analyte** | **Sample** | **Duplicate** | **Relative Percent Difference** | **Spike Amount** | **Lab Fortified Matrix (%)** | **Lab Fortified Blank (%)** | **Quality Control Sample (%)** | **Method Detection Limit** |
| L990271-1 | Hg | 0.23 | 0.38 | 49.2 | 0.002 | 82 | 110 | 113 | 0.02 |
| L990271-1 | Pb | <MDL | <MDL | NA | 20 | 94 | 92 | 107 | 0.20 |
| L990271-1 | Cd | <MDL | <MDL | NA | 20 | 97 | 93 | 93 | 0.02 |
| L990271-1 | As | <MDL | <MDL | NA | 2.0 | 84 | 105 | 91 | 0.04 |
| L990271-1 | Se | 0.307 | 0.292 | 5.0 | 2.0 | 83 | 100 | 93 | 0.04 |
| L990227-1 | Pb | <MDL | <MDL | NA | 20 | 90 | 96 | 90 | 0.2 |
| L990227-1 | Cd | <MDL | <MDL | NA | 20 | 94 | 98 | 96 | 0.02 |
| L990227-1 | Se | 0.299 | 0.247 | 19.0 | 2.0 | 78 | 106 | 106 | 0.04 |
| L990227-1 | As | 0.079 | 0.079 | 0.0 | 2.0 | 111 | 109 | 107 | 0.04 |

MDL - Method Detection Limit
NA - Not Applicable

**Table A8.** 1999 DEP DWM 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<br>Heptachlor MDL 0.012<br>Aldrin MDL 0.016<br>DDT MDL 0.011 |
| **Spike Amount** | 0.96 | 0.98 | 1.0 | 0.96 | Lindane 0.010<br>Heptachlor 0.010<br>Aldrin 0.010<br>DDT 0.020 |
| **Spike Recovered** | 0.95 | 1.0 | 0.67 | 0.91 | Lindane 0.0098<br>Heptachlor 0.0115<br>Aldrin 0.0120<br>DDT 0.0255 |
| **Spike % Recovery** | 99 | 102 | 67 | 95 | Lindane 98<br>Heptachlor 115<br>Aldrin 120<br>DDT 128 |

MDL – method detection limit

NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC lab fortified blank data for organics in fish tissue are pertinent to Boston Harbor samples.

**Table A9.** 1999 DEP DWM 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<br>DDT 0.012 | BZ# 118 0.0030 | 0.22 |
| | L990067-7 duplicate | DDE 0.012<br>DDT 0.014 | BZ# 118 0.0027 | 0.19 |
| | relative percent difference | DDE 0%<br>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
***** Fish tissue organic analytes (listed in Section A6) not appearing in the above table were included in the analysis and were not detected.
NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC duplicate data for organics in fish tissue are pertinent to Boston Harbor samples.

**Table A10.** 1999 DEP DWM 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<br>MDL 0.11 | PCB A1260<br>MDL 0.11 | Lindane MDL 0.009<br>Heptachlor MDL 0.012<br>Aldrin MDL 0.016<br>DDT MDL 0.011 | Lindane MDL 0.009<br>Heptachlor MDL 0.012<br>Aldrin MDL 0.016<br>DDT MDL 0.011 |
| **SPIKE AMOUNT** | 1.14 | 1.14 | Lindane 0.025<br>Heptachlor 0.025<br>Aldrin 0.025<br>DDT 0.050 | Lindane 0.025<br>Heptachlor 0.025<br>Aldrin 0.025<br>DDT 0.050 |
| **SPIKE RECOVERED** | 1.08 | 1.07 | Lindane 0.026<br>Heptachlor 0.024<br>Aldrin 0.026<br>DDT 0.052 | Lindane 0.026<br>Heptachlor 0.027<br>Aldrin 0.028<br>DDT 0.060 |
| **SPIKE % RECOVERY** | 95 | 94 | Lindane 104<br>Heptachlor 96<br>Aldrin 104<br>DDT 104 | Lindane 104<br>Heptachlor 108<br>Aldrin 112<br>DDT 120 |

MDL – method detection limit
NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC lab fortified matrix data for organics in fish tissue are pertinent to Boston Harbor samples.

### A5.4.2 1994 Boston Harbor Fish Toxics Data

DWM finds all 1994 fish tissue data from the Boston Harbor watershed to be acceptable and usable. All fish tissue data passed QC acceptance limits of the WES laboratory and lab-validated data were reported by WES without qualification. Field and laboratory SOPs are documented in the 1994 DEP fish toxics report (MADEP 1994).

Lab duplicate precision estimates for metals (Hg, Pb, Cd, As and Se) were generally 24% RPD or less. These values meet acceptance criteria. Lab accuracy estimates for metals using fortified sample matrix samples ranged from 64 to 127 % recovery for all analytes (<u>one Se matrix sample had 64% recovery; although the quality control sample for Se was better at 80%, there may have been significant matrix effects compromising the accuracy of sample analysis for Se</u>). Lab accuracy estimates for metals using lab-fortified blanks ranged from 73-132 % recovery, and for QC samples ranged from <MDL (Pb on two occasions) to 120 % recovery for all analytes. <u>On two occasions, QC samples for Pb showed < MDL. This indicates that sample results for lead (Pb) for the associated batches may have significant error.</u>

All lab organics blanks showed non-detectable concentrations. Lab duplicate data showed non-detectable concentrations for all analytes tested (this meets acceptance criteria, although does not allow for precision estimates as RPD). Lab fortified matrix sample spike/spike duplicate recovery using PCB arochlor 1260 was 146%, and that for lindane, heptochlor, aldrin and DDT were 63%, 91%, 109% and 64%, respectively. <u>This indicates potential error in the associated batch analysis of lindane and DDT.</u>

<u>Although the metals and organics data have been accepted without qualification, potential users of data involving poor quality control (as referenced above) are advised to consider the potential error in sample data for specific analytes</u>.

Relevant QC information for 1994 fish toxics data is provided in Tables A11 through A14 below. There were no field duplicate QC samples taken in 1994. Users should take the age of the data into account; 1994 data is not as usable as 1999 or more recent data in determining fish health or edibility.

**Table A11.** 1994 DEP OWM laboratory QA/QC data for metals in fish tissue. (Data expressed in mg/kg wet weight unless otherwise noted.)

| | | **Precision** | | | **LFM Accuracy** | | | | | **Accuracy (% Recovery)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sample ID | Analyte | Sample | Duplicate | RPD | Spike Amount | Spike Recovered | Spike Recovery (%) (WES LFM) | Sample Mean | LFM (spike + sample) | LFB | QCS | MDL | Analytical Method |
| 94-4636 | As | <MDL | <MDL | NA | NR | NA | 78 | NA | NA | 75 | 98 | 0.040 | EPA 200.9 |
| 94-4636 | Se | 0.169 | 0.172 | 1.8 | NR | NA | 72 | NA | NA | 132 | 92 | 0.040 | EPA 270.2 |
| 94-4636 | Cd | <MDL | <MDL | NA | NR | NA | 116 | NA | NA | 106 | 96 | 0.20 | EPA 213.1 |
| 94-4636 | Pb | <MDL | <MDL | NA | NR | NA | 110 | NA | NA | 96 | 90 | 1.00 | EPA 239.1 |
| 94-4254 | As | <MDL | <MDL | NA | NR | NA | 84 | NA | NA | 73 | 111 | 0.04 | EPA 200.9 |
| 94-4254 | Pb | <MDL | <MDL | NA | NR | NA | 113 | NA | NA | 117 | 97 | 1.0 | EPA 239.1 |
| 94-4254 | Cd | <MDL | <MDL | NA | NR | NA | 87 | NA | NA | 101 | 115 | 0.20 | EPA 213.1 |
| 94-4254 | Se | 0.084 | 0.078 | 7.4 | NR | NA | 72 | NA | NA | 87 | 76 | 0.04 | EPA 270.2 |
| 94-3967 | Se | 0.203 | 0.178 | 13.1 | NR | NA | 104 | NA | NA | 118 | 87 | 0.002 | EPA 270.2 |
| 94-3967 | As | 0.041 | <MDL | 2.5 | NR | NA | 80 | NA | NA | 70 | 109 | 0.04 | EPA 200.9 |
| 94-3967 | Pb | <MDL | <MDL | NA | NR | NA | 70 | NA | NA | 80 | 80 | 0.05 | EPA 200.7A |
| 94-3967 | Cd | <MDL | <MDL | NA | NR | NA | 110 | NA | NA | 80 | 100 | 0.03 | EPA 200.7A |
| 94-3613 | As | <MDL | <MDL | NA | NR | NA | 96 | NA | NA | 117 | 67 | 0.04 | EPA 200.9 |
| 94-3613 | Se | 0.14 | 0.13 | 7.4 | NR | NA | 127 | NA | NA | 91 | 114 | 0.002 | EPA 270.2 |
| 94-3613 | Cd | <MDL | <MDL | NA | NR | NA | 100 | NA | NA | 100 | 100 | 0.03 | EPA 213.1 |
| 94-3613 | Pb | <MDL | <MDL | NA | NR | NA | 110 | NA | NA | 110 | <MDL | 0.05 | EPA 239.1 |
| 94-2530 | Se | <MDL | <MDL | NA | NR | NA | 64 | NA | NA | 93 | 80 | 0.002 | EPA 270.2 |
| 94-2529 | As | <MDL | <MDL | NA | NR | NA | 75 | NA | NA | 89 | 91 | 0.04 | EPA 200.9 |
| 94-2529 | Pb | <MDL | <MDL | NA | NR | NA | 98 | NA | NA | 97 | 98 | 0.03 | EPA 239.1 |
| 94-2529 | Cd | <MDL | <MDL | NA | NR | NA | 102 | NA | NA | 90 | 100 | 0.01 | EPA 213.1 |
| 94-3064 | As | <MDL | <MDL | NA | NR | NA | 85 | NA | NA | 89 | 90 | 0.04 | EPA 200.9 |
| 94-3064 | Cd | <MDL | <MDL | NA | NR | NA | 100 | NA | NA | 100 | 100 | 0.01 | EPA 213.1 |
| 94-3064 | Pb | <MDL | <MDL | NA | NR | NA | 90 | NA | NA | 110 | <MDL | 0.03 | EPA 239.1 |
| 94-3064 | Se | 0.09 | 0.09 | 0 | NR | NA | 118 | NA | NA | 92 | 80 | 0.002 | EPA 270.2 |
| 94-3975 | Hg | 0.16 | 0.16 | 0 | NR | NA | 108 | NA | NA | 110 | 110 | 0.0002 | EPA 245.1 |
| 94-4228 | Hg | 1.07 | 1.05 | 1.9 | NR | NA | 98 | NA | NA | 104 | 110 | 0.0002 | EPA 245.1 |
| 94-3062 | Hg | 0.064 | 0.063 | 1.6 | NR | NA | 96 | NA | NA | 100 | 110 | 0.0002 | EPA 245.1 |
| 94-3540 | Hg | 0.082 | 0.102 | 21.7 | NR | NA | 88 | NA | NA | 99 | 115 | 0.0002 | EPA 245.1 |
| 94-4160 | Hg | 0.373 | 0.333 | 11.3 | NR | NA | 90 | NA | NA | 110 | 120 | 0.0002 | EPA 245.1 |
| 94-4650 | Hg | 0.090 | 0.115 | 24.4 | NR | NA | 92 | NA | NA | 105 | 110 | 0.0002 | EPA 245.1 |
| 94-2530 | Hg | 0.112 | 0.100 | 11.3 | NR | NA | 99 | NA | NA | 90 | 100 | 0.0002 | EPA 245.1 |

LFB - Laboratory Fortified Blank
NR - Not Reported
LFM - Laboratory Fortified Matrix
QCS - Quality Control Sample
LFM Calculation: SA x %SR = SR ; SR + SM = LFM
MDL - Method Detection Limit
RPD - Relative Percent Difference
NA - Not Applicable
NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC data for metals in fish tissue are pertinent to Boston Harbor samples.

**Table A12.** 1994 DEP OWM laboratory QA/QC 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 | LABORATORY SAMPLE NUMBER | ANALYTE | | |
|---|---|---|---|---|
| | | % Lipid | Pesticides | PCBs |
| 15 February 1995 | BLANK - 50 | 0.19 | ND | ND |
| 16 February 1995 | BLANK - 51 | 0.26 | ND | ND |
| 17 February 1995 | BLANK - 52 | 0.17 | ND | ND |

ND - Not detected or the analytical result is at or below the established method detection limit (listed in Table A5.5.1).
NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC data for metals in fish tissue are pertinent to Boston Harbor samples.

**Table A13.** 1994 DEP OWM 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 |
| 16 February 1995 | 94-4164 | ND | ND | 1.1% |
| | 94-4164 duplicate | ND | ND | 1.1% |
| | relative percent difference | NA | NA | 0% |
| 17 February 1995 | 94-4653 | ND | ND | 0.68 |
| | 94-4653 duplicate | ND | ND | 0.49 |
| | relative percent difference | NA | NA | 32 |

NA - not applicable
ND - not detected
* Fish tissue organic analytes (listed in Table A5.5.1) not appearing in the above table were included in the analysis and were not detected.
NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC data for metals in fish tissue are pertinent to Boston Harbor samples.

**Table A14.** 1994 DEP OWM laboratory QA/QC lab fortified matrix data for organics in fish tissue. The analytes were extracted and analyzed according to the modified AOAC 983.21 procedure for the analysis of PCBs and Organochlorine Pesticides. (Data expressed in µg/g wet weight unless otherwise noted.)

| DATE ANALYZED | 14 February 1995 | 15 February 1995 |
|---|---|---|
| **LABORATORY SAMPLE NUMBER** | Laboratory Spike - 29 | Laboratory Spike - 30 |
| **%LIPIDS** | 0.35 | 0.22 |
| **ANALYTE*** | PCB A1260 MDL 0.16 | Lindane MDL 0.16<br>Aldrin 0.15<br>Heptachlor 0.08<br>DDT 0.25 |
| **SPIKE AMOUNT** | NR | Lindane NR<br>Aldrin NR<br>Heptachlor NR<br>DDT NR |
| **SPIKE RECOVERED** | NR | Lindane NR<br>Aldrin NR<br>Heptachlor NR<br>DDT NR |
| **SPIKE % RECOVERY** | 146 | Lindane 63<br>Aldrin 109<br>Heptachlor 91<br>DDT 64 |

MDL – method detection limit
NR – not reported
* Fish tissue organic analytes (listed in Table A5.5.1) not appearing in the above table were included in the analysis and were not detected.
NOTE: Boston Harbor samples were batched with others. These laboratory QA/QC data for metals in fish tissue are pertinent to Boston Harbor samples.

## A6. Analytical Methods

The laboratory analytical methods used at WES to generate data used in this assessment report are provided in Table A15.

**Table A15.** 1999 and 1994 Analytical Methods and Method Detection Limits (MDLs).

| Analytes | EPA Method* | SM Methods** | Other Methods | MDLs (1999) | MDLs (1994) |
|---|---|---|---|---|---|
| **Discrete Water Sample Analytes** | | | | | |
| Fecal Coliform | | SM 9222D | | <6, <16 CFU/100ml | NA |
| E. Coli, MTEC | | SM 9213D | | NA | NA |
| Enterococcus | | SM 9230C | | NA | NA |
| Alkalinity | | SM 2320B | | 1.0, 2, 2.0 mg/l | NA |
| Chloride (4500) | | SM 4500CL-B | | 1, 1.0 mg/l | NA |
| Hardness | EPA 200.7 | | | 0.6, 0.66 mg/l | NA |
| Turbidity | EPA 180.1 | | | 0.10, 0.1 NTU | NA |
| Ammonia-N | EPA 350.1 | | | 0.02 mg/l | NA |
| Nitrate/Nitrite-N | EPA 353.1 | | | 0.02 mg/l | NA |
| Suspended Solids | | SM 2540D | | 1.0, 2.5 mg/l | NA |
| Total Kjeldahl Nitrogen | EPA351.2 | | | 0.10 mg/l | NA |
| Dissolved Reactive Phosphorus | | SM4500P E | | 0.005 mg/l | NA |
| Total Reactive Phosphorus | | SM4500P E | | 0.01 mg/l | NA |
| Total Phosphorus (Manual) | | SM 4500P-E | | 0.01, 0.005 mg/l | NA |
| BOD (2,5,7,14,21day) | | SM5210B | | 6.0 mg/l | NA |
| CBOD (2,5,7,14,21day) | | SM5210B | | 2 mg/l | NA |
| Chlorophyll *a* (DWM lab) | | SM10200H | | ND | NA |
| Apparent Color (DWM lab) | | SM2120B | | 15 pcu | NA |
| **Fish Tissue Analytes** | | | | | |
| PCB Arochlor 1242 | | | AOAC 983.21*** | 0.26 µg/g | 0.06 µg/g |
| PCB Arochlor 1254 | | | AOAC 983.21*** | 0.37 µg/g | 0.17 µg/g |
| PCB Arochlor 1260 | | | AOAC 983.21*** | 0.11 µg/g | 0.16 µg/g |

* = "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
***= WES SOP *Determination of Chlorinated Pesticides, PCB Aroclor(s) and PCB congeners in Fish and Biological Tissue* (modified AOAC 983.21)
ND – no data
NA – not applicable, not pertinent to data used in this report NOTE: all fish tissue MDL values reported in mass/mass wet weight

**Table A15. Continued.** 1999 and 1994 Analytical Methods and Method Detection Limits (MDLs).

| Analytes | EPA Method* | SM Methods** | Other Methods | MDLs (1999) | MDLs (1998) | MDLs (1994) |
|---|---|---|---|---|---|---|
| **Fish Tissue Analytes (continued)** | | | | | | |
| Chlordane | | | AOAC 983.21*** | 0.11 µg/g | 0.044 µg/g | 0.11 µg/g |
| Toxaphene | | | AOAC 983.21*** | 0.59 µg/g | 0.11 µg/g | 0.11 µg/g |
| a-BHC | | | AOAC 983.21*** | 0.009 µg/g | 0.017 µg/g | 0.19 µg/g |
| b-BHC | | | AOAC 983.21*** | 0.011 µg/g | 0.014 µg/g | 0.09 µg/g |
| Lindane | | | AOAC 983.21*** | 0.009 µg/g | 0.012 µg/g | 0.16 µg/g |
| d-BHC | | | AOAC 983.21*** | 0.043 µg/g | 0.029 µg/g | 0.02 µg/g |
| Hexachlorocyclopentadiene | | | AOAC 983.21*** | 0.33 µg/g | 0.0077 µg/g | 0.10 µg/g |
| Trifluralin | | | AOAC 983.21*** | 0.18 µg/g | 0.0062 µg/g | 0.11 µg/g |
| Hexachlorobenzene | | | AOAC 983.21*** | 0.18 µg/g | 0.0091 µg/g | 0.04 µg/g |
| Heptachlor | | | AOAC 983.21*** | 0.012 µg/g | 0.013 µg/g | 0.08 µg/g |
| Heptachlor Epoxide | | | AOAC 983.21*** | 0.015 µg/g | 0.013 µg/g | 0.59 µg/g |
| Methoxychlo | | | AOAC 983.21*** | 0.029 µg/g | 1.07 µg/g | 1.07 µg/g |
| DDD | | | AOAC 983.21*** | 0.011 µg/g | 0.010 µg/g | 0.13 µg/g |
| DDE | | | AOAC 983.21*** | 0.010 µg/g | 0.014 µg/g | 0.39 µg/g |
| DDT | | | AOAC 983.21*** | 0.011 µg/g | 0.013 µg/g | 0.25 µg/g |
| Aldrin | | | AOAC 983.21*** | 0.016 µg/g | 0.0092 µg/g | 0.15 µg/g |
| BZ#81 | | | AOAC 983.21*** | 0.0005 µg/g | NA | NA |
| BZ#77 | | | AOAC 983.21*** | 0.0005 µg/g | NA | NA |
| BZ#123 | | | AOAC 983.21*** | 0.0011 µg/g | NA | NA |
| BZ#118 | | | AOAC 983.21*** | 0.0025 µg/g | NA | NA |
| BZ#114 | | | AOAC 983.21*** | 0.0008 µg/g | NA | NA |
| BZ#105 | | | AOAC 983.21*** | 0.0019 µg/g | NA | NA |
| BZ#126 | | | AOAC 983.21*** | 0.0004 µg/g | NA | NA |
| BZ#167 | | | AOAC 983.21*** | 0.0009 µg/g | NA | NA |
| BZ#156 | | | AOAC 983.21*** | 0.0007 µg/g | NA | 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
***= WES SOP *Determination of Chlorinated Pesticides, PCB Aroclor(s) and PCB congeners in Fish and Biological Tissue* (modified AOAC 983.21)
ND – no data
NA – not applicable, not pertinent to data used in this report
NOTE: all fish tissue MDL values reported in mass/mass wet weight

**Table A15. Continued.** 1999 and 1994 Analytical Methods and Method Detection Limits (MDLs).

| Analytes | EPA Method* | SM Methods** | Other Methods | MDLs (1999) | MDLs (1998) | MDLs (1994) |
|---|---|---|---|---|---|---|
| **Fish Tissue Analytes (continued)** | | | | | | |
| BZ#157 | | | AOAC 983.21*** | 0.0007 µg/g | NA | NA |
| BZ#180 | | | AOAC 983.21*** | 0.0007 µg/g | NA | NA |
| BZ#169 | | | AOAC 983.21*** | 0.0003 µg/g | NA | NA |
| BZ#170 | | | AOAC 983.21*** | 0.0007 µg/g | NA | NA |
| BZ#189 | | | AOAC 983.21*** | 0.0007 µg/g | NA | NA |
| Arsenic | EPA 200.9 | | | 0.04 mg/kg | 0.040, 0.04, mg/kg | 0.040, 0.04, mg/kg 0.002 mg/L |
| Lead | EPA 239.1 | | | NA | NA | 1.0, 1.00 mg/kg 0.03, 0.05 mg/L |
| | EPA 200.7 | | | 0.20 mg/kg | 0.35, 0.19, 0.14, 0.20, 0.2, 0.140, mg/kg | 0.05 mg/l |
| Selenium | EPA 200.9 | | | 0.04 mg/kg | 0.040, 0.04, mg/kg | NA |
| | EPA 270.2 | | | NA | NA | 0.04, 0.040 mg/kg 0.002 mg/L |
| Cadmium | EPA 200.7 | | | 0.02 mg/kg | 0.02, 0.04, 0.020, mg/kg | 0.03 mg/l |
| | EPA 213.1 | | | NA | NA | 0.01, 0.20, 0.03 mg/kg |
| Mercury | EPA 245.6 | | | 0.02 mg/kg | 0.01, 0.010, 0.020, mg/kg | 0.0002 mg/L |

* = "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
***= WES SOP *Determination of Chlorinated Pesticides, PCB Aroclor(s) and PCB congeners in Fish and Biological Tissue* (modified AOAC 983.21)
ND – no data
NA – not applicable, not pertinent to data used in this report
NOTE: all fish tissue MDL values reported in mass/mass wet weight

## A7. CONCLUSION

The Boston Harbor data collected in 1999 (and in 1994 for fish toxics) were reviewed with regard to project data quality objectives (DQOs) and adherence to DEP/DWM and WES Laboratory SOPs for collection and analysis. The primary DQO elements of precision, accuracy, representativeness, completeness and comparability (PARCC) were evaluated, as were associated quality control data.

Based on DWM's data validation process, the majority of sample data were accepted without qualification, due mainly to acceptable analytical accuracy and overall precision. For data that did not meet the objectives outlined in Section A4, data were censored or accepted with qualification. These exceptions have been specifically noted in this appendix (refer to appropriate tables in Section A5). Where problems were evident for entire surveys or batched analyses, survey or batch data were censored or qualified, as appropriate.

The 1999 Boston Harbor data are comparable with past and future data collected by DWM and others, based on the use of standardized methods and procedures. Although buckets were used as necessary for sample collection from drop locations in 1999, this technique has been discontinued. Use of the bucket method has been noted and, while its use may affect data quality for solids-related (e.g., TSS, turbidity, nutrients) and bacteria analytes, the 1999 Boston Harbor data are considered comparable to other data collected via other and current grab sampling methods.

The following additional conclusions are evident based on the validation of all 1999 DWM data, and are relevant to Boston Harbor data.

- All qualitative and quantitative fish tissue toxics, benthic macroinvertebrate, aquatic habitat, fish population, and aquatic plant data were accepted without qualification. One specific consideration in using this data is the age of the 1994 fish tissue data; this data is approximately 8 years old and is not as usable as 1999 or more recent data in determining fish health or edibility.

- Hydrolab depth data was frequently compromised (censored/qualified) due to lack of proper depth calibration prior to use (see Table A2).

- The accuracy of Hydrolab conductivity readings was often reduced by using a calibration standard out of the range of all/most survey station conductivities (see Table A2).

- In many instances, the necessary equilibration time was not afforded for the taking of stable Hydrolab readings, resulting in censored/qualified data (see Table A2).

- No light interference problems were noted in 1999 in using the Hydrolab turbidity sensor, as had been observed in 1998.

- On various batch analysis dates, analysis of apparent color by DWM showed high readings (although below the estimated MDL of 15 PCU) for ambient field blanks. This did not result in censored/qualified data, but indicates that precision of readings by different analysts might be improved.

- DWM chlorophyll a analysis indicated high blanks (> MDL) and holding time violations for frozen filters (>24 days) on several occasions, resulting in censored/qualified data (see Table A5).

## REFERENCES


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# APPENDIX B - 1999 DEP DWM BOSTON HARBOR WATERSHED SURVEY RESULTS

## INTRODUCTION

The DEP DWM sampled in the Boston Harbor Watershed July through September 1999. Sampling components in selected wadeable streams included macroinvertebrate and habitat quality evaluations, fish population sampling, and fish sampling for organic and metal toxins in edible fillets. Baseline lake survey sampling included *in-situ* Hydrolab® Multiprobe Series 3 analyzer (hereafter referred to as Hydrolab®) measurements, Secchi depth, alkalinity, color, total phosphorus, and chlorophyll *a* sampling as well as macrophyte identification/density at the maximum extent of growth. Each sampling component is described in the sections that follow.

### *BASELINE LAKE SURVEYS*

*Mystic, Neponset, and Weymouth & Weir Subwatersheds*

One of the nine 303d listed lakes in the Mystic River Subwatershed was selected for baseline surveys. Another pond in the Mystic River Subwatershed not 303d listed was also sampled. Three of the twenty 303d listed lakes in the Neponset River Subwatershed were selected for baseline surveys. One of the five 303d listed lakes in the Weymouth & Weir Subwatershed was selected for baseline surveys. Lakes were preferentially targeted for sampling based on the severity of the nutrient-related problem and the size of the lake (MA DEP 1999a). Those lakes that were listed solely for non-nutrient related issues (e.g., lakes listed for fish consumption advisories) and those with previous diagnostic/feasibility studies were not selected. Baseline surveys were conducted to provide information on the current chemical, physical and biological conditions of the lake system (i.e., in-lake and in the surrounding watershed).

Baseline lake surveys generally included a macrophyte survey conducted once during the late summer at the peak of macrophyte growth (generally in July/August/September). The survey data are used in several ways: 1) to determine if the macrophyte growth causes nuisance conditions such that the lake would be listed or delisted on the state's 303d list for violations of water quality standards; 2) to determine if the lake meets designed uses in the 305b assessments; 3) to record baseline conditions to document changes in density of plant growth following implementation of a TMDL; 4) to document invasive species distributions in the state; and 5) to suggest macrophyte management options for the lake.

Trophic status (an indicator of the productivity level of a lake) is based on the evaluation of data collected during baseline surveys. Parameters used to determine trophic status include; oxygen levels, chlorophyll *a* concentrations, total phosphorus levels, Secchi disk measurements, and macrophyte density determinations.

The data are used to validate Total Maximum Daily Load (TMDL) phosphorus loading models and to document the present trophic conditions as well as assessing the status of lake's designated uses. The total phosphorus data are used to evaluate accuracy of land use loading estimates (Mattson and Isaac 1999) of total phosphorus to lakes by comparing predictions of lake concentrations based on modeling to actual measured lake concentrations. These may be used as a basis for estimation of internal loading or other unmeasured phosphorus sources. Concurrently a lake database will be developed for both 303d development and for 305b evaluation based on lakes that are on the current 303d list. The data contained in this database along with the other data collected are used in TMDL development or to monitor lakes for changes in water quality and nuisance plant growth after TMDL implementation.

### *MACROINVERTEBRATES*

Excerpted from *Boston Harbor Watershed 1999 Biological Assessment* technical memorandum (Fiorentino and Maietta, 2000), which is attached as Appendix C of this Assessment Report.

> The main objectives of biomonitoring in the Boston Harbor 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 focused on developing NPDES permits, Water Management Act permits, storm water management, and control of other nonpoint source (NPS) pollution. Specific tasks were:

1. Conduct benthic macroinvertebrate sampling at locations throughout the Boston Harbor 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 305b of the Clean Water Act.

***FISH POPULATION***

Fish population surveys are conducted to estimate the abundance and diversity of fish species within lakes/ponds or stream reaches. Surveys can include a habitat assessment component. Surveys conducted in 1999 by DWM in the Neponset River Subwatershed were performed in support of the BUDGETS Project being implemented by the Neponset River Watershed Association. The information generated from surveys is used in assessing the level of support of the Aquatic Life Use as defined in the Massachusetts Water Quality Standards

***FISH TOXICS MONITORING***

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 DEP Offices/Divisions, (Watershed Management, Research and Standards, and Environmental Analysis), the Department of Fisheries and Wildlife Environmental Law Enforcement, and the Massachusetts 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), PCBs 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.

During 1994, DEP OWM (now DEP DWM) monitored one station for toxics in fish flesh in the Weymouth & Weir sub-watershed. Lake Holbrook, a 32-acre water body located in Holbrook was sampled in July as part of Year 2 Watershed Surveys and again in August in response to a Public Request. Sampling for toxics in fish flesh also occurred during 1994 at two sites in the Neponset sub-watershed of the Boston Harbor Drainage Area. Results for Willet Pond, a 200acre water body located in Walpole/Westwood/Norwood and a stretch of the Neponset River in Canton/Norwood are presented in *The Neponset River Watershed 1994 Resource Assessment Report* (Kennedy *et al.*, 1995). During 1999, DEP DWM monitored two stations in the Mystic sub-watershed. Lower Mystic Lake, an 111acre water body located in Arlington/Medford, was sampled for toxics in fish flesh in June 1999 in response to a Public Request. In July 1999, as part of Year 2 Watershed Surveys, the Upper Mystic Lake a 167acre water body located in Winchester/Arlington/Medford was also sampled for toxics in fish flesh.

## MATERIALS AND METHODS

The DEP DWM sampling plan matrix for the Boston Harbor Watershed is summarized in Table B1.

**Table B1.** 1999 DEP DWM Boston Harbor Watershed sampling matrix.

| WATERBODY (SEGMENT #) | STATION[1] | June | July | August | September |
|---|---|---|---|---|---|
| ***Mystic River Subwatershed*** | | | | | |
| Aberjona River (MA71-01) | AR01 | | M | | |
| Winter Pond (MA71047) | A | | B | B | B |
| Upper Mystic Lake | F0080 | | T | | |
| Unnamed tributary to Lower Mystic Lake | C | | | | B |
| Lower Mystic Lake | D | | | | B |
| | F0081 | T | | | |
| | B | | | B | B |
| | A | | | B | B |
| Mill Brook | MI01 | | M | | |
| ***Neponset River Subwatershed*** | | | | | |
| Ganawatte Farm Pond (MA73037) | A | | B | B | B |
| Mill Brook (MA73-08) | MB01 | | M, P | | |
| Cobbs Pond (MA73009) | A | | B | B | B |
| Hawes Brook (MA73-16) | NE09 | | M, P | | |
| Traphole Brook (MA73-17) | 5B01 | | M, P | | |
| East Branch (locally known as Canton River) (MA73-05) | NE12 | | M, P | | |
| Pequid Brook (MA73-22) | PB01 | | M, P | | |
| Massapoag Brook (MA73-21) | 9BOB | | M, P | | |
| Beaver Brook (MA73-19) | BB01 | | M, P | | |
| Beaver Meadow Brook (MA73-20) | BM01 | | M, P | | |
| Unnamed Tributary to Steep Hill Brook (MA73-32) | SB01 | | M, P | | |
| Turners Pond (MA73059) | A | | B | B | B |
| ***Weymouth & Weir Subwatershed*** | | | | | |
| Old Quincy Reservoir***** (MA74017) | A | | B***** | | |
| Monatiquot River (MA74-08) | MR01 | | M | | |
| Old Swamp River (MA74-03) | SR01 | | M | | |
| Weir River (MA74-02) | WR01 | | M | | |

[1] Sampling did not necessarily occur at the same exact location although that which occurred in the general vicinity of the sampling station is listed together.
**B** – Baseline lake monitoring. Can include: Hydrolab® Multiprobe meter (depth, pH, dissolved oxygen, conductivity, temperature, total dissolved solids, turbidity) and secchi depth, alkalinity, color, total phosphorus, and chlorophyll *a*.
**M** – Macroinvertebrate sampling and habitat assessment
**P** – Fish population sampling
**T** – Toxics in fish tissue (Cd, Pb, Hg, As, Se, % lipids, PCBs, organochlorine pesticides)

***** No data collected, see Baseline Lake Survey Materials and Methods, and Results sections for details.

**Note:** Fish toxics monitoring was conducted by DEP OWM in 1994 in the Weymouth and Weir Subwatershed (Lake Holbrook, Holbrook). Data are presented in Table B8. Additional work was done at two sites in the Neponset River Subwatershed. Results are presented in *The Neponset River Watershed 1994 Resource Assessment Report* (Kennedy *et al.*, 1995). Fish toxics monitoring sampling locations are depicted in Figure B2.

### *BASELINE LAKE SURVEYS*

In the Boston Harbor Watershed baseline lake surveys were conducted July, August, and September 1999 to coincide with maximum growth of aquatic vegetation, highest recreational use, and highest lake productivity. Lakes were sampled three times each (generally at monthly intervals) (Figure B1).

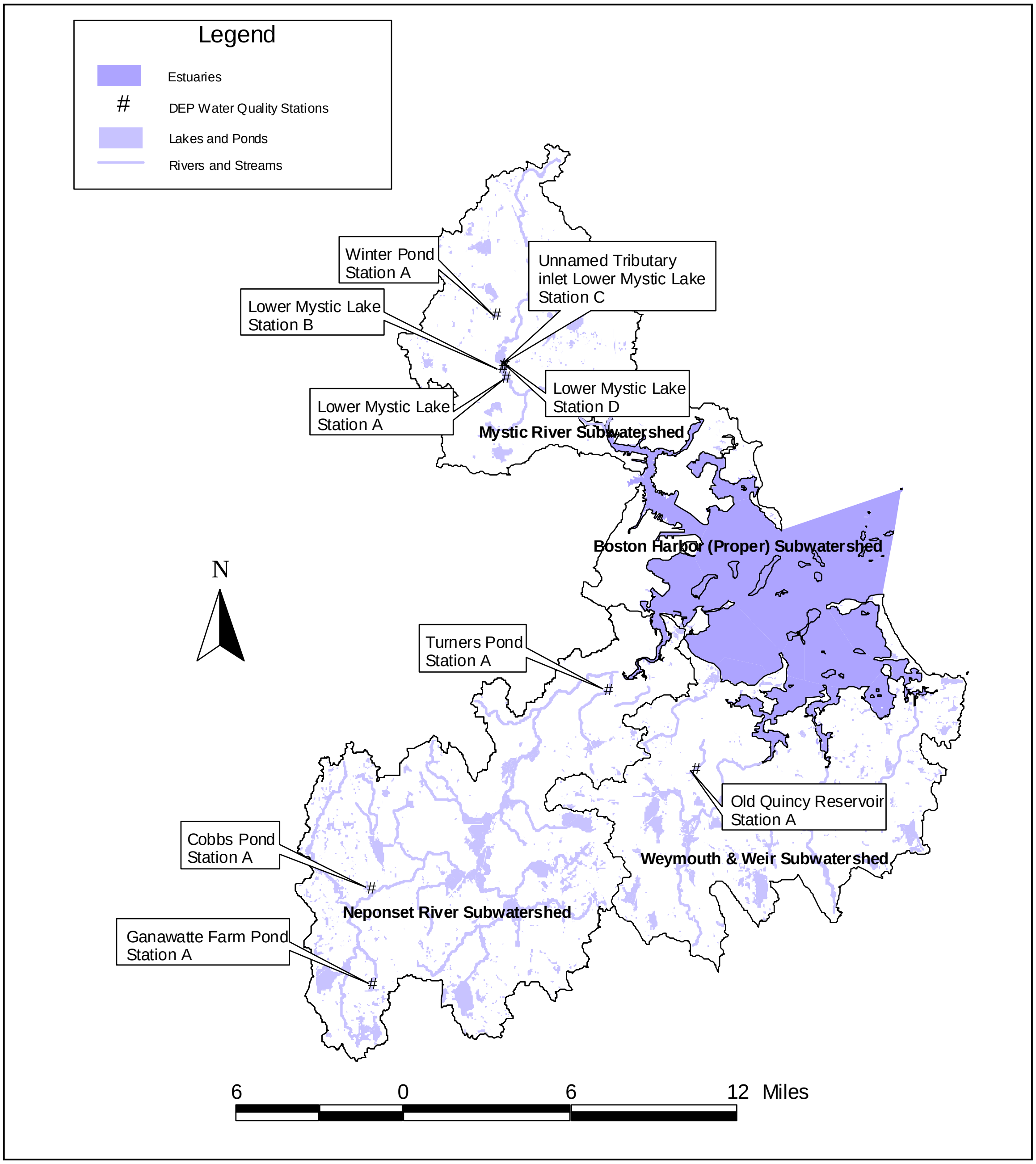


**Figure B1.** 1999 DEP DWM TMDL sampling stations located in the Boston Harbor Watershed.

*Mystic River Subwatershed*

- The deep hole in the southern basin of Lower Mystic Lake and a second site in the northwest quadrant were sampled the 5th and 24th of August 1999 and again on 21 September 1999. The inlet of Lower Mystic Lake at the spillway/dam in the northern basin was also sampled on 21 September1999.
- The deep hole in the center of the western lobe of Winter Pond was sampled 13 July, 10 August, and 7 September 1999.

*Neponset River Subwatershed*

- The deep hole near the dam in the southeastern end of Cobbs Pond was sampled on 15 July, 12 August, and 13 September 1999.
- The deep hole in the northern lobe of Ganawatte Farm Pond was sampled on 15 July, 12 August, and 13 September 1999.
- The deep hole in the southeastern quadrant of Turners Pond was sampled on 27 July, 24 August, and 21 September 1999.

*Weymouth & Weir Subwatershed*

- Sampling of the deep hole near the dam in the northeastern end of Old Quincy Reservoir was unsuccessful due to lack of water. The water body had been drained for a dam repair/dredging project slated for completion January of 2001.

## BENTHIC MACROINVERTEBRATE STUDIES

A DEP DWM technical memorandum entitled *Boston Harbor Watershed 1999 Biological Assessment* (Fiorentino and Maietta, 2000), presented as Appendix C of this report, details the collection, handling, and processing of aquatic macroinvertebrate samples (as well as the analysis results) from selected sites in the Boston Harbor Watershed during July 1999.

## FISH POPULATION

The DWM conducted fish population surveys at nine locations in the Neponset River Subwatershed during July 1999. A technical memorandum by DEP DWM personnel entitled *Boston Harbor Watershed 1999 Biological Assessment* (Fiorentino and Maietta, 2000), presented as Appendix C of this report, details the handling and processing of samples collected as well as results and analysis.

## 1999 FISH TOXICS

*Mystic River Subwatershed*

DWM staff collected fish via boat mounted electrofishing gear in the Lower Mystic Lake, (Arlington/Medford) on 24 June 1999 and in the Upper Mystic Lake (Winchester/Arlington/Medford) on 8 July 1999 (Figure B2). Fish were held in an onboard livewell until an appropriate sample size was reached, at which time the fish were placed in an ice filled cooler and brought back to the DWM laboratory for processing. Data for the Upper Mystic Lake (F0080), and the Lower Mystic Lake (F0081) is presented in Table B7. Protocols designed to assure accuracy and prevent cross-contamination of samples were followed for collecting, processing and shipping fish (MA DEP 1999b). 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, and 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 include the following:
Mercury is analyzed by a cold vapor method using a Perkin Elmer, FIMS (Flow Injection Mercury System) which uses Flow Injection Atomic Absorption Spectroscopy. Cadmium and lead are analyzed using a Perkin Elmer, Optima 3000 XL ICP – Optical Emission Spectrophotometer. Arsenic and selenium are analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer.

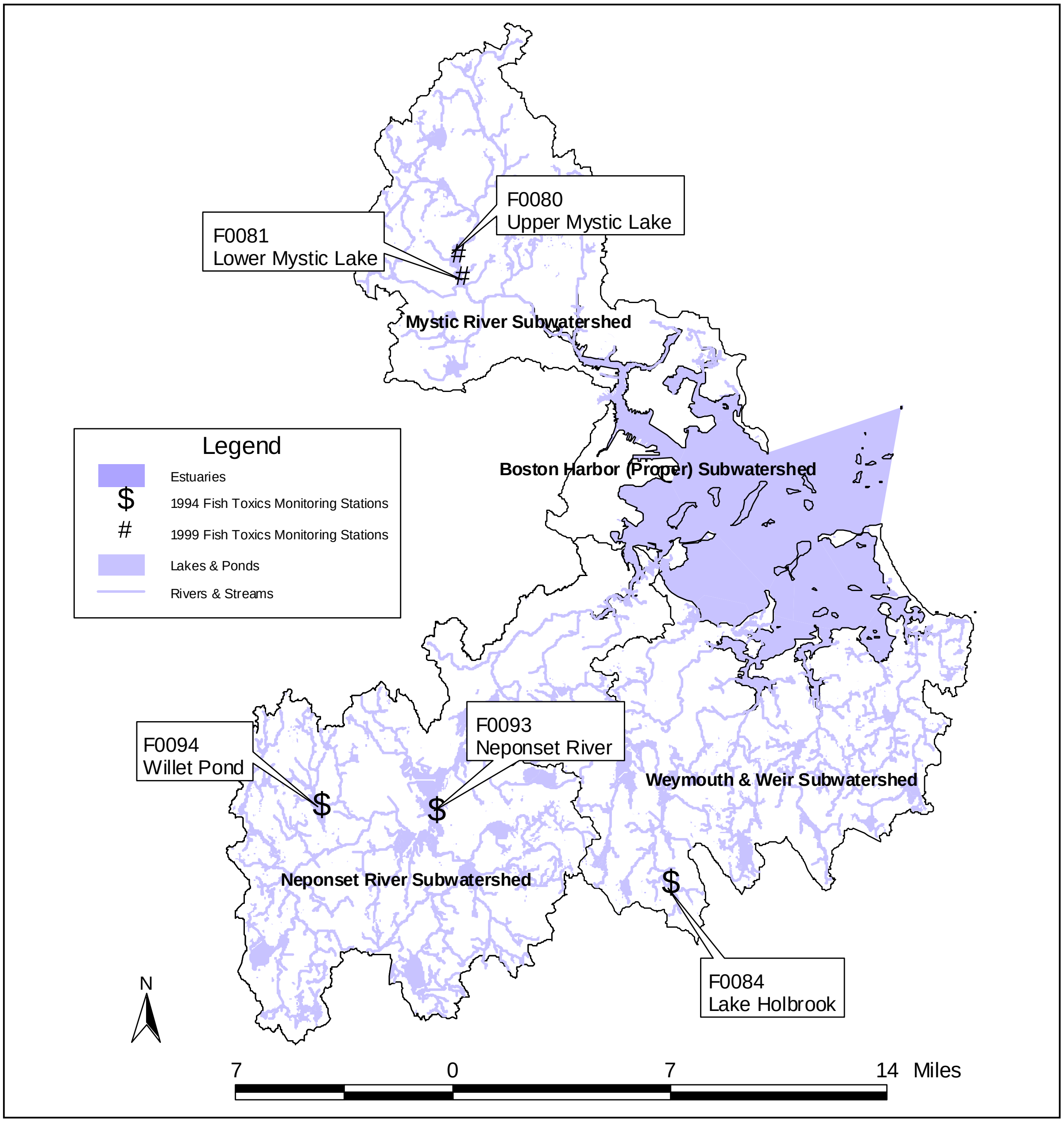


**Figure B2.** Locations of 1999 and 1994 DEP fish toxics monitoring stations in the Boston Harbor Watershed.

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).

### 1994 FISH TOXICS

*Weymouth & Weir Subwatershed*

In July and August 1994, DEP OWM conducted fish toxics monitoring in Lake Holbrook, Holbrook (Figure B2). Using boat-mounted electrofishing gear OWM staff collected fish on 13 July 1994 and then on 19 August trotlines were used. Fish selected for analysis were placed in an ice filled cooler and brought back to the OWM laboratory for processing. Data for Lake Holbrook (F0084) is presented in Table B8.

*Neponset River Subwatershed*

During July and August 1994, Willet Pond (Walpole/Westwood/Norwood) (F0094) and a portion of the Neponset River in Canton/Walpole (F0093) were monitored for fish toxics (Figure B2). These data are presented in *The Neponset River Watershed 1994 Resource Assessment Report* (Kennedy *et al.*, 1995).

## RESULTS

### *BASELINE LAKE SURVEYS*

*Mystic River Subwatershed*

Fifteen sites were surveyed for macrophytes on Winter Pond, Winchester (MA DEP 1999c). The pond was approximately 25% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant species occurring at greater than 50% of the observation sites were *Nymphaea* sp., *Utricularia* sp., and *Potamogeton epihydrus*. The trophic status is estimated as eutrophic. There was one non-native wetland species (*Lythrum salicaria)* sited at Winter Pond. There were no non-native aquatic species sited at Winter Pond.

No weed mapping was done on Lower Mystic Lake. Only two small areas of macrophytes were observed during a perimeter viewing on 21 September 1999.

*Neponset River Subwatershed*

Thirty sites were surveyed for macrophytes on Cobbs Pond, Walpole (MA DEP 1999c). The pond was approximately 90% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant species occurring at greater than 50% of the observation sites were *Lythrum salicaria*, *Nymphaea* sp., *Ceratophyllum demersum*, *Lemna* sp., *Wolffia* sp., and *Brasenia schreberi*. The trophic status is estimated as eutrophic. There were non-native wetland (*Lythrum salicaria*) and non-native aquatic (*Myriophyllum heterophyllum)* species sited at Cobbs Pond.

Twenty-five sites were surveyed for macrophytes on Ganawatte Farm Pond, Walpole/Foxborough/Sharon (MA DWM 1999). The pond was approximately 90% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant species occurring at greater than 50% of the observation sites were *Nymphaea* sp., *Lythrum salicaria*, *Brasenia schreberi, Decadon verticillatus*, and *Utricularia vulgaris*. The trophic status is estimated as hypereutrophic. There was one non-native wetland species (*Lythrum salicaria)* sited at Ganawatte Farm Pond. There were no non-native aquatic species sited at Ganawatte Farm Pond.

Eighteen sites were surveyed for macrophytes on Turners Pond, Milton (MA DEP 1999c). The pond was approximately less than 10% covered with dense or very dense aquatic plants. Of the plants observed (Table B2), the co-dominant species occurring at greater than 50% of the observation sites were *Lythrum salicaria*, *Typha latifolia,* macroscopic Algae, and *Nitella* sp. The trophic status is estimated as eutrophic. There was one non-native wetland species (*Lythrum salicaria)* sited at Turners Pond. There were no non-native aquatic species sited at Turners Pond.

*Weymouth & Weir Subwatershed*

No sampling was done at Old Quincy Reservoir. The water body was drained for a dam repair/dredging project slated for completion January of 2001.

**Table B2.** 1999 DEP DWM aquatic macrophyte, wetland vegetation, and macroalgae observations at selected 303d listed lakes in the Boston Harbor Watershed. Listed in descending order of frequency with percentage of observations in which plants occurred parenthetical. (n= total number of observation sites)

| *Mystic River Subwatershed* | *Neponset River Subwatershed* | | |
|---|---|---|---|
| **Winter Pond**<br>71047<br>**9/9/99**<br>**n=15** | **Cobbs Pond**<br>73009<br>**7/7/99**<br>**n=30** | **Ganawatte Farm Pond**<br>73037<br>**7/12/99**<br>**n=25** | **Turners Pond**<br>73059<br>**7/21/99**<br>**n=18** |
| *Nymphaea* sp. (100) | *Lythrum salicaria*[1] (83) | *Nymphaea* sp. (92) | *Lythrum salicaria*[1] (89) |
| *Utricularia* sp. (80) | *Nymphaea* sp. (77) | *Lythrum salicaria*[1] (76) | *Typha latifolia (83)* |
| *Potamogeton epihydrus* (53) | *Ceratophyllum demersum* (73) | *Brasenia schreberi* (60) | Macroscopic Algae (green, brown, blue-green) (56) |
| Filamentous Algae (40) | *Lemna* sp. (67) | *Decadon verticillatus* (60) | *Nitella* sp. (50) |
| *Lythrum salicaria*[1] (33) | *Wolffia* sp. (67) | *Utricularia vulgaris* (52) | Filamentous Algae (green) (39) |
| *Nitella* sp. (33) | *Brasenia schreberi* (63) | *Potamogeton* sp., thin leaf variety (36) | *Pontederia cordata* (33) |
| *Polygonum* sp. (33) | *Nuphar* sp. (30) | *Ceratophyllum demersum* (28) | *Sagittaria* sp. (22) |
| *Nymphaea* sp. (pink) (20) | *Polygonum* sp. (23) | *Cephalanthus occidentalis (12)* | *Iris* sp. (11) |
| | *Myriophyllum heterophyllum*[2] (20) | *Pontederia cordata* (12) | *Nuphar* sp. (11) |
| | *Typha* sp. (20) | *Lemna* sp. (8) | *Eleocharis sp. (6)* |
| | *Potamogeton* sp., thin leaf variety (13) | *Polygonum* sp. (4) | *Elodea sp. (6)* |
| | *Pontederia cordata* (10) | | *Nymphaea odorata (6)* |
| | *Utricularia vulgaris* (7) | | |
| | *Iris* sp. (3) | | |
| | *Peltandra virginica* (3) | | |
| | *Sagittaria* sp. (3) | | |

[1] non-native wetland species [2] non-native aquatic species

The *in-situ* Hydrolab® lake data for the Mystic River Subwatershed and the Neponset River Subwatershed are provided in Tables B3 and B4 respectively. Alkalinity, total phosphorus, apparent color, chlorophyll *a*, and Secchi depth data for the Mystic River Subwatershed and the Neponset River Subwatershed are provided in Tables B5 and B6 respectively. These data are managed and maintained in DWM's *Water Quality Data Access Database*.

**TABLE B3.** 1999 DEP DWM Mystic River Subwatershed *in-situ* Hydrolab® lake data.

| Date | OWMID | OWMID QA/QC | Time (24hr) | Depth (m) | Temp (°C) | pH (SU) | Cond @ 25 °C (µS/cm) | TDS (mg/l) | DO (mg/l) | SAT (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lower Mystic Lake (Palis: 71027)** | | | | | | | | | | |
| **Station: A** | **Description: deep hole, south basin, Arlington/Medford.** | | | | | | | | | |
| 08/05/99 | LB-0423 | | 13:01 | 0.5 | 26.0 **u** | 9.0 | 623 | 399 | 9.6 **u** | 117 **u** |
| | | | 13:05 | 1.8 | 25.8 | 9.0 | 624 | 399 | 9.5 | 116 |
| | | | 13:11 | 3.5 | 24.9 | 8.6 | 632 | 405 | 8.7 | 103 |
| | | | 13:18 | 4.0 | 22.1 **u** | 7.4 | 660 | 422 | 5.0 **u** | 56 **u** |
| | | | 13:24 | 7.0 | 13.6 | 6.8 | 697 | 446 | <0.2 | <2 |
| | | | 13:30 | 9.6 | 10.6 | 6.7 | 729 | 467 | <0.2 | <2 |
| | | | 13:34 | 10.9 | 9.3 | 6.6 | 767 | 491 | <0.2 | <2 |
| | | | 13:39 | 13.1 | 8.1 | 6.6 | 845 | 541 | <0.2 | <2 |
| | | | 13:41 | 15.0 | 7.7 | 6.6 | 1,016 | 650 | <0.2 | <2 |
| | | | 13:41 | 16.1 **m** | 7.2 **m** | 6.2 **m** | ** **cm** | ** **cm** | <0.2 **m** | <2 **m** |
| 08/24/99 | LB-0199 | | 13:11 | 0.5 | 24.0 | 8.7 | 610 | 390 | 10.0 | 117 |
| | | | 13:21 | 2.5 | 22.8 | 8.8 | 609 | 390 | 10.3 | 117 |
| | | | 13:31 | 4.5 | 21.7 **u** | 8.1 **u** | 622 **u** | 398 **u** | 7.6 **u** | 85 **u** |
| | | | 13:39 | 5.5 | 18.4 **u** | 6.9 | 668 | 427 | 0.7 | 7 |
| | | | 13:51 | 7.0 | 14.2 | 6.7 | 690 | 441 | <0.2 | <2 |
| | | | 13:59 | 10.0 | 10.7 | 6.5 | 718 | 459 | <0.2 | <2 |
| | | | 14:05 | 12.0 | 8.7 | 6.5 | 788 **c** | 504 **c** | <0.2 | <2 |
| | | | 14:10 | 14.0 | 7.9 | 6.5 | 914 **c** | 585 **c** | <0.2 | <2 |
| | | | 14:12 | 15.0 **m** | 7.7 **m** | 6.5 **m** | 999 **cm** | 639 **cm** | <0.2 **m** | <2 **m** |
| | | | 14:13 | 15.9 **m** | 7.3 **m** | 6.3 **m** | ** **cm** | ** **cm** | <0.2 **m** | <2 **m** |
| 09/21/99 | LB-0504 | | 08:55 | 0.5 | 19.7 | 7.3 | 487 | 312 | 7.9 | 85 |
| | | | 09:00 | 3.0 | 19.5 | 7.2 | 493 | 315 | 7.0 | 75 |
| | | | 09:07 | 7.0 | 18.0 | 6.8 | 551 | 353 | 1.7 **u** | 18 **u** |
| | | | 09:13 | 7.9 | 13.3 | 6.6 | 710 | 454 | <0.2 | <2 |
| | | | 09:17 | 9.0 | 11.6 | 6.5 | 721 **c** | 461 **c** | <0.2 | <2 |
| | | | 09:27 | 10.0 | 10.6 | 6.5 | 738 **c** | 473 **c** | <0.2 | <2 |
| | | | 09:32 | 11.0 | 9.6 | 6.5 | 780 **c** | 499 **c** | <0.2 | <2 |
| | | | 09:38 | 13.5 | 8.3 | 6.5 | 897 **c** | 574 **c** | <0.2 | <2 |
| | | | 09:44 | 16.0 | 7.4 | 6.3 | ** **c** | ** **c** | <0.2 | <2 |
| **Station: B** | **Description: northwest quadrant of pond, Arlington/Medford.** | | | | | | | | | |
| 08/05/99 | LB-0422 | | 10:51 | 0.4 | 26.0 | 9.0 | 621 | 397 | 9.2 | 112 |
| | | | 10:56 | 1.7 | 25.8 | 9.0 | 621 | 397 | 9.3 | 113 |
| | | | 11:01 | 3.3 | 25.7 | 8.9 | 621 | 398 | 8.8 **u** | 107 **u** |
| | | | 11:05 | 4.0 | 22.6 **u** | 7.6 | 652 | 417 | 5.7 | 66 |
| | | | 11:11 | 8.0 | 13.3 | 6.8 | 693 | 444 | <0.2 | <2 |
| | | | 11:21 | 12.0 | 8.2 | 6.7 | 761 | 487 | <0.2 | <2 |
| | | | 11:29 | 13.0 | 7.8 | 6.8 | 802 | 513 | <0.2 | <2 |
| | | | 11:37 | 14.5 | 7.6 | 6.8 | 857 | 548 | <0.2 | <2 |
| | | | 11:41 | 15.7 **m** | 7.5 **m** | 6.7 **m** | 981 **m** | 628 **m** | <0.2 **m** | <2 **m** |
| 08/24/99 | LB-0429 | | 14:35 | 0.5 | 24.6 | 8.7 | 611 | 391 | 10.0 | 118 |
| | | | 14:40 | 2.5 | 22.9 | 8.8 | 612 | 392 | 10.4 | 119 |
| | | | 14:46 | 4.5 | 22.3 | 8.6 | 610 | 390 | 9.1 | 103 |
| | | | 14:51 | 5.5 | 18.6 **u** | 6.9 | 665 | 426 | 0.8 | 8 |
| | | | 15:04 | 7.0 | 14.1 | 6.7 | 682 | 437 | <0.2 | <2 |
| | | | 15:11 | 10.0 **m** | 9.9 **m** | 6.6 **m** | 724 **m** | 463 **m** | <0.2 **m** | <2 **m** |
| | | | 15:17 | 12.0 | 8.4 | 6.7 | 762 | 487 | <0.2 | <2 |
| | | | 15:19 | 15.5 **m** | 7.6 **m** | 6.7 **m** | 896 **m** | 574 **m** | <0.2 **m** | <2 **m** |

**" i "** = **i**naccurate readings from Hydrolab® Multiprobe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, or lack of calibration of the depth sensor prior to use.

" **m** " = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" **u** " = **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" **c** " = greater than **c**alibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for <u>conductivity</u> (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or <u>turbidity</u> (>10, 20 or 40 NTU). It can also be used for <u>TDS and Salinity</u> calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

**Table B3. Continued.** 1999 DEP DWM Mystic River Subwatershed *in-situ* Hydrolab® lake data**.**

| Date | OWMID | OWMID QA/QC | Time (24hr) | Depth (m) | Temp (°C) | pH (SU) | Cond @ 25 °C (µS/cm) | TDS (mg/l) | DO (mg/l) | SAT (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lower Mystic Lake (Palis: 71027)** | | | | | | | | | | |
| **Station: B** | **Description: northwest quadrant of pond, Arlington/Medford.** | | | | | | | | | |
| 09/21/99 | LB-0448 | | 10:42 | 0.6 | 19.8 | 7.4 | 486 | 311 | 8.3 | 89 |
| | | | 10:47 | 3.5 | 19.5 | 7.3 | 490 | 314 | 7.3 | 79 |
| | | | 10:50 | 6.0 | 19.2 | 7.1 | 504 | 322 | 5.9 | 63 |
| | | | 10:57 | 7.0 | 17.9 | 6.8 | 570 | 365 | 1.4 **u** | 15 **u** |
| | | | 11:01 | 8.6 | 12.0 | 6.6 | 718 | 459 | <0.2 | <2 |
| | | | 11:06 | 10.0 | 10.4 | 6.6 | 737 **c** | 472 **c** | <0.2 | <2 |
| | | | 11:11 | 11.0 | 9.4 | 6.6 | 738 **c** | 473 **c** | <0.2 | <2 |
| | | | 11:15 | 11.9 | 8.6 | 6.7 | 771 **c** | 493 **c** | <0.2 | <2 |
| | | | 11:20 | 13.4 | 8.0 | 6.7 | 869 **c** | 556 **c** | <0.2 | <2 |
| **Winter Pond (Palis: 71047)** | | | | | | | | | | |
| **Station: A** | **Description: deep hole, center of western lobe, Winchester.** | | | | | | | | | |
| 07/13/99 | LB-0007 | | 14:04 | 0.5 | 24.8 | 6.8 | 363 | 232 | 7.3 | 85 |
| | | | 14:10 | 1.1 | 24.7 | 6.9 | 363 | 232 | 7.4 | 87 |
| 08/10/99 | LB-0159 | LB-0161 | 13:02 | 0.5 | 23.8 | 8.8 | 382 | 245 | 9.9 **u** | 116 **u** |
| | | | 13:09 | 1.0 | 22.7 | 8.2 | 382 | 245 | 9.0 | 103 |
| | LB-0161 | LB-0159 | 13:21 | 0.5 | 23.4 **u** | 8.6 **u** | 383 | 245 | 9.4 | 109 |
| | | | 13:26 | 1.0 | 22.8 | 8.2 **u** | 382 | 244 | 8.8 | 101 |
| 09/07/99 | LB-0307 | | 13:42 | 0.5 | 28.2 | 7.0 | 415 | 266 | 7.2 | 91 |

**" i "** = **i**naccurate readings from Hydrolab® Multiprobe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, or lack of calibration of the depth sensor prior to use.

" **m "** = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

" **u "** = **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

" **c** " = greater than **c**alibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified ("c") conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

**Table B4.** 1999 DEP DWM Neponset River Subwatershed *in-situ* Hydrolab® lake data.

| Date | OWMID | OWMID QA/QC | Time (24hr) | Depth (m) | Temp (°C) | pH (SU) | Cond @ 25 °C (µS/cm) | TDS (mg/l) | DO (mg/l) | SAT (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cobbs Pond (Palis: 73009)** | | | | | | | | | | |
| **Station: A** | **Description: deep hole, south eastern end of pond near dam, Walpole.** | | | | | | | | | |
| 07/15/99 | LB-0032 | | 12:25 | 0.5 | 21.9 | 6.5 | 212 | 135 | 3.4 | 38 |
| | | | 12:31 | 1.3 | 20.5 | 6.3 | 212 | 136 | 0.5 | 6 |
| 08/12/99 | LB-0180 | | 13:46 | 0.5 | 22.2 | 6.5 | 211 | 135 | 1.2 **u** | 13 **u** |
| | | | 13:52 | 1.0 | 21.6 | 6.4 | 212 | 135 | 0.8 **u** | 9 **u** |
| | | | 13:58 | 1.2 | 21.0 | 6.3 | 216 | 138 | <0.2 **u** | <2 **u** |
| 09/13/99 | LB-0336 | | 13:16 | 0.5 | 21.6 **u** | 6.3 | 192 | 123 | 2.7 **u** | 30 **u** |
| | | | 13:25 | 1.5 | 20.4 | 6.1 | 201 | 129 | 0.7 **u** | 7 **u** |
| **Ganawatte Farm Pond (Palis: 73037)** | | | | | | | | | | |
| **Station: A** | **Description: deep hole, northern end of pond, Walpole.** | | | | | | | | | |
| 07/15/99 | LB-0036 | | 10:17 | 0.5 | 18.8 | 5.8 | 139 | 89.1 | <0.2 | <2 |
| | | | 10:23 | 1.0 | 17.9 | 5.9 | 198 | 127 | <0.2 | <2 |
| 08/12/99 | LB-0186 | | 11:10 | 0.4 | 19.9 | 5.7 | 124 | 79.6 | 0.3 | 3 |
| | | | 11:17 | 0.7 | 19.4 | 5.7 | 128 | 81.7 | <0.2 | <2 |
| 09/13/99 | LB-0332 | LB-0337 | 10:26 | 0.5 | 19.6 | 5.7 | 114 | 72.9 | 1.2 | 13 |
| | | | 10:38 | 0.8 | 19.3 | 5.7 | 115 | 73.8 | 0.8 | 8 |
| | LB-0337 | LB-0332 | 10:48 | 0.5 | 19.4 | 5.7 | 114 | 72.8 | 0.9 | 10 |
| | | | 10:56 | 0.8 | 19.2 | 5.7 | 116 | 74.0 | 0.8 | 8 |
| **Turners Pond (Palis: 73059)** | | | | | | | | | | |
| **Station: A** | **Description: deep hole in southeastern quadrant, Milton.** | | | | | | | | | |
| 07/27/99 | LB-0046 | | 09:52 | 0.5 | 26.8 | 9.9 | 260 | 167 | 14.0 | 173 |
| | | | 09:58 | 1.5 | 26.6 | 9.8 | 256 | 164 | 12.8 | 157 |
| | | | 10:05 | 2.5 | 23.8 | 6.9 **u** | 246 | 157 | 0.4 | 5 |
| | | | 10:12 | 3.5 | 18.8 | 6.5 | 263 | 168 | <0.2 | <2 |
| | | | 10:17 | 4.5 | 13.1 | 6.4 | 279 | 179 | <0.2 | <2 |
| | | | 10:22 | 5.5 | 10.4 | 6.4 | 306 | 196 | <0.2 | <2 |
| | | | 10:28 | 6.5 | 9.5 | 6.4 | 348 | 223 | <0.2 | <2 |
| 08/24/99 | LB-0194 | | 09:29 | 0.5 | 23.1 | 7.4 | 240 | 154 | 8.2 | 94 |
| | | | 09:36 | 1.5 | 22.6 | 7.4 | 240 | 154 | 8.3 | 94 |
| | | | 09:41 | 2.5 | 22.0 | 6.9 | 240 | 153 | 6.4 | 72 |
| | | | 09:51 | 3.5 | 19.4 | 6.4 | 280 | 179 | <0.2 | <2 |
| | | | 09:56 | 4.4 | 14.4 **u** | 6.4 | 281 | 180 | <0.2 | <2 |
| | | | 10:00 | 5.5 | 11.3 | 6.4 | 322 | 206 | <0.2 | <2 |
| | | | 10:07 | 6.2 | 10.3 | 6.3 | 341 | 218 | <0.2 | <2 |
| 09/21/99 | LB-0500 | | 13:22 | 0.5 | 20.7 | 7.3 | 205 | 131 | 9.9 **u** | 108 **u** |
| | | | 13:27 | 1.0 | 20.0 | 7.1 | 204 | 131 | 9.4 | 102 |
| | | | 13:31 | 1.5 | 19.9 | 6.9 | 203 | 130 | 8.2 | 89 |
| | | | 13:36 | 2.5 | 19.7 | 6.6 | 207 | 133 | 6.1 | 65 |
| | | | 13:41 | 3.5 | 19.4 | 6.3 | 213 | 136 | 1.8 | 19 |
| | | | 13:47 | 4.0 | 18.7 | 6.5 | 245 | 157 | <0.2 | <2 |

“ **i** ” = **i**naccurate readings from Hydrolab® Multiprobe likely; may be due to significant pre-survey calibration problems, post-survey calibration readings outside typical acceptance range for the low ionic check and for the deionized blank water check, or lack of calibration of the depth sensor prior to use.

“ **m** ” = **m**ethod not followed; one or more protocols contained in the DWM Hydrolab® SOP not followed, i.e. operator error (e.g. less than 3 readings per station (rivers) or per depth (lakes), or instrument failure not allowing method to be implemented.

“ **u** ” = **u**nstable readings, due to lack of sufficient equilibration time prior to final readings, non-representative location, highly-variable water quality conditions, etc. See Section 4.1 for acceptance criteria.

“ **c** ” = greater than **c**alibration standard used for pre-calibration, or outside the acceptable range about the calibration standard. Typically used for conductivity (>718, 1,413, 2,760, 6,668 or 12,900 uS/cm) or turbidity (>10, 20 or 40 NTU). It can also be used for TDS and Salinity calculations based on qualified (“c”) conductivity data, or that the calculation was not possible due to censored conductivity data (TDS and Salinity are calculated values and entirely based on conductivity reading). See Section 4.1 for acceptance criteria.

**Table B5.** 1999 DEP DWM Mystic River Subwatershed *physico-chemical* data.

| Date | Time (24hr) | Secchi Depth (m) | Station Depth (m) | OWMID | OWMID QA/QC | Sample Depth (m) | Alkalinity (mg/l) | Color (PCU) | Total Phosphorus (mg/l) | Chlorophyll *a* ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lower Mystic Lake (Palis: 71027)** | | | | | | | | | | |
| **Station: A** | | | | Description: deep hole, south basin, Arlington/Medford. | | | | | | |
| 08/05/99 | ** | 2.6 | 22.6 | | | | | | | |
| | | | | LB-0424 | | 0 - 7.0 | -- | -- | -- | 5 |
| | | | | LB-0419 | | 0.5 | 55 | -- | 0.015d | -- |
| | | | | LB-0420 | | 13.0 | 59 | 17 | 0.22d | -- |
| | | | | LB-0425 | | 22.0 | **m | -- | 22d | -- |
| 08/24/99 | ** | 2.9 | 21.5 | | | | | | | |
| | | | | LB-0197 | | 0 - 8.7 | -- | -- | -- | **h |
| | | | | LB-0195 | | 0.5 | 58 | <15d | 0.018 | -- |
| | | | | LB-0198 | | 7.0 | -- | -- | 0.028 | -- |
| | | | | LB-0196 | | 13.0 | 60 | <15d | 0.10 | -- |
| 09/21/99 | 10:03 | 2.1 | ** | | | | | | | |
| | | | | LB-0441 | | 0 - 6.0 | -- | -- | -- | **p |
| | | | | LB-0439 | | 0.5 | 45 | 30 | 0.028 | -- |
| | | | | LB-0440 | | 7.0 | -- | -- | 0.032 | -- |
| | | | | LB-0442 | | 13.0 | 66 | 40 | 0.17 | -- |
| **Station: B** | | | | Description: northwest quadrant of pond, Arlington/Medford. | | | | | | |
| 08/05/99 | ** | 2.6 | 16.2 | | | | | | | |
| | | | | LB-0421 | | ** - ** | -- | -- | -- | 7 |
| | | | | LB-0417 | LB-0416 | 0.5 | 56 | -- | **d | -- |
| | | | | LB-0416 | LB-0417 | 0.5 | 54 | <15 | **d | -- |
| | | | | LB-0418 | | 15.5 | 79 | 55 | 0.59d | -- |
| 08/24/99 | ** | ** | 15.9 | | | | | | | |
| | | | | LB-0200 | | 0.5 | -- | -- | 0.013 | -- |
| | | | | LB-0427 | | 15.2 | -- | -- | 1.0 | -- |
| 09/21/99 | 11:30 | 2.0 | 13.5 | | | | | | | |
| | | | | LB-0445 | | ** - ** | -- | -- | -- | 1 |
| | | | | LB-0443 | | 0.5 | 22 | 30 | 0.032 | -- |
| | | | | LB-0444 | | 13.5 | 80 | 70 | 0.51 | -- |
| **Station: D** | | | | Description: in northern basin near spillway, Arlington. | | | | | | |
| 09/21/99 | ** | ** | ** | | | | | | | |
| | | | | LB-0446 | | 0.5 | -- | -- | 0.034 | -- |
| **Winter Pond (Palis: 71047)** | | | | | | | | | | |
| **Station: A** | | | | Description: deep hole, center of western lobe, Winchester. | | | | | | |
| 07/13/99 | 14:01 | 1.4 | 1.5 | | | | | | | |
| | | | | LB-0009 | | ** - ** | -- | -- | -- | 14b |
| | | | | LB-0008 | | 0.5 | 14 | 29m | 0.093 | -- |
| | | | | LB-0010 | | 1.0 | 13 | 39m | 0.080 | -- |
| 08/10/99 | 13:00 | 1.1 | 1.5 | | | | | | | |
| | 13:00 | 1.0 | | LB-0160 | | 0 - 1.0 | -- | -- | -- | 5 |
| | | | | LB-0158 | | 0.5 | 18 | 60 | 0.072 | -- |
| | | | | LB-0157 | | 0.5 | 18 | 55 | 0.071 | -- |
| 09/07/99 | 14:00 | >1.1 | 1.1 | | | | | | | |
| | | | | LB-0309 | | ** - ** | -- | -- | -- | **m |
| | | | | LB-0308 | | 0.5 | 20 | -- | 0.091 | -- |

" ** " = Censored or missing data
" -- " = No data
" b " = **b**lank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).
" d " = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected
" h " = **h**olding time violation (usually indicating possible bias low)
" m " = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.
" p " = samples not **p**reserved per SOP or analytical method requirements.

**Table B6.** 1999 DEP DWM Neponset River Subwatershed *physico-chemical* data.

| Date | Time (24hr) | Secchi Depth (m) | Station Depth (m) | OWMID | OWMID QA/QC | Sample Depth (m) | Alkalinity (mg/l) | Color (PCU) | Total Phosphorus (mg/l) | Chlorophyll *a* (mg/m$^3$) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cobbs Pond (Palis: 73009)** | | | | | | | | | | |
| **Station: A** | | | Description: deep hole, south eastern end of pond near dam, Walpole. | | | | | | | |
| 07/15/99 | 13:00 | 1.0 | 1.8 | | | | | | | |
| | | | | LB-0035 | | 0 - 1.5 | -- | -- | -- | **m |
| | | | | LB-0033 | | 0.5 | 34 | 80**d** | 0.18 | -- |
| | | | | LB-0034 | | 1.3 | 33 | 70**d** | 0.11 | -- |
| 08/12/99 | 13:44 | 1.2 | 1.8 | | | | | | | |
| | | | | LB-0178 | | ** - 1.3 | -- | -- | -- | 21 |
| | | | | LB-0177 | | 0.5 | 40 | 55**d** | 0.17 | -- |
| | | | | LB-0179 | | 1.3 | 39 | 75**d** | 0.15 | -- |
| 09/13/99 | 13:15 | 1.0 | 2.0 | | | | | | | |
| | | | | LB-0335 | | 0 - 1.5 | -- | -- | -- | 4 |
| | | | | LB-0333 | | 0.5 | 32 | 80 | 0.11 | -- |
| | | | | LB-0334 | | 1.5 | 30 | 75 | 0.075 | -- |
| **Ganawatte Farm Pond (Palis: 73037)** | | | | | | | | | | |
| **Station: A** | | | Description: deep hole, northern end of pond, Walpole. | | | | | | | |
| 07/15/99 | 10:02 | 0.4 | 1.5 | | | | | | | |
| | | | | LB-0031 | | 0 - 1.2 | -- | -- | -- | **m |
| | | | | LB-0027 | LB-0028 | 0.5 | 12 | 230**d** | 0.030**d** | -- |
| | | | | LB-0028 | LB-0027 | 0.5 | 13 | 120**d** | 0.04**d** | -- |
| | | | | LB-0030 | | 1.0 | 15 | 120**d** | 0.044 | -- |
| 08/12/99 | 11:10 | 0.3 | 1.2 | | | | | | | |
| | | | | LB-0184 | | ** - 0.7 | -- | -- | -- | 18 |
| | | | | LB-0182 | LB-0181 | 0.5 | 14 | 70B**d** | **m | -- |
| | | | | LB-0181 | LB-0182 | 0.5 | 12 | 120**d** | **m | -- |
| | | | | LB-0185 | | 0.7 | 13 | 17**d** | **m | -- |
| 09/13/99 | 10:30 | 0.5 | 1.4 | | | | | | | |
| | 10:35 | 0.5 | | LB-0331 | | 0 - 0.8 | -- | -- | -- | 1 |
| | | | | LB-0328 | LB-0327 | 0.5 | 12 | 70**d** | 0.035 | -- |
| | | | | LB-0327 | LB-0328 | 0.5 | 12 | 110**d** | 0.034 | -- |
| | | | | LB-0330 | | 0.8 | 12 | 90 | 0.032 | -- |
| **Turners Pond (Palis: 73059)** | | | | | | | | | | |
| **Station: A** | | | Description: deep hole in southeastern quadrant, Milton. | | | | | | | |
| 07/27/99 | 10:45 | 0.6 | 7.0 | | | | | | | |
| | | | | LB-0042 | | 0 - 1.8 | -- | -- | -- | 67**b** |
| | | | | LB-0040 | LB-0039 | 0.5 | 21 | 40 | 0.053 | -- |
| | | | | LB-0039 | LB-0040 | 0.5 | 20 | 44 | 0.054 | -- |
| | | | | LB-0043 | | 6.5 | 51 | 960 | 0.91 | -- |
| 08/24/99 | 9:25 | 1.3 | 6.7 | | | | | | | |
| | | | | LB-0192 | | 0 - 3.9 | -- | -- | -- | **h |
| | | | | LB-0190 | LB-0189 | 0.5 | 22 | 26**d** | 0.037 | -- |
| | | | | LB-0189 | LB-0190 | 0.5 | 23 | <15**d** | 0.038 | -- |
| | | | | LB-0193 | | 6.2 | 62 | 140**d** | 0.95 | -- |
| 09/21/99 | 14:05 | 1.2 | 4.5 | | | | | | | |
| | | | | LB-0342 | | ** - 4.0 | -- | -- | -- | 2 |
| | | | | LB-0343 | | ** | 44 | 36 | **m | -- |
| | | | | LB-0339 | LB-0340 | 0.5 | 19 | 29 | 0.048 | -- |
| | | | | LB-0340 | LB-0339 | 0.5 | 18 | 31 | 0.048 | -- |

**" ** "** = Censored or missing data
**" -- "** = No data
" **b** " = **b**lank Contamination in lab reagent blanks and/or field blank samples (indicating possible bias high and false positives).
" **d** " = precision of field **d**uplicates (as RPD) did not meet project data quality objectives identified for program or in QAPP; batch samples may also be affected
" **h** " = **h**olding time violation (usually indicating possible bias low)
" **m "** = **m**ethod SOP not followed, only partially implemented or not implemented at all, due to complications with sample matrix (e.g. sediment in sample, floc formation), lab error (e.g. cross-contamination between samples), additional steps taken by the lab to deal with matrix complications, and lost/unanalyzed samples.
" **p** " = samples not **p**reserved per SOP or analytical method requirements.

***FISH POPULATION***

Results from the DEP DWM 1999 fish population studies in the Neponset River Subwatershed are presented in Appendix C, *Boston Harbor Watershed 1999 Biological Assessment* (Fiorentino and Maietta, 2000).

***FISH TOXICS MONITORING***

**1999 FISH TOXICS**

The results of DEP DWM 1999 fish toxics monitoring surveys are briefly described below for each lake sampled (MA DEP 1999d). These lakes sampled in 1999 are located in the Mystic River Subwatershed of the Boston Harbor Watershed. Survey results are presented in Table B7.

**Lower Mystic Lake** (Table B7) (F0081)
Samples of largemouth bass (*Micropterus salmoides*), yellow perch (*Perca flavescens*), white perch (*Morone americana)*, and common carp (*Cyprinus carpi)* were collected from Lower Mystic Lake, Arlington/Medford. The lipids content ranged between 0.15 and 2.1%. Cadmium and lead were not detected in the edible fillets of any sample analyzed for these analytes from Lower Mystic Lake. Arsenic levels ranged from 0.04 to 0.11 mg/kg-wet weight. Selenium levels ranged from 0.17 to 0.31 mg/kg wet weight. Mercury in the fish tissue from Lower Mystic Lake ranged from 0.08 to 0.41 mg/kg-wet weight. PCBs and pesticides were detected in three of the four samples analyzed from Lower Mystic Lake. PCB A1260 ranged from 0.14 to 0.46 μg/g, BZ#105 ranged from 0.0089 to 0.024 μg/g, and BZ#118 was detected at 0.039 μg/g. The pesticide DDD values ranged from 0.015 to 0.064 μg/g and DDE values ranged from 0.013 to 0.070 μg/g. All other PCBs and pesticides were not detected (see Appendix A – Data Validation Report for 1999 DEP/DWM Boston Harbor Drainage Area Monitoring Data for list of analytes and detection limits).

**Upper Mystic Lake** (Table B7) (F0080)
Samples of largemouth bass, yellow perch, brown bullhead (*Ameiurius nebulosus*), and bluegill (*Lepomis macrochirus*) were collected from Upper Mystic Lake, Winchester/Arlington/Medford. The lipids content ranged between 0.05 and 0.15%. Cadmium, arsenic, PCBs, and lead were not detected in the edible fillets of any sample analyzed for these analytes from Upper Mystic Lake. Selenium levels ranged from 0.12 to 0.34 mg/kg wet weight. Mercury in the fish tissue from Upper Mystic Lake ranged from 0.09 to 0.30 mg/kg-wet weight. The pesticide DDE was detected at values that ranged from 0.012 to 0.016 μg/g. All other pesticides were not detected (see Appendix A – Data Validation Report for 1999 DEP/DWM Boston Harbor Drainage Area Monitoring Data for list of analytes and detection limits).

**1994 FISH TOXICS**

The results of DEP OWM 1994 fish toxics monitoring surveys (MA DEP 1994a) are briefly described below for the lake sampled in the Weymouth & Weir Subwatershed of the Boston Harbor Drainage Area. Survey results are presented in Table B8. Additional work was done at two sites in the Neponset River Subwatershed of the Boston Harbor Watershed. Results are presented in *The Neponset River Watershed 1994 Resource Assessment Report* (Kennedy *et al.*, 1995).

**Lake Holbrook** (Table B8) (F0084**)**
Samples of largemouth bass, white perch, yellow perch, and American eel (*Anguilla rostrata)* were collected from Lake Holbrook, Holbrook. The lipids content ranged between 0.16 and 0.72%. Cadmium, arsenic, pesticides, and lead were not detected in the edible fillets of any sample analyzed for these analytes from Lake Holbrook. Selenium levels ranged from non-detect <0.002 to 0.178 mg/kg wet weight. Mercury in the fish tissue from Lake Holbrook ranged from 0.067 to 0.21 mg/kg-wet weight. The PCB A1254 was detected at 0.55 μg/g. All other PCBs were not detected (see Appendix A – Data Validation Report for 1999 DEP/DWM Boston Harbor Drainage Area Monitoring Data for list of analytes and detection limits).

Based on these data no fish consumption advisories were issued for any of the Mystic River or the Weymouth & Weir Subwatershed water bodies of the Boston Harbor Watershed. The additional work done at two sites in the Neponset River Subwatershed did result in fish consumption advisories. Results are presented in *The Neponset River Watershed 1994 Resource Assessment Report* (Kennedy *et al.*, 1995). The most current Fish Consumption Advisory list issued by the MDPH is available online at http://www.state.ma.us/dph/beha/fishlist.htm.]

**Table B7.** 1999 DEP DWM fish toxics monitoring data for Lower Mystic Lake, (Arlington/Medford), and Upper Mystic Lake (Winchester/Arlington/Medford). Results, reported in wet weight, are from composite samples of fish fillets with skin off.

| Sample ID | Collection Date | Species[1] Code | Length (cm) | Weight (g) | Composite Sample ID (lab sample #) | Cd (mg/kg) | Hg (mg/kg) | Pb (mg/kg) | As (mg/kg) | Se (mg/kg) | Lipids (%) | PCB* (µg/g) | Pesticides* (µg/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lower Mystic Lake, (Arlington/Medford) F0081** | | | | | | | | | | | | | |
| MRF99-1 | 6/24/99 | C | 52.0 | 1820 | 99247 (L990227-1) | <0.02 | 0.15 | <0.20 | 0.08 | 0.27 | 2.1 | PCB A1260 = 0.46<br>BZ#105 = 0.024<br>BZ#118 = 0.039 | DDD = 0.064<br>DDE = 0.070 |
| MRF99-2 | 6/24/99 | C | 52.5 | 1730 | | | | | | | | | |
| MRF99-3 | 6/24/99 | C | 54.0 | 2180 | | | | | | | | | |
| MRF99-4 | 6/24/99 | LMB | 41.0 | 1140 | 99248 (L990227-2) | <0.02 | 0.41 | <0.20 | 0.11 | 0.17 | 0.21 | PCB A1260 = 0.14<br>BZ#105 = 0.010 | DDD = 0.015<br>DDE = 0.017 |
| MRF99-5 | 6/24/99 | LMB | 37.6 | 780 | | | | | | | | | |
| MRF99-6 | 6/24/99 | LMB | 37.5 | 880 | | | | | | | | | |
| MRF99-7 | 6/24/99 | WP | 23.9 | 160 | 99249 (L990227-3) | <0.02 | 0.28 | <0.20 | 0.08 | 0.31 | 0.16 | BZ#105 = 0.0089 | DDE = 0.013 |
| MRF99-8 | 6/24/99 | WP | 24.2 | 160 | | | | | | | | | |
| MRF99-9 | 6/24/99 | WP | 21.0 | 120 | | | | | | | | | |
| MRF99-10 | 6/24/99 | YP | 18.9 | 80 | 99250 (L990227-4) | <0.02 | 0.08 | <0.20 | 0.04 | 0.30 | 0.15 | ND | ND |
| MRF99-11 | 6/24/99 | YP | 19.7 | 90 | | | | | | | | | |
| MRF99-12 | 6/24/99 | YP | 18.1 | 80 | | | | | | | | | |
| **Upper Mystic Lake, (Winchester/Arlington/Medford) F0080** | | | | | | | | | | | | | |
| UML99-1 | 7/8/99 | LMB | 38.0 | 640 | 99256 (L990271-1) | <0.02 | 0.30 | <0.20 | <0.04 | 0.31 | | | |
| UML99-2 | 7/8/99 | LMB | 33.7 | 540 | | | | | | | | | |
| UML99-3 | 7/8/99 | LMB | 33.6 | 550 | (L990280-1) duplicate | | | | | | 0.05<br>0.08 | ND<br>ND | DDE = 0.012<br>DDE = 0.016 |
| UML99-4 | 7/8/99 | YP | 25.7 | 200 | 99257 (L990271-2) | <0.02 | 0.20 | <0.20 | <0.04 | 0.31 | | | |
| UML99-5 | 7/8/99 | YP | 24.3 | 160 | | | | | | | | | |
| UML99-6 | 7/8/99 | YP | 24.6 | 170 | (L990280-2) | | | | | | 0.12 | ND | ND |
| UML99-7 | 7/8/99 | B | 18.1 | 120 | 99258 (L990271-3) | <0.02 | 0.21 | <0.20 | <0.04 | 0.34 | | | |
| UML99-8 | 7/8/99 | B | 19.3 | 130 | | | | | | | | | |
| UML99-9 | 7/8/99 | B | 18.3 | 110 | (L990280-3) | | | | | | 0.06 | ND | ND |
| UML99-10 | 7/8/99 | BB | 29.1 | 300 | 99259 (L990271-4) | <0.02 | 0.09 | <0.20 | <0.04 | 0.12 | | | |
| UML99-11 | 7/8/99 | BB | 25.5 | 170 | (L990280-4) | | | | | | 0.15 | ND | ND |

[1]Species bluegill (B) *Lepomis macrochirus*
brown bullhead (BB) *Ameiurus nebulosus*
common carp (C) *Cyprinus carpio*
largemouth bass (LMB) *Micropterus salmoides*
white perch (WP) *Morone americana*
yellow perch (YP) *Perca flavescens*

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

***Note:** Analytes listed in Appendix A and not appearing in the table were included in the analysis and were not detected

**Table B8.** 1994 DEP OWM fish toxics monitoring data for Lake Holbrook, Holbrook. Results, reported in wet weight, are from composite samples of fish fillets with skin off.

| Sample ID | Collection Date | Species[1] Code | Length (cm) | Weight (g) | Composite Sample ID (lab sample #) | Cd (mg/kg) | Hg (mg/kg) | Pb (mg/kg) | As (mg/kg) | Se (mg/kg) | Lipids (%) | PCB* (µg/g) | Pesticides* (µg/g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LHF94-1 | 7/13/94 | LMB | 39.1 | 850.0 | 94001 (94-2529) | <0.01 | 0.067 | <0.03 | <0.002 | <0.002 | | | |
| LHF94-2 | 7/13/94 | LMB | 37.4 | 850.0 | | | | | | | | | |
| LHF94-3 | 7/13/94 | LMB | 37.4 | 820.0 | (94-2531) | | | | | | 0.20 | ND | ND |
| LHF94-4 | 7/13/94 | LMB | 34.7 | 700.0 | | | | | | | | | |
| LHF94-6 | 7/13/94 | WP | 18.9 | 100.0 | 94002 (94-2530) | <0.01 | 0.106 | <0.03 | <0.002 | <0.002 | | | |
| LHF94-7 | 7/13/94 | WP | 17.6 | 90.0 | | | | | | | | | |
| LHF94-8 | 7/13/94 | WP | 17.2 | 80.0 | | | | | | | | | |
| LHF94-9 | 7/13/94 | WP | 17.6 | 90.0 | (94-2533) | | | | | | 0.49 | ND | ND |
| LHF94-10 | 7/13/94 | WP | 17.9 | 90.0 | | | | | | | | | |
| LHF94-11 | 7/13/94 | YP | 17.0 | 90.0 | 94003 (94-2532) | NR | NR | NR | NR | NR | 0.16 | ND | ND |
| LHF94-12 | 7/13/94 | YP | 17.9 | 90.0 | | | | | | | | | |
| LHF94-13 | 8/19/94 | AE | 73.1 | 970 | 94017 (94-3969) | <0.01 | 0.21 | <0.03 | <0.002 | 0.178 | | | |
| LHF94-14 | 8/19/94 | AE | 66.5 | 650 | (94-3968) | | | | | | 0.72 | PCB A1254 0.55 | ND |

[1]Species
american eel (AE) *Anguilla rostrata*
largemouth bass (LMB) *Micropterus salmoides*
white perch (WP) *Morone americana*
yellow perch (YP) *Perca flavescens*

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

**NR** – not requested

***Note:** Analytes listed in Appendix A and not appearing in the table were included in the analysis and were not detected

## LAKES

Lake synoptic survey results from 1994 DEP OWM summer surveys in the Neponset River Subwatershed of the Boston Harbor Watershed are presented in Table B9 (MA DEP 1994b).

**Table B9.** Neponset River Subwatershed 1994 summer lake status. NOTE: All waters are Class B.

| LAKE | WATERBODY IDENTIFICATION CODE (WBID) | SIZE ACRES | TROPHIC STATUS ESTIMATE | OBSERVATIONS, Objectionable Conditions |
|---|---|---|---|---|
| Billings Street/East Street Pond, Sharon | MA73065 | 3 | Eutrophic | Non-native plants (Mh), 100% of surface dense with aquatic plants |
| Bird Pond, Walpole | MA73002 | 25 | Eutrophic | Non-native plants (Ls), water turbid, ~20% of surface dense with aquatic plants (very dense along northeast shore) |
| Blue Hills Reservoir, Quincy | MA73004 | 14 | Unknown | Non-native plants (Pa) |
| Bolivar Pond, Canton | MA73005 | 22 | Eutrophic | Non-native plants (Cc, M. sp,), very turbid (black to brown) |
| Buckmaster Pond, Westwood | MA73006 | 27 | Mesotrophic | Non-native plants (M. sp,) |
| Clark Pond, Walpole | MA73008 | 6 | Eutrophic | Non-native plants (Mh, Tn), 100% of surface dense with aquatic plants |
| Cobbs Pond, Walpole | MA73009 | 24 | Eutrophic | Non-native plants (Ls, M. sp.), 100% of surface very dense with floating or submerged aquatic plants |
| Crackrock Pond, Foxborough | MA73010 | 14 | Eutrophic | ~50% of pond covered with floating vegetation, water low, pond shallow, bottom mucky, organic (possibly fecal) odor emanating from area |
| Ellis Pond, Norwood | MA73018 | 19 | Eutrophic | Non-native plants (Cc, Ls), surface very densely covered in northeast cove, *Cabomba* around shore of main body |
| Farrington Pond (Plain Street Pond), Stoughton | MA73040 | 5 | Eutrophic | Non-native plants (Ls, Mh), ~100% of surface covered with floating leaf or submergent plants, deltas created from road runoff |
| Flynns Pond, Medfield | MA73019 | 8 | Mesotrophic | ~33% of surface covered with aquatic plants, south end covered with floating leaf plants, water tea colored |
| Forge Pond, Canton | MA73020 | 25 | Eutrophic | Non-native plants (Pa), much debris, oozy mud on bottom, very turbid, water depth low, mostly filled in |
| Ganawatte Farm Pond, Walpole/Sharon/Foxborough | MA73037 | 55 | Eutrophic | >90% of surface dense with aquatic plants, very dark stained water |

**WBID** – Waterbody Identification code.
**Non-native Plants:** **Cc** = *Cabomba caroliniana*, **Ls** = *Lythrum salicaria*, Mh = *Myriophyllum heterophyllum*, **Ms** = *Myriophyllum spicatum,* **Mq** = *Marsilea quadrifolia,* **Pa** = *Phragmites australis,* **Pc** = *Potamogeton crispus,* ***Tn*** = *Trapa natans.*
**Note:** **M. sp.** – Possible *Myriophyllum heterophyllum*, requires further confirmation when flowering heads are evident.

**Table B9. Continued.** Neponset River Subwatershed 1994 summer lake status. NOTE: All waters are Class B.

| LAKE | WATERBODY IDENTIFICATION CODE (WBID) | SIZE ACRES | TROPHIC STATUS ESTIMATE | OBSERVATIONS, Objectionable Conditions |
|---|---|---|---|---|
| Glen Echo Pond, Canton/Stoughton | MA73022 | 16 | Unknown | Non-native plants (M. sp,) |
| Hammer Shop Pond, Sharon | MA73023 | 4 | Unknown | ~50% of pond covered with very dense floating leaf plants |
| Jewells Pond, Medfield | MA73026 | 3 | Mesotrophic | Scum on surface, turbid water, some fairly dense submerged aquatic plants |
| Lymans Pond, Westwood | MA73021 | 26 | Eutrophic | 100% of surface dense with aquatic plants |
| Manns Pond, Sharon | MA73028 | 11 | Eutrophic | Non-native plants (Cc, Mq), water very turbid (likely <4' secchi), plants covering littoral zone |
| Massapoag Lake, Sharon | MA73030 | 397 | Mesotrophic | Non-native plants (Mh), many dead yellow perch washed up on beach (sized 4 to 10 inches most in 5 to 6 inch range) |
| Memorial Pond, Walpole | MA73012 | 7 | Hypereutrophic | Non-native plants (Ls), dense to very dense patches of weeds cover most of pond, grayish blue translucent turbidity in water, oily sheen on surface in places, much debris on bottom, milky turbidity with yellowish cast toward outlet, shallow |
| Neponset Reservoir, Foxborough | MA73034 | 268 | Eutrophic | Non-native plants (Cc, Ls, M. sp), aquatic plants very dense in southeast cove area, pond very turbid (from grey-green to brown) |
| Pinewood Pond, Stoughton | MA73039 | 21 | Eutrophic | Non-native plants (Ls, Mh), 75-100% aquatic plant coverage over entire pond |
| Plimpton Pond South, Walpole | MA73042 | 5 | Unknown | No longer a pond (marsh area only) channelized through upper end |
| Ponkapog Pond, Canton | MA73043 | 203 | Mesotrophic | Non-native plants (Ls, Mh, Ms), dense to very dense aquatic plant coverage at beach |
| Popes Pond, Milton | MA73044 | 13 | Hypereutrophic | Non-native plants (Ls), turbid brown (Secchi <4'), submergent plants very dense at southwest end |
| Reservoir Pond, Canton | MA73048 | 243 | Mesotrophic | Non-native plants (Cc, Ls, M. sp.), orange-brown stain, much debris on bottom |

**WBID** – Waterbody Identification code.
**Non-native Plants: Cc** = *Cabomba caroliniana*, **Ls** = *Lythrum salicaria*, **Mh** = *Myriophyllum heterophyllum*, **Ms** = *Myriophyllum spicatum,* **Mq** = *Marsilea quadrifolia,* **Pa** = *Phragmites australis,* **Pc** = *Potamogeton crispus,* ***Tn*** = *Trapa natans.*
**Note: M. sp.** – Possible *Myriophyllum heterophyllum*, requires further confirmation when flowering heads are evident.

**Table B9. Continued.** Neponset River Subwatershed 1994 summer lake status. NOTE: All waters are Class B.

| LAKE | WATERBODY IDENTIFICATION CODE (WBID) | SIZE ACRES | TROPHIC STATUS ESTIMATE | OBSERVATIONS, Objectionable Conditions |
|---|---|---|---|---|
| Russell Pond (Pine Tree Pond), Milton | MA73003 | 6 | Eutrophic | Non-native plants (Ls, Pc), ~20% of pond covered with macrophytes, brown turbidity (Secchi <4') |
| Sprague Pond, Dedham/Boston | MA73053 | 13 | Mesotrophic | Non-native plants (Ls), moderate brown-green turbidity, extensive algal growth on rocks, trash in water (tires, metal, axils, logs...) |
| Town Pond, Stoughton | MA73056 | 6 | Eutrophic | Non-native plants (Cc, M. sp.), 75-100% aquatic plant coverage likely by end of summer |
| Turner Pond, Walpole | MA73058 | 17 | Mesotrophic | Non-native plants (Cc), *Cabomba* dense near shore, heavy tea stain |
| Turners Pond, Milton | MA73059 | 11 | Eutrophic | Non-native plants (Ls), green-grey turbidity (Secchi likely <4'), algal bloom, margin of pond ringed with emergent macrophytes out to 10 feet |
| Willet Pond, Walpole/Westwood/Norwood | MA73062 | 200 | Unknown | Non-native plants (Ls, M. sp.) |
| Woods Pond (Stoughton Pond), Stoughton | MA73055 | 21 | Eutrophic | Non-native plants (Ls, M. sp.), 100% aquatic plant density |

**WBID** – Waterbody Identification code.
**Non-native Plants: Cc** = *Cabomba caroliniana*, **Ls** = *Lythrum salicaria*, **Mh** = *Myriophyllum heterophyllum*, **Ms** = *Myriophyllum spicatum,* **Mq** = *Marsilea quadrifolia,* **Pa** = *Phragmites australis,* **Pc** = *Potamogeton crispus,* ***Tn*** = *Trapa natans.*
**Note: M. sp.** – Possible *Myriophyllum heterophyllum*, requires further confirmation when flowering heads are evident.

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# APPENDIX C- 1999 DEP DWM BIOMONITORING TECHNICAL MEMORANDUM

*Technical Memorandum (TM-71-1)*

Subject: BOSTON HARBOR WATERSHED 1999 BIOLOGICAL ASSESSMENT

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

Date: 25 August 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 water body 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 (MADEP/DWM) 1999 Boston Harbor watershed assessments, aquatic benthic macroinvertebrate biomonitoring was conducted to evaluate the biological health of various portions of the watershed. A total of 14 biomonitoring stations were sampled to investigate the effects of various point source and nonpoint source stressors—both historical and current—on the aquatic communities of the Mystic River, Weymouth/Weir River, and Neponset River sub-basins. Stream segments in the Mystic River, Weir River and Weymouth River sub-basins were previously "unassessed" by DEP, while historical DEP biomonitoring stations in the Neponset River sub-basin—most recently assessed in 1994 (MA DEP 1995)—were reevaluated to determine if water quality and habitat conditions have improved or worsened over time. In addition, macroinvertebrate and fish sampling conducted by DEP/DWM in the East Branch portion of the Neponset River sub-basin will provide the Neponset River Watershed Association (NepRWA) with biological information to be used in their multi-year project*, Budgets: Balancing Uses with Demands and Generating Effective Techniques for Sustainability* (NepRWA 1998). A multi-phase project, *Budgets* addresses the topic of water resource management and the importance of balancing consumptive water use with instream ecological needs and developing mechanisms and techniques to provide the data necessary for informed decision-making (NepRWA 1999). Sampling locations, along with station identification numbers and 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 305b of the Clean Water Act, all Boston Harbor watershed stations were compared to a regional reference station thought to represent the "best attainable" 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). Regional reference stations were established in Hawes Brook (NE09) and Traphole Brook (5B01)—both in the Neponset River sub-basin. Both stations were situated upstream from all known point sources of water pollution, and they were also assumed to be relatively unimpacted by nonpoint sources. The decision of which reference station to use for comparison to a study site was primarily based on comparability of ambient water temperature, stream morphology, flow regimes, and drainage area. Hawes Brook was designated the warm-water reference station and Traphole Brook was designated the cold-water reference station. Both streams served as reference stations during DEP's 1994 biomonitoring survey in the Neponset River sub-basin.

During "year 1" of its 5-year basin cycle, problem areas within the Boston Harbor watershed were better defined through such processes as coordination with appropriate groups (EOEA Basin Teams, EPA, watershed associations, 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 Boston Harbor watershed biomonitoring survey.

The main objectives of biomonitoring in the Boston Harbor 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 focused on developing NPDES permits, Water Management Act permits, stormwater management, and control of other nonpoint source (NPS) pollution. Specific tasks were:

4. Conduct benthic macroinvertebrate sampling at locations throughout the Boston Harbor watershed.
5. Based upon the macroinvertebrate data, identify river segments within the watershed with potential point/nonpoint source pollution problems; and
6. 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 305b of the Clean Water Act.

**Table 1.** List of macroinvertebrate biomonitoring stations sampled during the 1999 Boston Harbor watershed surveys, including station identification number, station description, and sampling date.

| Station | Drainage Area ($mi^2$) | **BOSTON HARBOR WATERSHED** Site description | Sampling Date |
|---|---|---|---|
| 73-9BOB | 4.41 | Massapoag Brook, downstream from Manns Pond, Sharon, MA | 6 July 1999 |
| 73-NE09 | 8.61 | Hawes Brook, downstream from Route 1A (Washington St.), Norwood, MA | 6 July 1999 |
| 73-MB01 | 2.36 | Mill Brook, downstream from Millbrook Road, Medfield, MA | 6 July 1999 |
| 73-5B01 | 2.66 | Traphole Brook, downstream from Coney Street, Walpole, MA | 6 July 1999 |
| 73-SB01 | 5.00 | Unnamed tributary to Steep Hill Brook, downstream from Central Street, Stoughton, MA | 7 July 1999 |
| 73-BM01 | 2.82 | Beaver Meadow Brook, downstream from Pine Street, Canton MA | 7 July 1999 |
| 73-BB01 | 2.46 | Beaver Brook, downstream from Maskwonicut Street, Sharon, MA | 7 July 1999 |
| 73-NE12 | 28.15 | East Branch Neponset River, downstream from Neponset Street, Canton, MA | 7 July 1999 |
| 73-PB01 | 6.39 | Pequit Brook, upstream from Sherman Street, Canton, MA | 8 July 1999 |
| 74-MR01 | 27.64 | Monatiquot River, downstream from Middle Street, Braintree, MA | 8 July 1999 |
| 74-SR01 | 4.39 | Old Swamp River, upstream from Route 3N, Weymouth, MA | 8 July 1999 |
| 74-WR01 | 14.57 | Weir River, upstream from Route 228, Hingham, MA | 8 July 1999 |
| 71-AR01 | 24.83 | Aberjona River, downstream from USGS gage, Winchester, MA | 9 July 1999 |
| 71-MI01 | 4.96 | Mill Brook, upstream from Mill Street, Arlington, MA | 9 July 1999 |

**Table 2.** List of perceived problems addressed during the 1999 Boston Harbor watershed macroinvertebrate biomonitoring survey. Specific biomonitoring stations addressing each problem are also listed.

| Issues/Problems | **BOSTON HARBOR WATERSHED** Neponset River Sub-basin |
|---|---|
| Groundwater withdrawals/reduced flows | 73-9B0B; 73-5B01; 73-SB01; 73-BB01; 73-NE12; 73-BM01; 73-PB01; 73-MB01 |
| NPS (trash, habitat degradation, road runoff, unknown) | 73-9B0B; 73-NE09; 73-5B01; 73-SB01; 73-BB01; 73-NE12; 73-BM01; 73-PB01; 73-MB01 |
| Issues/Problems | **BOSTON HARBOR WATERSHED** Mystic River Sub-basin |
| Urban runoff (including stormwater), CSOs, illicit stormdrain/sewer connections, low DO, pathogens | 71-AR01; 71-MI01 |
| Issues/Problems | **BOSTON HARBOR WATERSHED** Weymouth/Weir River Sub-basin |
| Groundwater withdrawals/reduced flows | 74-WR01; 74-SR01 |
| Sewer overflows, road runoff, failing septic systems | 74-SR01 |
| Miscellaneous NPS (habitat degradation, stormwater/road runoff, trash) | 74-MR01 |

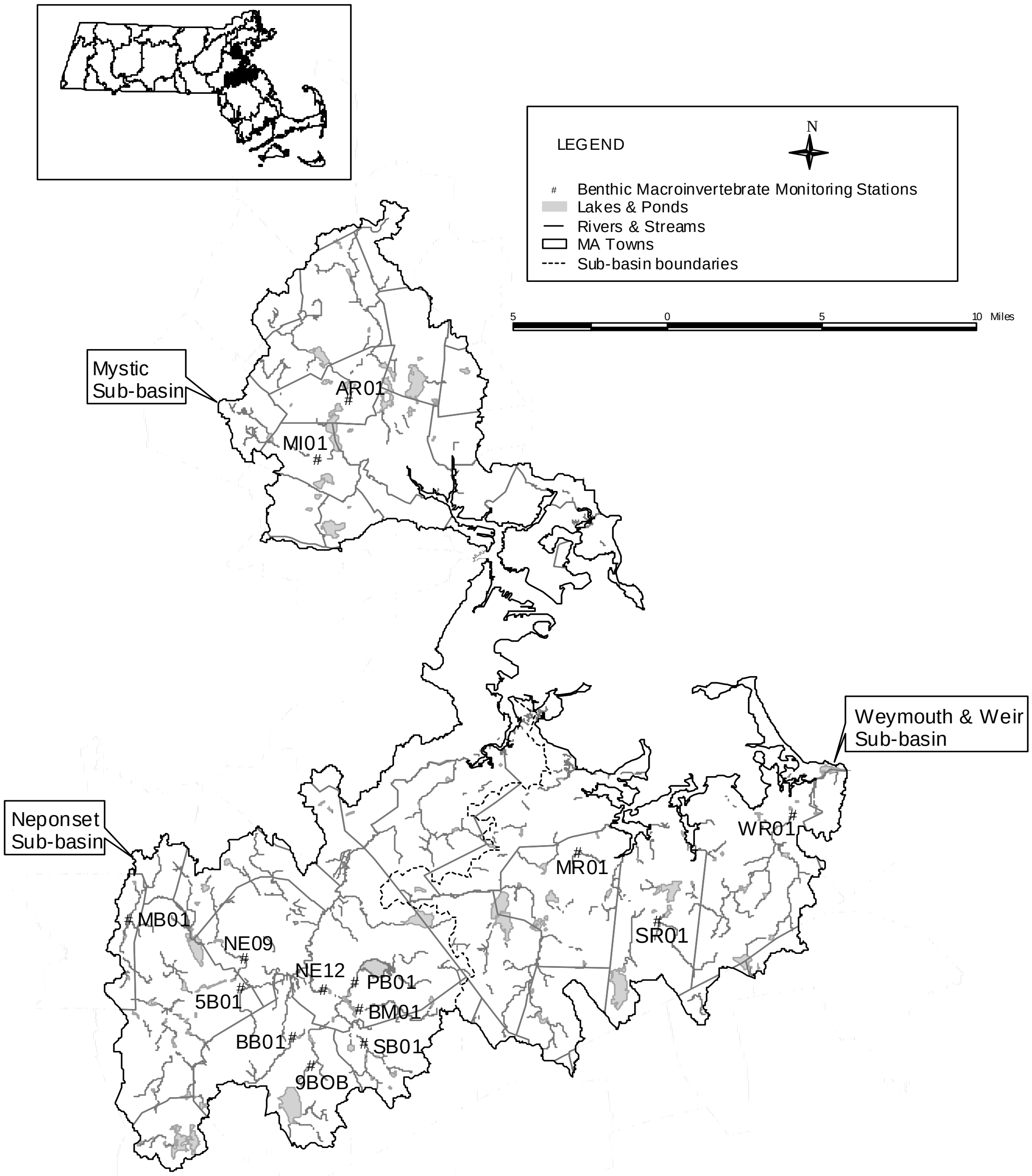


**Figure 1.** Locations of DEP biomonitoring stations sampled during the 1999 Boston Harbor watershed survey.

# METHODS

### ***MACROINVERTEBRATE SAMPLING***

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 USEPA Rapid Bioassessment Protocols (RBPs) (Barbour et al. 1999). Sampling was conducted 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, 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 water body 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, 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 Boston Harbor 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 matter (FPOM) levels are high.

## *FISH POPULATION SAMPLING*

Fish population data were collected from selected Neponset River sub-basin stations to supplement the macroinvertebrate biomonitoring data. Collection methods used to assess fish populations were in accordance with the *Preliminary Biological Monitoring and Assessment Protocols for Wadeable Rivers and Streams* (Tetra Tech, Inc. 1995), and followed essentially a modified version of RBP Protocol V (Barbour et al. 1999). Fish community sampling was conducted at each tributary station between 27 and 29 July 1999 by DWM using a battery-powered backpack electroshocking unit (Smith-Root™ Model 12).

One pass was made in a representative stream reach (containing riffle, run, and pool habitat when available) measuring approximately 100 meters. Fish sampling commenced at the downstream riffle or other barrier (e.g., seine net, culvert, etc.) and proceeded upstream in side-to-side sweeps. Sampling was terminated at a constriction or other barrier to migration (such as a net) at the upstream end of the reach. Attempts were made to pick up all fish observed. All fish collected were held in plastic buckets for identification, enumeration, and subsequent release. Also noted and recorded on field sheets were general conditions of fish, including the presence of anomalies such as deformities, eroded fins, fungus, lesions, emaciation, and tumors. Voucher specimens were retained and preserved for later verification if field identifications were questionable.

### FISH POPULATION ANALYSIS

The RBP V protocol (Barbour et al. 1999) calls for the analysis of the data generated from fish collections using an established Index of Biotic Integrity (IBI) similar to that described by Karr et al. (1986). Since no formal IBI exists for Massachusetts surface waters, the data provided by this sampling effort were used to assess the general condition of the resident fish population as a function of abundance and diversity.

## 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 (FFG) and tolerance value (TV) of each taxon.

Summary tables of the RBP III data analyses, including biological metric calculations, metric scores, and impairment scores, are included in the Appendix as well. Table A2 is the summary table for all warm-water Neponset River sub-basin stations using NE09 as the regional reference station. Table A3 is the summary table for those Neponset River sub-basin stations that require a cold-water reference site, using 5BOB as the regional reference station. Tables A4 and A5 summarize comparisons of the NE09 benthos to stations in the Mystic River sub-basin and Weymouth/Weir River sub-basin respectively. 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 A6. Finally, the appendix includes the taxa list for fish collected in the Neponset River sub-basin biomonitoring stations (Table A7).

The 1999 biomonitoring data for this watershed generally indicate nonpoint source-related problems in most of the tributary streams examined. Various forms of urban runoff, coupled with habitat degradation, compromise water quality and biological integrity in the Mystic River sub-basin. Habitat constraints and/or miscellaneous NPS pollution impair aquatic life in the Neponset River and Weymouth/Weir River sub-basins. In addition, several streams examined in the Neponset River sub-basin remain relatively non-impacted and are indicative of the “best attainable” conditions in the watershed.

### *Neponset River Sub-basin*

The Neponset River sub-basin is located in eastern Massachusetts, within the metropolitan Boston area. The basin encompasses portions of Boston, Quincy, Milton, Dedham, Westwood, Dover, Medfield, Walpole, Foxborough, Sharon, Stoughton, and Randolph, while the entire towns of Canton and Norwood are located within its boundaries. From the outlet of the Neponset Reservoir to its mouth in Dorchester Bay the Neponset River falls approximately 270 feet in elevation. The Neponset River is 29.5 miles in length and drains 117 square miles. The river is impounded by 12 dams and passes through several mills and private reservoirs.

Boston, Quincy, Dedham and Milton comprise the lower basin. These communities are primarily urbanized and contain a wide variety of industrial, commercial and service-oriented interests. The middle portion of the basin—Westwood, Norwood and Canton—has a variety of industry. Development in Westwood and Norwood is heavy along Routes 1 and 1A, including both manufacturing and wholesale/retail trade. There is a concentration of industrial/commercial usage in Canton along Route 138 and the East Branch Neponset River. The Stoughton/Randolph drainage areas are comprised of residential and commercial development. Most of the industrial development in the upper watershed is in Walpole, concentrated along the Routes 1-1A corridor. The area of Foxborough located within the watershed is primarily residential, as are the other towns in the basin—Dover, Medfield and Sharon.

***Hawes Brook***

The Hawes Brook subwatershed consists of Bubbling and Mill brooks and several unnamed tributaries to Pettee and Willet ponds, as well as Germany Brook which flows into Ellis Pond. Hawes Brook is the named stream from the outlet of Ellis Pond to its confluence with the Neponset River in Norwood. The Hawes Brook system drains portions of Dover, Westwood, and Walpole and is dominated by residential, recreational, and commercial land use.

**NE09**—Hawes Brook, mile point 0.2, downstream from Washington Street, Norwood, MA

*Habitat*

The NE09 sampling reach began approximately 150 m downstream from Washington Street, in a residential area of Norwood. This station was chosen as the warm-water reference station because the habitat quality was considered good with respect to stability and composition of instream substrates. Indeed, well-developed riffle and run areas dominated the reach, and an abundance of cobble provided excellent epifaunal habitat for macroinvertebrates. Instream cover for fish was less than optimal, primarily due to a lack of deep-water areas and habitat variety. In fact, much of the instream fish cover present existed in the form of trash—scrap metal, cans, plastics, and other debris. Instream vegetation consisted of rooted submergent macrophytes (*Potamogeton crispus*) midreach and filamentous algae at the lower end of the reach where the mostly shaded sampling area gave way to a partially open canopy. Both stream banks were fairly well-vegetated and stable, with "rip-rap" and concrete block walls providing additional bank reinforcement at the top and bottom of the reach respectively. Some streambank erosion and associated runoff originating from an adjacent restaurant parking lot were observed along the right (south) bank near the top of the reach. Other forms of nonpoint source pollution existed primarily in the form of lawn runoff, yard waste, and trash—all associated with the numerous adjacent residences located throughout the sampling reach. NPS pollution may be exacerbated by the extremely narrow riparian buffer—mainly comprised of a thin strip of red maple (*Acer rubrum*) and slippery elm (*Ulmus rubra*)—between the stream channel and the abutting yards. NE09 received a total habitat assessment score of 131/200 (Table A6).

*Benthos*

As with the 1994 bioassessment conducted here, this reach of the stream was characterized by a macroinvertebrate assemblage indicating a healthy aquatic community. A richness of 7 intolerant EPT taxa was recorded—the most of any biomonitoring station in the basin—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 biotic index of 4.93 was low relative to many of the biomonitoring stations in the survey, indicating the dominance of the Hawes Brook benthos assemblage by pollution-sensitive taxa. NE09 received a total metric score of 34/36 (Table A2).

*Fish*

Fish sampling at NE09 resulted in the collection of fallfish (*Semotilus corporalis*), American eel (*Anguilla rostrata*), bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and white sucker (*Catostomus commersoni*) (Table A7). The fish assemblage was dominated by pond species which are most likely emigrating from the many impoundments located upstream. The presence of impoundments both upstream and downstream of the sampling reach, and the rather limited total length of true lotic habitat in general, make restoration of a stream fish assemblage problematic.

### *Traphole Brook*

The Traphole Brook subwatershed drains portions of Sharon, Walpole, and Norwood. The mostly forested upper portion of the subwatershed gives way to residential and commercial land use as the stream heads in a northeasterly direction towards its confluence with the Neponset River in Sharon. Two highways—Interstate 95 and Route 1—intersect Traphole Brook approximately midbasin. This tributary supports a self-sustaining cold-watery fishery, and the water temperature was the coolest documented in the basin. Findings from DEP's 1994 Neponset River Watershed Resource Assessment Report indicated that septic system failure may compromise water quality in some portions of this stream (MA DEP 1995).

**5B01**—Traphole Brook, mile point 1.7, downstream from Coney Street, Walpole, MA

*Habitat*

The 5B01 sampling reach began approximately 200 m downstream from Coney Street, in a densely forested portion of the subwatershed. Hardwoods were predominant throughout most of the reach, save for some overhanging shrubs (*Viburnum* sp.) and jewelweed (*Impatiens capensis*) along the lower half. Cool, clear riffles dominated the reach, and along with an abundance of rocky substrates offered excellent instream habitat for macroinvertebrates. Fish cover was good, with snags, boulders, and overhanging vegetation providing much of the stable habitat; however, pool areas were somewhat limited. With the exception of filamentous green algal mats near the bottom of the sampling reach and occasional patches of moss, instream vegetation was virtually absent. Both stream banks were well-vegetated and stable, and the extensive maple-dominated (*Acer rubrum*) riparian zone was only minimally disturbed. An adjacent yard near the bottom of the reach was a potential source of NPS pollution (e.g., grass clippings and other yard waste/runoff) but was fairly well-buffered from the stream by shrubs and other vegetation. The Coney Street crossing just upstream was a potential source of NPS inputs; however, no signs of runoff (e.g., instream sedimentation) were observed during sampling. 5B01 received a total habitat assessment score of 168/200 (Table A6).

*Benthos*

The benthic community encountered at 5B01 reflected the excellent habitat available in this portion of Traphole Brook. A diverse assemblage of clean-water taxa dominated the sample, including three species of stoneflies (Plecoptera), generally considered the most pollution-sensitive insect order. In addition to numerous intolerant EPT taxa, the elmid beetles—a relatively intolerant insect family whose plastron respiration requires well-oxygenated instream conditions (Peckarsky et al. 1990)—were well represented in the 5B01 sample as well (Table A1). A biotic index of 2.67 was quite low relative to the other biomonitoring stations in the survey, indicating the dominance of the Traphole Brook benthos assemblage by highly pollution-sensitive taxa. 5B01 received a total metric score of 32/36 (Table A3). The balanced trophic structure and optimum community structure (composition and dominance) found at 5B01 corroborate its use as a regional reference station (cold-water). Biological integrity appears to have remained optimal here since the last DEP biological survey conducted in 1994, when a diverse macroinvertebrate community dominated by intolerant taxa was documented (MA DEP 1995).

*Fish*

A total of 76 fish were collected in the 5B01 sampling reach. The sample included 29 brown trout (*Salmo trutta*) and 47 brook trout (*Salvelinus fontinalis*)—generally considered the most pollution-sensitive species found in lotic waters (Table A7).  While some of the fish collected appeared to be stocked (as evidenced by size and/or fin quality) the majority of fish appeared to be part of reproducing populations of both brown and brook trout. There were many age classes present, including a large number of young-of-the-year (0+). It appeared that most, if not all, available high quality fish habitat was being utilized.

Spawning habitat for brook and brown trout normally consists of gravelly shallows, especially in areas with upwellings of springwater. As such, sedimentation (resulting from road crossings, construction sites, streambank alteration, etc) can be detrimental to trout spawning habitat and should be minimized. Efforts to protect flow and habitat quality will be key in maintaining this unique brook and brown trout assemblage. The presence of high quality trout habitat is relatively rare in the eastern part of the Commonwealth making Traphole Brook a valuable resource with regard to overall biological diversity within the Neponset River sub-basin.

***Massapoag Brook***

From its headwaters in Massapoag Lake—the largest lake in the Neponset River sub-basin—Massapoag Brook flows through several small impoundments along its course to Forge Pond in Canton. The majority of this subwatershed lies in Sharon, which is served entirely by on-site septic systems. Municipal (Town of Sharon) groundwater wells abutting Massapoag Lake have historically resulted in reduced water levels in the lake and reductions in outflow from the lake (NepRWA 1998). Flow regulation at the Massapoag Lake outlet and further downstream at Manns Pond, and its effect on downstream flows and resident biota, is an ongoing concern in this subwatershed.

**9BOB**—Massapoag Brook, mile point 3.9, downstream from Manns Pond, Sharon, MA

*Habitat*

The 9BOB sampling reach began approximately 100 m downstream from Manns Pond and terminated immediately below the pond outlet. The steep gradient of this portion of the stream provided numerous riffle areas of varying depths, and along with abundant cobble/boulder substrates, afforded macroinvertebrates with excellent epifaunal habitat. Instream root masses and aquatic mosses provided additional benthic microhabitat. Fish habitat was excellent as well, with numerous pools and a variety of stable habitat (e.g., snags, submerged logs, undercut banks) providing ample cover. Both stream banks were well-vegetated, while boulders and root masses provided good stability. A forested riparian zone consisting of mainly red maple (*Acer rubrum*) and fern understory extended undisturbed from the left (south) bank and provided adequate buffer from an adjacent road (Billings Street) near the right (north) bank. 9BOB received a total habitat assessment score of 183/200—the highest score received by a biomonitoring station in the 1999 Boston Harbor watershed survey (Table A6).

*Benthos*

Despite the excellent habitat available the 9BOB benthos assemblage received a total metric score of only 20, representing 59% comparability to the warm-water reference station at NE09 and resulting in “slightly impacted” biological status (Table A2). The dominance of the community by relatively few taxa, particularly the filter-feeding caddisflies (filter-feeding sponges were extremely abundant as well, but not included in the sample) Hydropsychidae and Philopotamidae indicates an unbalanced community responding to an overabundance of fine particulate organic matter (FPOM) in the water column. Significant deposits of FPOM were also observed on much of the instream substrates. That the assemblage is dominated by filter-feeders is not surprising, as upstream impoundments are no doubt a contributing source of suspended FPOM; however, the high densities represented by these taxa are somewhat disconcerting and indicative of the effects of moderate enrichment. Typically, in lentic systems such as the impoundments upstream, 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.

The enrichment effects (e.g., dominance of filter-feeders, reduced EPT index) reflected in the 9BOB benthic community are probably most directly related to the productive nature of Manns Pond immediately upstream. Trophic status for this impoundment was determined to be eutrophic during the 1994 lake assessments conducted by MA DEP (1995). As with the 1994 survey of Manns Pond, dense cover by non-native macrophytes was observed during the time of the 1999 biosurvey at 9BOB. Nutrient/organic loadings originating from inadequate septic systems, or miscellaneous forms of urban runoff, probably contribute to the productive conditions that supply an abundant FPOM food resource to the downstream aquatic community.

*Fish*

Fish sampling at 9BOB found an assemblage dominated by “pond” species, further corroborating the influence that the upstream impoundment has on aquatic community structure in this portion of Massapoag Brook. Brown bullhead (*Ameiurus nebulosus*), bluegill (*Lepomis macrochirus*), and pumpkinseed (*Lepomis gibbosus*) made up 80 percent of the fish collected at this location. In addition, largemouth bass (*Micropterus salmoides*) and golden shiner (*Notemigonus crysoleucas*) were also part of the sample. Two white sucker (*Catostomus commersoni*) and three American eel (*Anguilla rostrata*) were collected as well (Table A7).

The presence of Manns Pond located just upstream from the study reach is clearly having an impact on the fish assemblage at this station. The majority of the pond fishes present appeared to be 2-year olds which most likely emigrated from the pond during high flows. The physical habitat within the reach does not support stable populations of pond fishes (i.e., reproducing populations represented by multiple age classes). The absence of “stream” species may be due to direct competition with the fish coming out of pond and/or periodic low-flow events and insufficient re-population from downstream areas. The restoration and maintenance of a more typical stream fish assemblage in this reach may be problematic due to the presence of the pond and the potential for periodic flow interruption. Efforts to restore a stream fish assemblage by maintaining minimum baseflow in this reach may be unrealistic or ineffective due to competition from pond species emigrating from Manns Pond.

### ***Beaver Brook***

From its headwaters in Sharon, Beaver Brook drains an area of mostly forest, wetland, and other open space as it flows in a northeasterly direction towards its confluence with Massapoag Brook. Despite the relatively undeveloped nature of this small subwatershed, the presence of three groundwater wells adjacent to Beaver Brook may have pronounced effects on instream baseflow and biological potential.

**BB01**—Beaver Brook, mile point 0.75, downstream from Maskwonicut Street, Sharon, MA

*Habitat*

The mostly shaded BB01 sampling reach began approximately 300 m downstream from Maskwonicut Street in a forested portion of the watershed. Though relatively shallow, the riffle-dominated reach offered excellent habitat for macroinvertebrates. Cobble and gravel substrates were prevalent throughout this portion of the stream, and along with dense instream moss cover, provided optimal epifaunal substrates for benthic organisms. Fish habitat was also good, with undercut banks, snags, and boulders providing ample instream cover. Occasional patches of the rooted submergent macrophyte, water starwort (*Callitriche* sp.), probably offered additional microhabitat for fish and invertebrates as well. Both steam banks were well-vegetated and stabilized by boulders and root masses. The maple (*Acer rubrum*) dominated riparian zone was extensive along both stream banks in the sampling reach, although upstream from the reach the riparian buffer between the right (east) bank and an adjacent railroad track was minimal. In addition to the nearby railroad tracks, a road crossing (Maskwonicut Street) just upstream from the sampling reach was a potential source of NPS pollution inputs. BB01 received a total habitat assessment score of 179/200 (Table A6).

*Benthos*

The benthos assemblage at BB01 received a total metric score of 28, representing 82% comparability to the warm-water reference community at NE09 and resulting in an aquatic assessment of “non/slightly impacted” (Table A2). The fact that the biotic index was actually lower (4.35) than at NE09, and the taxa richness (32) was the highest of all the Boston Harbor watershed biomonitoring stations, suggests good biological diversity at BB01 and a community dominated by pollution-sensitive forms. Only the EPT/Chironomidae metric scored poorly—the result of a relatively high abundance of midges compared to reference conditions. That the Chironomidae dominate the BB01 assemblage may be significant, since several of the midges present are considered tolerant of low-flow conditions (Bode, NY DEC, personal communication).

When using the cold-water community at 5B01 as the reference station, BB01 received a total metric score of 24, representing 75% comparability to the “best attainable” conditions of Traphole Brook (Table A3). Despite the resulting “slightly impacted” assessment, several of the metrics for the BB01 assemblage scored better than, or as well as, the reference station—most notably, the taxa richness and EPT index metrics (Table A3). The apparent discrepancy in community structure between BB01 and 5B01 may in fact be the result of differing physico-chemical conditions (e.g., ambient water temperature, baseflow)—be they naturally-occurring or anthropogenically induced—rather than water quality effects at BB01.

*Fish*

The fish community at the Beaver Brook sampling location contained a total of four fish. The sample included one brown trout (*Salmo trutta*), one white sucker (*Catostomus commersoni*), one largemouth bass (*Micropterus salmoides*), and one redfin pickerel (*Esox americanus americanus*) (Table A7). The low fish abundance was surprising, as this segment contained a diverse mix of pool, riffle, and run/glide habitat containing excellent fish cover in the form of snags, undercut banks, and boulders. The occurrence—albeit infrequent—of salmonids at BB01 suggests this stream can support a cold-water biological community, corroborating the use of 5B01 as the primary macroinvertebrate reference station for the BB01 benthic community.

It is unclear as to why fish were largely absent from the BB01 stream reach. Interestingly, species which are representative of a wide range of tolerances to both dissolved oxygen and temperature were found. It is possible that episodic low-flow events may be responsible for the absence of fish due to “de-watering” of habitat. Water quality data—if available—should also be examined to determine if low pH or dissolved oxygen might be contributing to the low fish abundance. This station is a good candidate for additional fish community assessment in the future.

### *Beaver Meadow Brook*

From its source in Glen Echo Pond in Stoughton/Canton, Beaver Meadow Brook flows in a westerly direction to Bolivar Pond in Canton. The subwatershed drains mostly wetland, open space, and light to moderately developed residential portions of Canton. Several groundwater withdrawals exist along Beaver Meadow Brook, and an additional well is proposed near Route 138.

**BM01**—Beaver Meadow Brook, mile point 0.20, downstream from Pine Street, Canton, MA

*Habitat*

The BM01 sampling reach began approximately 300 m upstream from Bolivar Pond, in a forested portion of the watershed. While reduced baseflow during spring reconnaissance of this stream resulted in mostly exposed substrates and less than optimal sampling conditions, water levels had improved dramatically when DWM returned to sample the stream during the July macroinvertebrate survey. Snags, undercut banks, and rocky substrates that were exposed just a few weeks earlier were subjected to a variety of flow regimes during the time of the biosurvey, resulting in excellent fish and macroinvertebrate habitat. Riparian vegetation was undisturbed and dominated by hardwoods, most notably red maple (*Acer rubrum*), ash (*Fraxinus americana*), and hop hornbeam (*Ostrya virginiana*). Herbaceous growth was observed in the understory and along the stream banks, consisting of poison ivy (*Rhus radicans*), rose (*Rosa* sp.), greenbrier (*Smilax rotundifolia*), ferns, and jewelweed (*Impatiens capensis*). In addition to herbaceous growth, stream banks were stabilized by boulders and large root masses. Instream aquatic vegetation and algae were not observed; however, instream turbidity made it difficult to see submerged vegetation. NPS pollution existed in the form of instream trash, with runoff from a nearby apartment complex posing a threat as well. BM01 received a total habitat assessment score of 176/200 (Table A6).

*Benthos*

Based on ambient water temperature and the fish assemblage present at BM01, it was determined that the warm-water reference station NE09 should serve as the primary reference station for the BM01 benthos community. The BM01 macroinvertebrate assemblage received a total metric score of 30, representing 88% comparability to NE09 and resulting in a "non-impacted" assessment for biological condition (Table A2). Community composition metrics scored well relative to reference conditions, with good representation of pollution-sensitive taxa.

Even when using the cold-water station at Traphole Brook as a reference station, taxa richness and EPT richness at BM01 were comparable to "least impacted" conditions (Table A3). Community structure differed from the 5B01 reference station, however—largely the result of dissimilar trophic structure. Trophic structure at BM01 was skewed towards the filter-feeders, as indicated by the hyperdominance of hydropsychid and philopotamid caddisflies (Table A1). When compared to the cold-water reference station, the BM01 benthic community received a total metric score of 20, representing 63% comparability and placing the assemblage in the "slightly impacted" category (Table A3).

Upstream impoundments no doubt are a contributing source of FPOM to the BM01 macroinvertebrate community, and probably have a more significant influence on community structure than do fluctuating baseflow levels in this portion of Beaver Meadow Brook. It is unclear the extent to which current water quality conditions in the upstream impoundments are affecting instream turbidity at BM01; however, other potential sources (e.g., runoff from nearby roads, parking lots, and numerous gravel pits) no doubt exist in this subwatershed.

*Fish*

Fish species present in order of abundance included brown bullhead (*Ameiurus nebulosis*), white sucker (*Catostomus commersoni*), largemouth bass (*Micropterus salmoides*), American eel (*Anguilla rostrata*), pumpkinseed (*Lepomis gibbosus*), darter (*Etheostoma olmstedi*), yellow perch (*Perca flavescens*), redfin pickerel (*Esox americanus*), and golden shiner (*Notemigomus crysoleucas*) (Table A7). The majority of the fish (91%) were young-of-the-year brown bullhead (n=72), white sucker (n=15), and largemouth bass (n=8). It is possible that the slightly turbid conditions of this stream precluded the efficient collection of darters, as they can be difficult to see even under the best conditions. The presence of impoundments both upstream and downstream of this location is almost certainly having an effect on fish community composition in this portion of Beaver Meadow Brook.

### *Mill Brook*

Comprised of Tubwreck, Mill and Mine brooks, this small subwatershed contains numerous municipal water supply wells in the towns of Dover, Medfield and Walpole. The total withdrawal from the subwatershed was 1.4 million gallons per day (MGD) in 1994. The only discharge to the sub-basin, other than the return of wastewater through a small number of septic systems, is the filter backwash water from the Harold E. Willis Water Treatment Plant in Walpole, which discharges into a wetland area adjacent to

Mine Brook. The Mill Brook subwatershed is experiencing considerable development in the form of single family home subdivisions. Stormwater controls to prevent construction impacts such as erosion and sedimentation from subdivisions in Medfield were found by DEP to be improperly installed and presumed ineffective (MA DEP 1995). While documented as supporting a cold-water fishery as recently as 1987 (based upon the records of the DFWELE), no salmonids (i.e., trout) were found during DEP/DWM's 1994 biological monitoring effort in Mill Brook. Furthermore, the water temperature was higher than expected (26°C).

After receiving the discharge from the headwater stream of Tubwreck Brook, Mill Brook flows in a southerly direction through areas of extensive wetlands, forest, and light residential development before entering Jewells Pond in Medfield. From this small impoundment the stream—now Mine Brook—continues in a southerly direction until it joins the Neponset River just downstream from Turner Pond in Walpole.

**MB01**—Mill Brook, mile point 5.90, downstream from Millbrook Road, Medfield, MA

*Habitat*

The MB01 sampling reach began approximately 100 m downstream from Millbrook Road and ended at the road crossing. The shaded reach meandered through a mostly deciduous forest, dominated by red maple (*Acer rubrum*), red oak (*Quercus rubra*), and ash (*Fraxinus americana*). A shrubby understory of sweet pepperbush (*Clethra alnifolia*) and azalea was also present. Rocky substrates consisting of cobble, pebble, and gravel were common throughout much of the reach; however, extremely low baseflow resulted in much exposed benthos habitat. In fact, it was estimated that only about 50% of the stream channel contained water despite the heavy rain received during the previous week. The shallow nature of those riffle, run, and pool areas present resulted in less than optimal epifaunal habitat for macroinvertebrates and poor instream fish cover. Instream vegetation existed mainly as moss, with some macrophytes (*Lemna* sp., *Callitriche* sp.) present as well. Filamentous green algae covered < 5% of the sampling reach. There was some evidence of sediment deposition, with the Millbrook Road crossing the most likely source of NPS inputs. Stream bank and riparian habitat parameters rated excellent, especially along the right (west) bank where the vegetative buffer extended undisturbed. The left (east) bank was well-vegetated and stable as well, although some understory vegetation appeared to be removed as part of the landscaping efforts of an adjacent home. The MB01 station received a total habitat assessment score of 143/200 (Table A6).

*Benthos*

The MB01 macroinvertebrate community received a total metric score of 26 when compared to the Hawes Brook reference station. This represents 76% comparability to the warm-water reference condition, placing the MB01 benthos assemblage in the “slightly impacted” category (Table A2). However, the presence of trout (as discussed below) during the 1999 biosurvey here suggests that comparisons to the cold-water reference station of 5B01 may be more appropriate. That said, MB01 received a total metric score of 20, representing only 63% comparability to “best attainable” conditions when using the Traphole Brook station as the reference. The resulting assessment places MB01 in the “slightly impacted” category for biological condition (Table A3).

Regardless of which reference station is used, it appears that habitat is almost certainly limiting to biological potential at MB01. Instream habitat constraints related to reduced baseflow, in particular, appear to compromise biological integrity in this portion of Mill Brook. Interestingly, taxa richness at MB01 is higher than both reference station assemblages; however, it is the diversity of chironomids rather than more intolerant taxa that contributes most to the high richness seen in the MB01 community. In fact, the Chironomidae comprise more than 60% of the MB01 assemblage, contributing to an EPT/Chironomidae metric value that is by far the lowest of all the Neponset River sub-basin biomonitoring stations (Table A2 and A3). Of further note is the fact that many of the Chironomidae present in the MB01 assemblage—including the dominant taxon, *Micropsectra* sp.—may display low-flow adaptations, having been observed in high densities in other northeastern streams subjected to flow constraints (Fiorentino 2000; Fiorentino 1999; Bode, NY DEC, personal communication).

*Fish*

Electroshocking efficiency was rated excellent. Contrary to the findings of DEP's 1994 fish survey of this stream, MB01 presently appears to support a cold-water fishery. Fish species present in order of abundance included brook trout (*Salvelinus fontinalis*), darter (*Etheostoma olmstedi*), redfin pickerel (*Esox americanus*), chain pickerel (*Esox niger*), and largemouth bass (*Micropterus salmoides*) (Table A7). Total number of individuals was relatively low (n=45), however, most of the available habitat was being utilized. The presence of a large number of native brook trout is indicative of excellent water quality, further corroborating that habitat constraints are most limiting to the aquatic community at MB01. It is appears that these fish were one-year (1+) olds and it is unclear why no young of the year were observed or collected. The presence of darter and redfin pickerel is encouraging in that both are species which thrive in lotic environments. The chain pickerel and largemouth bass most likely originated from Chickering Lake or the small impoundment located just upstream from the sample location.

Spawning habitat for brook trout normally consists of gravelly shallows, especially in areas with upwellings of springwater. As such, sedimentation (resulting from road crossings, construction sites, streambank alteration, etc.) can be extremely detrimental to brook trout spawning habitat and should be minimized. Additional assessment in this stream would help to better document conditions that may threaten the brook trout population present. Efforts to protect flow and habitat quality will be key in maintaining the brook trout, darter, and redfin pickerel assemblage at MB01.

### *East Branch Neponset River*

The East Branch Neponset River is the major tributary to the mainstem Neponset River, and therefore strongly influences downstream water quality conditions. The contributing subwatersheds to the East Branch Neponset River are comprised of tributary systems containing several lakes and impoundments. Discharge from Massapoag, Steep Hill, Beaver Meadow, and Pequit brooks is received by the East Branch before it heads in a westerly direction towards its confluence with the mainstem Neponset River in Canton. Much of the East Branch subwatershed is comprised of various forms of commercial, industrial, and residential development. The urbanized nature of the subwatershed gives way to extensive wetland (Fowl Meadow) near its confluence with the mainstem.

DEP's 1994 resource assessment efforts in the East Branch Neponset River revealed severely degraded conditions. In particular, biological monitoring revealed significant impacts and resulted in an aquatic life use-support determination of "non-support." In addition, the 1994 monitoring survey found water temperature in this tributary to be extremely high (31°C), posing a significant threat to the biota in both the East Branch and in the Neponset River downstream from the confluence.

**NE12**—East Branch Neponset River, mile point 1.80, downstream from Neponset Street, Canton, MA

*Habitat*

The NE12 sampling reach began approximately 200 m downstream from Neponset Street in a highly channelized (i.e., banks almost completely "rip-rapped") portion of the stream. The reach was virtually one continuous riffle of varying depths, with large boulders and cobble substrates providing excellent epifaunal habitat for macroinvertebrates. Deep water and large substrates offered good cover for fish, although other forms of stable habitat (e.g., snags, submerged logs, instream vegetation) were absent. Minimally-buffered parking lots adjacent to the sample area and the upstream road crossing offered potential NPS inputs in the form of runoff; however, sediment inputs were not evident during the time of sampling. Bank stability was good along the left (south) bank due to the presence of "rip-rap"; however, vegetative removal and collapsing "rip-rap" along the right (north) bank resulted in considerable erosion and bank instability. Riparian vegetation was extremely reduced along both banks, consisting of a thin layer of red maple (*Acer rubrum*) and ash (*Fraxinus americana*) and a limited herbaceous layer of jewelweed (*Impatiens capensis*), poison ivy (*Rhus radicans*), and rose (*Rosa* sp.). Instream vegetation and algae appeared absent, although turbidity made it difficult to see growth on bottom substrates. NE12 received a total habitat assessment score of 152/200 (Table A6).

*Benthos*

The NE12 benthos assemblage received a total metric score of only 18, representing 53% comparability to the warm-water reference station (Table A2). The “slightly/moderately impacted” assessment for biological status (relative to warm-water reference conditions) here was the poorest received by a Neponset River sub-basin biomonitoring station during the 1999 watershed survey. Metric values for EPT index (4) and percent dominant taxon (38%) performed particularly poorly relative to the other biomonitoring stations (Table A2), and indicate an unbalanced assemblage dominated by more tolerant filter-feeding taxa. As with the benthos sample collected here during the 1994 DEP biosurvey, hydropsychid caddisflies dominated the assemblage (though not at the extremely hyperdominant levels documented in 1994), indicating high concentrations of FPOM in the water column. It is possible that water quality conditions at NE12 have improved slightly since the 1994 biosurvey, based on increases in taxa richness and better representation by additional trophic groups. Nevertheless, highly productive upstream impoundments—particularly Bolivar and Forge ponds, which were found to be eutrophic during DEP’s 1994 lakes survey—no doubt continue to be contributing sources of the FPOM food resource delivered to the NE12 aquatic community. In addition, historically high levels of turbidity in these ponds may contribute to the turbid conditions observed at NE12 during the 1999 biosurvey.

*Fish*

Fish sampling efficiency rated poor due to fast, deep, and turbid water. Fish species present in order of abundance included fallfish (*Semotilus corporalis*), redbreasted sunfish (*Lepomis auritus*), American eel (*Anguilla rostrata*), bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), yellow bullhead (*Ameiurus natalis*), largemouth bass (*Micropterus salmoides*), and spottail shiner (*Notropis hudsonius*) (Table A7). As with the 1994 DEP fish survey here, overall numbers of fish were very low (n=36); however, conditions were not conducive to electroshocking and many fish were missed. The fish assemblage is dominated by pond species that are most likely emigrating from the many impoundments located upstream. The presence of impoundments both upstream and downstream of the sampling reach, and the rather limited total length of lotic habitat, in general, makes restoration of a stream fish assemblage problematic.

***Pequit Brook***

The Pequit Brook subwatershed in Canton, which includes Reservoir Pond, discharges into Forge Pond. From its headwaters in the northeastern corner of Canton, Pequit Brook drains an extensive wetland area before reaching an area of much residential and commercial development in the vicinity of Route 138 and the Reservoir Pond inlet. Downgradient from the pond, the stream meanders through mostly undeveloped forest before entering Forge Pond near the center of Canton.

**PB01**—Pequit Brook, mile point 0.60, upstream from Sherman Street, Canton, MA

*Habitat*

The PB01 sampling reach was approximately 0.50 miles upstream from Sherman Street, in a densely forested portion of the subwatershed. Considerable gradient and a variety of large substrates created riffle areas that offered excellent epifaunal habitat to benthic macroinvertebrates. In addition, numerous snags and submerged logs, pools, and large rubble provided excellent fish cover. Bank and riparian habitat parameters were excellent—banks were well-vegetated and stabilized with boulders and root masses. Riparian vegetation was well developed and undisturbed, consisting of a deciduous forest of maple (*Acer* spp.), grey birch (*Betula* sp.), white ash (*Fraxinus americana*), and red oak (*Quercus rubra*). Herbaceous growth—most notably skunk cabbage (*Symplocarpus foetidus*), jewelweed (*Impatiens* *capensis*), and ferns (*Onoclea sensibilis*; *Osmunda regalis*)–was present in the understory and along both stream banks. Moss was the only instream vegetation observed, covering about half of the reach and providing additional microhabitat for benthic organisms. There were no signs of NPS pollution in the sampling reach. PB01 received a total habitat assessment score of 181/200—one of the highest habitat evaluations received by a biomonitoring station during the Boston Harbor watershed survey (Table A6).

*Benthos*

Despite the presence of a large impoundment upstream, the PB01 benthic community was not hyperdominated by filter-feeders. Rather, the assemblage displayed optimum community structure and balanced trophic structure—a variety of pollution-sensitive taxa were present representing numerous feeding guilds. In fact, total taxa richness (27) was higher than both reference stations and was higher than all but one community sampled during the 1999 biosurveys; EPT richness (7) was actually higher than the cold-water reference station (Table A2 and A3).

PB01 received a total metric score of 30, representing 88% comparability to the warm-water reference station at Hawes Brook (Table A2). In fact, with the exception of the EPT/Chironomidae metric, most metrics performed better than those of NE09. The PB01 macroinvertebrate community was considered "non-impacted" relative to warm-water reference conditions.

The PB01 benthos assemblage received a total metric score of 26, representing 81% comparability to the cold-water reference community (Table A3). An abundance of the midge *Parametriocnemus* sp. at PB01 contributed most to the low scoring EPT/Chironomidae metric and dissimilar community structure relative to reference conditions at 5B01 (Table A3). The high relative abundance of this taxon at PB01 may be significant, as it is known to survive dry conditions or periods of reduced baseflow (Bode, NY DEC, personal communication). The PB01 macroinvertebrate community was found to be "non/slightly impacted" when compared to cold-water conditions; however, the discrepancy in water temperature between PB01 and 5B01—as noted by NepRWA (1999)—suggests that the warm-water conditions at NE09 might be more appropriate for biological comparisons with PB01.

*Fish*

Fish sampling efficiency was excellent. Fish species present in order of abundance included largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*), brown bullhead (*Ameiurus nebulosus*), bluegill (*Lepomis macrochirus*), redfin pickerel (*Esox americanus*), white sucker (*Catostomus commersoni*), and American eel (*Anguilla rostrata*)—the latter four species being represented by a total of eight fish (Table A7). Overall numbers of fish were very low (n=36) with the majority of the fish (n=30) being young-of-the-year of pond species. The apparent inability of Pequit Brook to support a cold-water fishery corroborates the use of the NE09 reference station as the primary reference condition for comparisons to the PB01 benthic community.

The location of Reservoir Pond just upstream, and Forge Pond just downstream is clearly having an impact on the fish assemblage at this station. The majority of the pond fishes present appeared to be young-of-the-year that most likely emigrated from Reservoir Pond during high flows. The physical habitat within the reach does not support stable populations of pond fishes (i.e., reproducing populations represented by multiple age classes). The absence of "stream" species may be due to direct competition with fish originating from the pond and/or periodic low-flow events and inability for re-population to occur from downstream areas. The restoration and maintenance of a more typical stream fish assemblage in this reach may be problematic due to the presence of the pond and the potential for periodic flow interruption. Efforts to restore a stream fish assemblage by maintaining minimum flows may also be ineffective due to competition from pond species emigrating from Reservoir Pond.

### *Unnamed tributary to Steep Hill Brook*

This small subwatershed is the source of the municipal water supply for the town of Stoughton. In 1994, the Stoughton Water Department withdrew an average of 1.17 MGD from wells in the vicinity of

Pinewood, Muddy and Town ponds (MA DEP 1995). From its relatively undeveloped source in Dry Pond, this unnamed tributary to Steep Hill Brook flows in a northerly direction through Muddy and Town ponds. After draining an urbanized portion of the subwatershed in the northwestern corner of Stoughton—including Pinewood Pond—the stream enters Bolivar Pond in Canton.

**SB01**— Unnamed tributary to Steep Hill Brook, mile point 1.0, downstream from Central Street, Stoughton, MA

*Habitat*

The SB01 sampling reach began approximately 500 m downstream from Central Street in Stoughton, a short distance downstream from two municipal groundwater supplies for the Town of Stoughton. The reach consisted of a series of well-developed riffle areas interspersed with deep pools that meandered through a forested area and terminated at the downstream extent of a defunct mill. An abundance of cobble and gravel/pebble substrates offered excellent epifaunal habitat for macroinvertebrates, while numerous snags, submerged logs, and overhanging vegetation provided excellent fish cover. Both stream banks were well-vegetated with herbaceous and shrubby growth, especially rose (*Rosa multiflora*), riverbank grape (*Vitis riparia*), poison ivy (*Rhus radicans*), and bittersweet (*Celastrus* sp.). Bank stability was good along the right (east) bank, while the extremely steep nature of the left (west) bank resulted in small areas of erosion along the upper portion of the reach. The effects from dumping (i.e., trash deposits) were observed along much of the left bank, apparently originating from an adjacent shopping center/parking lot and exacerbated by the steepness of the bank and the narrow riparian buffer on this side of the channel. The riparian zone along the right bank was extensive and undisturbed, consisting mainly of red maple (*Acer rubrum*), elm (*Ulmus rubra*), and an uncultivated field. The SB01 biomonitoring station received a total habitat assessment score of 169/200 (Table A6).

*Benthos*

Temperature data collected by NepRWA (1999) indicate that this stream is incapable of supporting a cold-water fishery. As a result, the warm-water reference station of NE09 was used as the primary reference condition for biological comparisons to the SB01 macroinvertebrate community. SB01 received a total metric score of 20, representing 59% comparability to “least impacted” conditions at NE09 and resulting in a “slightly impacted” bioassessment (Table A2). Comparisons to the cold-water reference yielded similar results (56% comparability; “slightly impacted”). Despite relatively high taxa richness, the SB01 benthos assemblage was characterized by a displacement of pollution-sensitive EPT taxa by moderately tolerant organisms—most notably the filter-feeding hydropsychid caddisflies. Between the hydropsychids and another net-spinning caddisfly, Philopotamidae, filter-feeding caddisflies comprised almost 60% of the benthos sample, indicating a preponderance of suspended FPOM in this portion of this stream. Numerous upstream impoundments—including the highly productive Town Pond, documented as eutrophic due to nuisance and non-native vegetation (MA DEP 1995)—probably deliver an abundance of organic particulates to the SB01 community.

It appears, then, that water quality rather than habitat quality is most limiting to biological potential in this portion of this unnamed Steep Hill Brook tributary. Furthermore, water quality degradation at SB01 and its effects on biological integrity may be exacerbated by occasional periods of reduced baseflow.

*Fish*

Fish species present in order of abundance included pumpkinseed (*Lepomis gibbosus*), largemouth bass (*Micropterus salmoides*), white sucker (*Catostomus commersoni*), chain pickerel (*Esox niger*), and American eel (*Anguilla rostrata*) (Table A7). Overall numbers were very low (n=36) with the majority of the fish (n=29) being young-of-the-year.

The presence of a number of ponds located both upstream and downstream from the sampling reach appears to be dictating community structure in the SB01 fish assemblage. It is unclear whether low-flow events may be affecting habitat in this reach; however, the presence of a number of deep pools should provide refugia during low-flow episodes.

## *Mystic River Sub-basin*

The Mystic River sub-basin has an approximate drainage area of 69 square miles with a population of over 500,000 people. It lies to the immediate north of Boston and its boundaries are entirely within the Commonwealth of Massachusetts. A sizeable portion of the basin, over 23 square miles, forms the Aberjona River which has its origins in Reading. The Aberjona River is the main tributary of the Upper Mystic Lake. The overflow from the Upper Mystic Lake forms the Lower Mystic Lake. Mill Brook is a tributary to the Lower Lake entering at its southerly end. The Mystic River begins at the outlet of the Lower Lake. It flows in a southeasterly direction for a distance of 7.4 river miles through or bordering the towns of Arlington, Medford, Somerville, Everett, Charlestown, and Chelsea before finally discharging into inner Boston Harbor. The Mystic River's main tributaries are Alewife Brook which enters at the Arlington-Somerville line and the Malden River forming the border between the towns of Medford and Everett.

### *Aberjona River*

The Aberjona River flows in a southerly direction for a distance of 8.7 river miles through highly urbanized portions of Wilmington, Woburn, and Winchester before discharging into the Upper Mystic Lake. There are three main tributaries to the Aberjona which are listed in downstream order: Hall's Brook in Woburn, Sweetwater Brook in Woburn, and Horn Pond Brook in Winchester. Sources of pollution in the Aberjona River and its tributaries are in the form of nonpoint source runoff and industrial discharges.

**AR01**—Aberjona River, mile point 9.70, at USGS gaging station, Winchester, MA

*Habitat*

The AR01 sampling reach began approximately 100 m downstream from the USGS gaging station in Winchester, terminating at a small dam immediately adjacent to the gage. Much of the reach consisted of deep run/pool areas, with well-developed riffle (shallow and deep) areas present near the top and bottom of the reach. While gravel and sand were the most abundant substrate types in the sampling reach, cobble and larger substrates were common in the riffle areas and provided excellent overall epifaunal habitat for macroinvertebrates. Fish habitat was less than optimal here, with rubble/boulder and a few snags providing the majority of the cover. Instream sediment deposition was observed throughout the reach, with sand and gravel bars present in the lower portion of the reach and moderate deposition evident in the slower pool areas midreach. The numerous stormdrain outfalls, as well as upstream road crossings and adjacent roadways (Mystic Valley Parkway, Washington Street among others) along much of the Aberjona River, probably account for most of the sediment inputs to this portion of the river. The effects of urban runoff in this segment are probably exacerbated by the narrow riparian buffer along both sides of the river. Like much of the Aberjona River, riparian vegetation in the AR01 sampling reach consists of a thin layer of trees (red oak, *Quercus rubra*; elm, *Ulmus rubra*; birch, *Betula* sp.; and silver maple, *Acer saccharinum*) and mowed grassy areas used for recreation. The displacement of trees, shrubs, and herbaceous vegetation by manicured lawn may account for the frequent areas of erosion and instability along both banks in the sampling reach. Filamentous forms of green algae covered approximately 10% of the reach and were restricted to the rocky substrates in the riffle areas. Moderate levels of instream turbidity were observed, suggesting possible water quality degradation. The AR01 biomonitoring station received a total habitat assessment score of 132/200 (Table A6).

*Benthos*

The AR01 benthos assemblage received a total metric score of 16 when compared to the Hawes Brook reference station. This was the lowest score received by a biomonitoring station in the Boston Harbor watershed survey, representing only 47% comparability to reference conditions and resulting in a biological assessment of "moderately impacted" (Table A4). Reductions in total taxa richness as well as EPT index were indicative of an impaired macroinvertebrate community and poor water quality conditions. Those EPT taxa present—filter-feeding Hydropsychidae—were hyperdominant, comprising over 60% of the sample. The abundance of filter-feeding organisms, along with gathering collectors such as the oligochaete worms and gammarid amphipods, implies 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 AR01 benthos assemblage was the second highest of all the Boston Harbor watershed biomonitoring stations, corroborating the effects of organic enrichment and possibly low levels of dissolved oxygen. The absence of a periphyton-based trophic guild (i.e., algal grazers) is evidenced by the conspicuous lack of scrapers among the AR01 macroinvertebrate assemblage.

Past studies conducted by MA DEP (1982; 1989) in the Mystic River sub-basin conclude that the river is affected by typical urban nonpoint sources such as stormwater, in-place sediment, and accelerated eutrophication from excessive nutrient input. Low dissolved oxygen, elevated fecal coliform bacteria, and high ammonia-nitrogen levels all have historically contributed to water quality degradation throughout the sub-basin. Findings of the 1999 biomonitoring survey suggest that water quality impairment remains a problem in the Aberjona River portion of the sub-basin, as indicated by an aquatic community structured in response to organic enrichment and nutrient loadings.

***Mill River***

Mill Brook is a tributary to Lower Mystic Lake entering at its southerly end. Originating in the eastern portion of Lexington, Mill Brook drains highly urbanized portions of Arlington before entering the Lower Lake near Mt. Pleasant Cemetery. The stream has been culverted underground at several points along its course.

**MI01**—Mill Brook, mile point 0.30, upstream from Mill Street, Arlington, MA

*Habitat*

The MI01 sampling reach began approximately 300 m upstream from Mill Street in Arlington, and immediately upstream from a small bridge leading to a restaurant parking lot. Shallow riffle areas comprised of cobble and gravel substrates provided good epifaunal habitat for macroinvertebrates. The shallow nature of the reach, however, along with an obvious lack of stable cover provided fish with very poor habitat. Fish and benthic habitat was compromised by substantial deposits of sand throughout the sampling reach and extremely low baseflow (stream channel <70% full). Flow was further reduced to the point that the channel was completely dry a short distance downstream in Mt. Pleasant Cemetery—the site of the originally proposed sampling reach. The riparian zone in the MI01 sampling reach was typical of a highly urbanized stream—parking lots have resulted in almost complete removal of a vegetative buffer along the right (south) bank while a narrow layer of mowed grass and “false bamboo” (*Polygonum* sp.) comprised the riparian zone along the left bank. Stormdrains, parking lot runoff, and erosion along the right bank all contribute sediment loads to this portion of the stream. MI01 received a total habitat assessment score of 99/200—easily the lowest evaluation of any of the 1999 Boston Harbor watershed biomonitoring stations (Table A6).

*Benthos*

The MI01 benthos received a total metric score of 20, representing 59% comparability to the NE09 reference station (Table A4). While the resulting bioassessment for MI01 was “slightly impacted,” it is possible that biological integrity at this station is more degraded than is indicated from the RBP analysis. The absence of EPT taxa, coupled with the highest biotic index (7.50) of any of the 1999 biomonitoring stations, indicate water quality degradation relating to organic enrichment and possibly low levels of dissolved oxygen at MI01. The relatively high taxa richness for the MI01 assemblage is misleading, as virtually all taxa present are either chironomids or oligochaete worms that display high tolerance of organic pollution, no doubt contributing to the high biotic index at this station. In addition, the dominance of the MI01 benthic community by the chironomid *Micropsectra* sp. may reflect the low-flow conditions evident here during the 1999 biosurvey, as this taxon has been known to predominate in streams subjected to periods of reduced flow (Fiorentino 2000; Fiorentino 1999; Bode, NY DEC, personal communication). Decreasing discharge and the subsequent elimination of epifaunal habitat at MI01 may also contribute to the conspicuous absence of EPT taxa, as many of these organisms are particularly susceptible to substrate exposure and stranding.

It appears, then, that habitat degradation in the form of sediment deposition, riparian vegetation removal, and substrate exposure due to low baseflow—coupled with water quality degradation from organic loadings—compromise biological integrity in this portion of Mill Brook.

### *Weymouth/Weir River Sub-basin*

The Weymouth/Weir River sub-basin is located in southeastern Massachusetts, and drains into Hingham Bay. The following municipalities are located in the sub-basin: the City of Quincy, the towns of Randolph, Braintree, Hingham, Holbrook, Weymouth, and portions of Avon and Rockland. The Weymouth/Weir sub-basin is comprised of five subwatersheds—Furnace Brook, Town River, Weymouth Fore River, Weymouth Back River, and Weir River. Furnace Brook, a 2.7 mile stream located in Quincy, flows northeast to Blacks Creek which drains to Quincy Bay, and the remaining four rivers flow generally northeast to Hingham Bay. The Weymouth Fore and Weymouth Back Rivers are both tidally influenced.

The Town River system originates as Town Brook in the Blue Hills. The stream flows 3.2 miles from the Old Quincy Reservoir through downtown Quincy to the Town River. The Town River then flows into Town River Bay, which joins with the Weymouth Fore River at Germantown Point before flowing into Hingham Bay.

The Weymouth Fore River system originates at Lake Holbrook in Holbrook, and flows northerly as the Cochato River for 4.0 miles. The Farm River, a 2.7 mile river beginning in Milton, joins the Cochato River in Braintree to form the Monatiquot River. The Monatiquot River, considered the mainstem, flows north then east for a total of 4.3 miles to the Weymouth town line where the river becomes a tidal estuary and is called the Weymouth Fore River. Several of the tributaries that contribute to the river's flow are: Lee Brook, Glovers Brook, Tumbling Brook, and Cranberry Brook.

The Weymouth Back River system is to the east of the Weymouth Fore River, and the hydrology parallels that of the Weymouth Fore River. The Old Swamp River originates in Rockland and flows northerly for 4.4 miles to the south of Whitmans Pond. The Mill River originates at the outlet of Weymouth Great Pond and flows 3.5 miles to the western shores of Whitman Pond. The Weymouth Back River originates at the outlet of Whitmans Pond in Weymouth. It flows northerly under a network of streets and intersections for 0.8 miles to the Weymouth Back River estuary, forming the town line between Weymouth and Hingham.

The final subwatershed is the Weir River, the easternmost of the five rivers. The Weir River is formed at the confluence of Crooked Meadow River and Fulling Mill Brook, and flows 2.8 miles to its tidal portion in Hingham. This system is comprised of the Plymouth, Crooked Meadow, and Weir rivers. Tributaries to these rivers include Accord Brook, Norroway Brook, Tumbling Brook, and the Eel River.

#### *Monatiquot River*

The Monatiquot River drains extremely urbanized portions of Braintree and Quincy as it makes its way eastward towards its tidally influenced mouth—an important smelt spawning area—at the Weymouth Fore River. Heavy industrial, commercial, and residential development threaten habitat and biological integrity throughout the entire subwatershed.

**MR01**—Monatiquot River, mile point 5.80, downstream from Middle Street, Braintree, MA

*Habitat*

Although the EOEA Boston Harbor Watershed team requested that macroinvertebrate sampling be conducted near the mouth of the Monatiquot River near McCusker Drive, the extremely limited epifaunal habitat made application of DWM macroinvertebrate sampling protocols problematic. As a result, sampling was conducted a short distance upstream in a reach between Middle Street and Adams Street in East

Braintree. A considerably more productive reach in terms of instream habitat availability, sampling at MR01 allowed for a more useful interpretation of the benthos data**,** particularly as it relates to overall water quality in this portion of the river. The MR01 biomonitoring station began approximately 100 m downstream from Middle Street, in a shallow stretch of water dominated by rocky substrates and good current velocity. The abundance of boulders and cobble subjected to well-developed riffles provided excellent epifaunal habitat for macroinvertebrates. Fish cover was only marginal due to the lack of stable habitat and shallow nature of the reach. The reach was almost completely channelized, with "rip-rap" placed along both banks. Despite the reinforcement of both banks with these large boulders, occasional areas of erosion and sloughing were observed, possibly due to vegetative removal along the banks and disruption of the riparian zone. Only a few red maples (*Acer rubrum*) separated the left (west) bank from the expansive parking lot of a construction equipment and materials business—piles of excavated materials were deposited at numerous points along the bank. Red maple and "false bamboo" (*Polygonum cuspidatum*) comprised the reduced riparian zone along the right (east) bank. With the exception of occasional patches of filamentous green algae and mosses, instream aquatic vegetation was absent. In addition to probable NPS inputs from the adjacent construction company, nonpoint source pollution observed in the sampling reach existed mainly as trash and sediment deposits. Silty deposits on the instream substrates and in pools probably originate from the numerous upstream road crossings and adjacent roadways. Runoff potential in this portion of the Monatiquot River is probably increased by the largely impervious nature of the surrounding landscape in this subwatershed. MR01 received a total habitat assessment score of 128/200—the second lowest habitat score received by a Boston Harbor watershed station during the 1999 survey (Table A6).

*Benthos*

Metric scores calculated for the MR01 benthos assemblage totaled 16, representing 47% comparability to the reference station at Hawes Brook (Table A5). Loss of EPT taxa and scrapers, as well as hyperdominance of one taxon, contribute to the "moderately impacted" conditions at MR01 (Table A5). Filter-feeding hydropsychid (*Cheumatopsyche* sp.; *Hydropsyche betteni* gr.) and philopotamid (*Chimarra* sp.) caddisflies have displaced virtually all other taxa and trophic guilds at this station, indicating a highly unbalanced community responding to an overabundance of FPOM in the water column (Table A1). Heavy deposits of fine organic material, comprising 95% of the organic substrate components at MR01, were observed throughout the sampling reach and corroborate that fine organics are the dominant food resource in this portion of the river. Moderate levels of turbidity, probably caused by the heavy loads of sediment or suspended material often associated with eutrophic conditions, were observed at the MR01 station as well. These fine materials can be deleterious because they can reduce light penetration and consequently plant growth (instream aquatic vegetation was minimal at MR01), smother hard surfaces, and fill interstices within the substrate (Wiederholm 1984). Resident biota at MR01, then, may be subsequently affected by obstructions in food collection or respiration caused by fine deposits of organic material. Eutrophication of upstream impoundments, as well as direct nutrient/organic loadings to the Monatiquot River itself probably account for the organically enriched conditions reflected in the aquatic community at MR01. In addition to water quality constraints, habitat degradation (especially riparian) probably compromises biological integrity at MR01 as well—though to a lesser degree.

***Old Swamp River***

A much less developed subwatershed than the Monatiquot River, the Old Swamp River drains residential portions of Rockland and Weymouth as it makes its way northward to Whitmans Pond. A good deal of this subwatershed remains open space, often in the form of vast wetland areas. Adjacent sewage overflows and septic systems threaten water quality in the Old Swamp River, while heavy water withdrawals may impact instream/riparian habitat and resident instream biota.

**SR01**—Old Swamp River, mile point 0.40, upstream from USGS gage, Weymouth, MA

*Habitat*

Nestled in the narrow wooded strip between the north and southbound lanes of Route 3 in Weymouth, the SR01 sampling reach began at the USGS gage and extended upstream under a closed canopy for approximately 100 m. Riffle areas were common—albeit shallow—and comprised of abundant rocky substrates that afforded excellent epifaunal habitat to macroinvertebrates. In addition, an abundance of instream mosses and large root masses provided benthic microhabitat as well. Fish habitat, however, suffered from a lack of stable cover and slight sand deposition in pools. Sand inputs may be the result of runoff from Route 3 or sources further upstream. Reconnaissance activities conducted upstream revealed areas of massive riparian zone removal and erosion in the vicinity of a housing development located between Pleasant Street and Oak Street in Weymouth. Both stream banks were well-vegetated and moderately stable, and despite the proximity of the adjacent highway, a hardwood forest dominated by red maple (*Acer rubrum*) and birch (*Betula* sp.) provided an adequate riparian buffer. The SR01 sampling reach received a total habitat assessment score of 147/200 (Table A6).

*Benthos*

The SR01 benthos received a total metric score of 22, representing 65% comparability to the reference station NE09 (Table A5). Community composition—especially richness of sensitive taxa—was slightly less here than expected given the optimal epifaunal habitat available. A reduction in EPT taxa, and the displacement of these intolerant forms by the Chironomidae, led to metric score reductions that resulted in a "slightly impacted" bioassessment. It is unclear whether the reduced EPT index is the result of low dissolved oxygen levels—historically in violation of water quality standards in this portion of the river (MA DEP 1991)—or other forms of environmental stress. High scores (6) for taxa richness, biotic index, and scraper/filterer metrics suggest the SR01 community remains fairly balanced (i.e., not skewed toward a particular trophic group), and is not structured in response to serious organic enrichment.

### *Weir River*

The extensive drainage area of this subwatershed encompasses much of Hingham, as well as parts of Weymouth, Hull, and Cohasset. The Weir River flows through an area of multiple land uses—residential, commercial, recreational—as it heads northward towards its tidally influenced mouth and Hingham Bay. Urban NPS inputs originating in Hingham Center, as well as heavy water withdrawals throughout the subwatershed, pose the greatest threat to water quality and biological integrity in the Weir River.

**WR01—**Weir River, mile point 4.0, upstream from Route 228, Hingham, MA

*Habitat*

The WR01 sampling reach began immediately upstream from Route 228 in a fairly rural portion of Hingham and extended upstream for 100 m. Riffle areas were somewhat limited, restricted to the top and bottom portions of the reach. Rocky substrates were abundant yet small, consisting mostly of small-sized cobble and pebble. Sand and gravel comprised about half of the reach. Dense beds of aquatic vegetation—most notably pondweed (*Potamogeton* sp.), smart weed (*Polygonum* sp.), and mosses provided additional microhabitat for macroinvertebrates; however, epifaunal habitat was considered less than optimal. Fish habitat was worse, with instream vegetation and overhanging shrubs providing the only cover. Considerable instream sediment deposition further compromised fish and macroinvertebrate habitat. Instream algal cover was minimal, consisting of a thin green film on rocky substrates and submerged logs; however, an abundance of filamentous green algae had been observed during reconnaissance activities here during the spring. Both banks were well-vegetated with wetland vegetation and shrubs, and only infrequent small areas of erosion were observed. Riparian vegetation was diverse and undisturbed, with a wooded area comprised of red maple (*Acer rubrum*), elm (*Ulmus rubra*), white ash (*Fraxinus americana*), and willow (*Salix* sp.) near the lower half of the right (east) bank giving way to shrubby layers of riverbank grape *(Vitis riparia*) and pasture. An unmowed field of purple loosestrife (*Lythrum salicaria*), rose (*Rosa* sp.), and grasses along the left (west) bank provided a good vegetative buffer from the adjacent road (Route 228). WR01 received a total habitat assessment score of 143/200 (Table A6).

*Benthos*

The WR01 benthos assemblage received a total metric score of 28, representing 82% comparability to reference conditions at NE09 and placing it just outside the "non-impacted" category for biological condition (Table A5). Taxa richness (24) and biotic index (5.14) were comparable to the reference community, while an EPT index of 6 was only slightly less (Table A5). Unlike most biomonitoring stations in the Boston Harbor watershed, the Weir River community was not dominated by the filter-feeding organisms often reflective of enriched conditions, as indicated by the high value for the scraper/filterer metric (Table A5). Rather, the presence of numerous feeding groups indicates balanced trophic structure and multiple food resources in this portion of the river. An abundance of fairly intolerant heptageniid mayflies and elmid beetles (e.g., *Stenelmis* sp.), both of which require well-oxygenated instream conditions, corroborates the importance of periphyton as a food resource at WR01.

The greatest threat to the resident benthic community at WR01 may be instream sedimentation. Sand and other fine sediments drastically reduce macroinvertebrate microhabitat by filling the interstitial spaces of epifaunal substrates. In addition, the filling of pools with sediment reduces fish cover and may be detrimental to fish egg incubation.

## SUMMARY/RECOMMENDATIONS

**Hawes Brook (NE09)—**Upstream impoundments clearly influence trophic structure of the NE09 benthos assemblage, as well as community composition of the resident fish community. And while the benthic community at this reference station appeared relatively healthy, habitat degradation poses a serious threat to biological integrity in this portion of Hawes 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. 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.

**Traphole Brook (5B01)—**Both the macroinvertebrate and fish communities were dominated by highly sensitive taxa, reflecting overall excellent biological integrity and good water quality in this portion of Traphole Brook. Every effort should be made to maintain the diverse benthic community and cold-water fishery found here. Maintaining current baseflow as well as instream and riparian habitat is essential, and biomonitoring (macroinvertebrates and fish) is strongly recommended during the next "year 2 activities" for this basin**.**

**Massapoag Brook (9BOB)—**Despite the excellent instream and riparian habitat available here, the macroinvertebrate community was moderately impacted and indicative of enriched conditions. Nutrient/organic loadings originating from inadequate septic systems, or miscellaneous forms of urban runoff, probably contribute to the productive conditions of upstream impoundments that supply an abundant FPOM food resource to the 9BOB aquatic community. Outreach on septic system maintenance in concert with investigation of septic systems in this subwatershed should be conducted. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP watershed survey in 2004.

**Beaver Brook (BB01)—**Though the BB01 macroinvertebrate community was only minimally impaired, the presence of potential "low-flow" indicator species, as well as a suppressed fish population despite the excellent fish habitat, suggest that occasional periods of reduced baseflow may compromise biological potential in this stream. The presence of highly intolerant forms of fish and invertebrates suggests that factors (e.g., water quantity) other than water quality may most influence biological integrity here. Additional fish community and macroinvertebrate sampling should be conducted here during the next "year 2" phase of the "basin cycle" for this subwatershed. Monitoring physico-chemical parameters such as dissolved oxygen and pH may aid in the interpretation of future biomonitoring data collected here.

**Beaver Meadow Brook (BM01)—**Upstream impoundments no doubt are a contributing source of FPOM to the BM01 macroinvertebrate community, and probably have a more significant influence on fish and benthic community structure than do fluctuating baseflow levels in this portion of Beaver Meadow Brook.

It is unclear the extent that current water quality conditions in the upstream impoundments may affect instream turbidity at BM01; however, other potential sources (e.g., runoff from nearby roads, parking lots, and numerous gravel pits) no doubt exist in this subwatershed and should be investigated. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP watershed survey in 2004.

**Mill Brook (MB01)—**It appears that habitat is almost certainly limiting biological potential at MB01. Instream habitat constraints related to reduced baseflow (e.g., exposed/unavailable substrates and fish cover, lack of pools, shallow riffles), in particular, appear to compromise biological integrity in this portion of Mill Brook. Numerous macroinvertebrate taxa thought to display adaptations to reduced flow were observed at MB01. The presence of a cold-water salmonid fishery, as well as other sensitive fish species suggest that water quality here is generally good. Environmental impacts due to reduced flow, and changes in water quality (elevated temperatures) from water supply well withdrawals in a small subwatershed such as Mine/Mill Brook, combined with increases in residential developments, and an out-of-basin transfer of the wastewater via the sewer system, may very well be manifested by changes in the aquatic environment. It is strongly recommended that strict water conservation measures be employed by the communities in the Mine/Mill Brook system. In addition, outreach efforts should be aimed at consumers to make them aware of the environmental consequences of ever-increasing demands for water, and of measures that can be taken to alleviate existing adverse effects on limited water supplies.

In addition, instream deposition threatens biological integrity at MB01 as well. Sediment inputs—which can be detrimental to trout spawning habitat and epifaunal benthos habitat, and that most likely originate from the Millbrook Road crossing—should be minimized here. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP watershed survey in 2004.

**East Branch Neponset River (NE12)**—Highly productive upstream impoundments, which deliver warm FPOM-rich water to the aquatic community at NE12, strongly influence fish and macroinvertebrate community structure and function here. Despite the reduced riparian buffer on either side of the river, water quality rather than habitat quality is probably most limiting to biological integrity in this portion of the Neponset River. Water quality impairment in upstream impoundments, particularly Bolivar and Forge ponds, will need to be addressed before improvements in biological conditions of downstream lotic communities are to be realized. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP watershed survey in 2004.

**Pequit Brook (PB01)**—The large reservoir upstream appears to influence community structure of the PB01 fish population more than the resident benthos. The benthic community here was “non-impacted,” although the dominance of *Micropsectra* sp. may indicate occasional baseflow reductions. Likewise, a fairly suppressed fish community and lack of reproducing pond species—despite the excellent habitat available during the sampling period—suggest periodic flow interruption. While occasional low baseflow in this stream may be naturally-occurring (i.e., there are no known water withdrawals in this subwatershed), an investigation of water release practices in Reservoir Pond may be warranted. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP watershed survey in 2004.

**Unnamed tributary to Steep Hill Brook (SB01)**—Numerous upstream impoundments—including the highly productive Town Pond, documented as eutrophic due to nuisance and non-native vegetation (MA DEP 1995)—probably deliver the high densities of organic particulates that shape community structure and function at SB01. While water quality rather than habitat quality appears most limiting to biological potential in this portion of the stream, the extent that water quality degradation at SB01 and its effects on biological integrity may be exacerbated by occasional periods of reduced baseflow is unknown. The dumping of trash along the left (west) bank should be discouraged. Biomonitoring (macroinvertebrates and fish) is recommended here during the next DEP watershed survey in 2004.

**Aberjona River (AR01)**—As this is a highly urbanized subwatershed, it is not surprising that the AR01 benthic community is structured in response to organic enrichment and nutrient loadings. While it will be difficult to eliminate or isolate sources of urban runoff (stormwater, road runoff, illicit sewer connections) that most impact biological integrity in the Aberjona River, streambank stabilization and restoration of an adequate riparian buffer may help to alleviate the effects of some NPS inputs to this portion of the river.

**Mill Brook (MI01**)—Habitat degradation in the form of sediment deposition, riparian vegetation removal, and substrate exposure due to low baseflow—coupled with water quality degradation from organic loadings—compromise biological integrity at MI01. The culverting of segments of this stream, and the highly urbanized nature of this subwatershed, make elimination and/or isolation of urban inputs problematic. However, streambank stabilization and restoration of a riparian buffer would help to reduce the effects of road and parking lot runoff in this portion of Mill Brook.

**Monatiquot River (MR01)—**Eutrophication of upstream impoundments, as well as direct nutrient/organic loadings to the Monatiquot River itself probably account for the organically enriched conditions reflected in the aquatic community at MR01. In addition to water quality constraints, habitat degradation (especially riparian) probably compromises biological integrity at MR01 as well—though to a lesser degree. A site visit to the construction/excavating company adjacent to the MR01 reach is recommended to determine the extent that the property is a source (though other upstream sources no doubt exist) of sediment inputs to this portion of the river. Improvements to the riparian zone along the left bank of the reach would be beneficial as well. A stream clean-up effort would address the trash that apparently enters the river from the Middle Street crossing.

**Old Swamp River (SR01)**—Impairment to the SR01 benthic community appears to be the result of water quality degradation rather than habitat limitations. In addition, water quality effects may be exacerbated by periodic water withdrawal-induced flow reductions, although evidence of habitat constraints (e.g., exposed epifaunal substrates) resulting from reduced baseflow was not observed during the time of sampling. Septic system failures and sewer overflows are a perceived threat to water quality, while riparian disturbances and streambank erosion in the vicinity of Pleasant Street may deliver sediment loads to this portion of the river. Biomonitoring is recommended here during the next DEP watershed survey in 2004. Fish population sampling, which has not historically been done by DEP in this subwatershed, should accompany the macroinvertebrate sampling effort.

**Weir River (WR01)**—Although the resident biota at WR01 appear only minimally impacted at most, instream deposition threatens biological integrity in this portion of the river. Origins of sedimentation are unknown; however, upstream road crossings and other potential sources of sediment inputs should be investigated. BMP implementation or more efficient street sweeping practices in the vicinity of Hingham Center may reduce sediment loads to this portion of the Weir River. Biomonitoring is recommended here during the next DEP watershed survey in 2004. Fish population sampling, which has not historically been performed by DEP in this subwatershed, should accompany the macroinvertebrate sampling effort.

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APPENDIX

## Macroinveretebrate taxa list, RBPIII analyses, and Habitat evaluations

Table A1. Species-level taxa list and counts, functional feeding groups (FFG), and tolerance values (TV) for macroinvertebrates collected from stream sites in the Boston Harbor watershed between 6 and 9 July 1999. Refer to Table 1 for a complete listing and description of sampling stations.

| TAXON | FFG | TV | 5B01 | 9BOB | AR01 | BB01 | BM01 | MB01 | MI01 | MR01 | NE09 | NE12 | PB01 | SB01 | SR01 | WR01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ferrissia* sp. | SC | 6 | | | | 1 | | | | | | | | | | |
| *Gyraulus parvus* | SC | 8 | | | | | | | | | | 1 | | | | |
| *Laevapex fuscus* | SC | 7 | | | | | | | | | | | | | | 2 |
| Physidae | GC | 8 | | | 1 | 1 | | | | | | 3 | | 1 | | |
| Pisidiidae | FC | 6 | | | 8 | 1 | | | | 1 | 4 | 4 | 2 | 1 | | 2 |
| Lumbricina | GC | 8 | | | | | | | 1 | | | | | | | |
| Enchytraeidae | GC | 10 | 1 | | | | | | 6 | | | | | | | |
| *Nais behningi* | GC | 6 | 1 | | | | | | | | | | | | | |
| *Nais communis* | GC | 8 | | | | | 2 | | 18 | | | | 1 | | | |
| *Nais elinguis* | GC | 10 | | | 3 | | | | 1 | | | | | | | |
| *Nais simplex* | GC | 6 | | | | | | | 2 | | | | | | | |
| *Nais variabilis* | GC | 10 | | | | | | | 8 | | | | | | | |
| *Pristinella osborni* | GC | 10 | | | | | | | 2 | | | | | | | |
| Tubificidae IWB | GC | 10 | | | 5 | | | | | | | | | | | |
| Tubificidae IWH | GC | 10 | | | | | | | 1 | | | | | | | |
| *Lumbriculus variegatus* | GC | 5 | 7 | | | 1 | 3 | 1 | | 3 | 4 | | 10 | | 11 | 2 |
| Glossiphoniidae | PR | 7 | | | | | | | | | | | | | | 1 |
| *Caecidotea communis* | GC | 8 | | | | | 1 | | | 1 | | | 1 | | 2 | 2 |
| *Crangonyx* sp. | GC | 6 | | | 1 | | | | | | | | | | | 1 |
| *Gammarus* sp. | GC | 6 | | | 14 | 7 | 4 | | 1 | 4 | | 2 | 3 | 2 | 22 | 12 |
| Hydrachnidia | PR | 6 | | | | 1 | | 1 | | | 1 | 3 | 1 | | 2 | 1 |
| Baetidae | GC | 4 | | | | | | | | | | | | 1 | | |
| Baetidae (short terminal filament) | GC | 6 | 7 | | | | | | | | | | | | | |
| Baetidae (subequal terminal filament) | GC | 6 | | | | | | | | | | | | 2 | | |
| Heptageniidae | SC | 4 | | 4 | | | 1 | 2 | | | 3 | 1 | 8 | | | 12 |
| Leptophlebiidae | GC | 2 | | | | 1 | | | | | | | | | | |
| *Stenonema* sp. | SC | 3 | | | | | | 1 | | | | | 3 | | | 1 |
| Coenagrionidae | PR | 9 | | | | 1 | | | | | | | | 1 | | |
| *Isoperla* sp. | PR | 2 | 1 | | | | | | | | | | | | | |
| *Leuctra* sp. | SH | 0 | 38 | | | | | | | | | | | | | |
| *Paragnetina* sp. | PR | 1 | | | | 7 | | | | | | | | | | |
| Peltoperlidae | SH | 0 | 5 | | | | | | | | | | | | | |
| *Perlesta placida* | PR | 5 | | | | | | | | | | | 2 | | | 1 |
| Plecoptera | GC | 3 | | 1 | | | | | | | | | | 2 | | |
| *Nigronia* sp. | PR | 0 | 1 | 2 | | 2 | 1 | 1 | | | 2 | | 3 | 4 | 1 | |
| *Cheumatopsyche* sp. | FC | 5 | | 14 | 23 | 3 | 16 | 2 | | 23 | 24 | 12 | 6 | 25 | 7 | 7 |
| *Chimarra* sp. | FC | 4 | | 30 | | 11 | 27 | 1 | | 12 | 15 | 9 | 6 | 13 | 11 | 2 |
| *Dolophilodes* sp. | FC | 0 | 4 | | | | | | | | | | | | | |
| *Glossosoma* sp. | SC | 0 | | | | 1 | 1 | | | | 2 | | | | 2 | |
| *Hydropsyche betteni* gr. | FC | 6 | | 34 | 39 | | 11 | 9 | | 43 | 15 | 36 | 7 | 10 | 7 | 7 |
| *Hydropsyche morosa* gr. | FC | 6 | 11 | | | 5 | 3 | | | | 8 | | | | | |
| *Hydropsyche* sp. | FC | 4 | | | | | 1 | | | | | | | | | |
| Hydropsychidae | FC | 4 | | | | 4 | 5 | 11 | | | | | 3 | 10 | | 7 |
| *Neophylax* sp. | SC | 3 | | | | | | | | | | | 1 | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Oecetis* sp. | PR | 5 | | | | | | | | | 4 | | | | | |
| *Phylocentropus* sp. | FC | 5 | | | | | | | | | | | | | | 1 |
| *Pycnopsyche* sp. | SH | 4 | | | | | | | | | | | 1 | | | |
| *Macronychus glabratus* | SH | 5 | | | | | | | | | | | 1 | | | |
| *Optioservus* sp. | SC | 4 | 6 | | | 1 | | | | | | | | | 1 | 1 |
| *Oulimnius latiusculus* | SC | 4 | 7 | | | | | 6 | | | | | | 1 | 1 | |
| *Promoresia* sp. | SC | 2 | | | | 11 | | | | | | | | | | |
| *Promoresia tardella* | SC | 2 | 8 | | | 2 | | | | | | | | | | |
| *Psephenus herricki* | SC | 4 | | | | | | | | | | | | | | 5 |
| *Stenelmis crenata* | SC | 5 | | | | | | 1 | | | | | | | | |
| *Stenelmis* sp. | SC | 5 | | | | 1 | 4 | 1 | | | 3 | | 8 | | 1 | 18 |
| *Brillia* sp. | SH | 5 | | | | | | | 2 | | | | | | | |
| *Chelifera* sp. | PR | 6 | 1 | | | | | 2 | 2 | | | | 2 | | | |
| Chironomini | GC | 6 | | | | | | 1 | | | | | | | | |
| *Chironomus* sp. | GC | 10 | | | | | | | 3 | | | | | | | |
| *Cladotanytarsus* sp. | FC | 5 | | | | | | | | | | | | | | 2 |
| *Conchapelopia* sp. | PR | 6 | | | 1 | | 1 | 4 | 6 | 3 | | | 1 | 2 | 3 | 3 |
| *Corynoneura* sp. | GC | 4 | | | | | | | | | | | | | 1 | |
| *Cricotopus annulator* | SH | 7 | | | 1 | | | | 1 | | | | | | | |
| *Cricotopus bicinctus* | GC | 7 | | | | | | | 1 | | | | | | | |
| *Cricotopus intersectus* gr. | SH | 7 | | | | | | | 1 | | | | | | | |
| *Cricotopus* sp. | SH | 7 | | | | | | | | | | | 1 | | | |
| *Cricotopus/Orthocladius* sp. | GC | 7 | | | | | | | 1 | | | | | | | |
| *Cryptochironomus* sp. | PR | 8 | | | | | | | | | | | | 1 | | |
| *Diamesa* sp. | GC | 5 | 1 | | | 1 | 3 | | 3 | | 3 | 1 | | 1 | 2 | |
| Diamesinae | GC | 2 | | | | | | | 1 | | | | | | | |
| *Dicranota* sp. | PR | 3 | 2 | | | 2 | | 1 | | | | | | | | |
| *Eukiefferiella devonica* gr. | GC | 4 | | | | | | 1 | | | | | | | 1 | |
| *Heleniella* sp. | GC | 5 | | | | | | | 1 | | | | | | | |
| *Hemerodromia* sp. | PR | 6 | | | 1 | | 1 | | 8 | 4 | 1 | | 1 | 1 | | |
| *Krenopelopia* sp. | PR | 7 | | | | 2 | | | | | | | | | | |
| *Larsia* sp. | PR | 7 | | | | | | 1 | | | | | | | | |
| *Meropelopia* sp. | PR | 6 | | | | 1 | | | | | | | | | | |
| *Micropsectra* sp. | GC | 7 | 1 | | | | | 15 | 21 | | | | | | | |
| *Micropsectra/Tanytarsus* sp. | FC | 7 | | | | | | | | | | | | | 1 | |
| *Microtendipes pedellus* gr. | FC | 6 | | | | 2 | | | | | | | | | | 4 |
| *Microtendipes rydalensis* gr. | FC | 6 | | | | 11 | | | | | | | | | | |
| *Microtendipes* sp. | FC | 5 | | | | | | | | | | | | 1 | | |
| *Nanocladius* sp. | GC | 7 | | | | | | | | | | 1 | | | | |
| Orthocladiinae | GC | 5 | | | | 1 | | | | | | | | | | |
| *Orthocladius* sp. | GC | 6 | | | | | | | 2 | | | 1 | | | | |
| *Paradelphomyia* sp. | PR | 5 | | | | | | 1 | | | | | | | | |
| *Parametriocnemus* sp. | GC | 5 | | | | 5 | 2 | 2 | | | 2 | | 18 | 6 | 5 | |
| *Phaenopsectra* sp. | SC | 7 | | | | | | | 1 | | | | | | | |
| *Polypedilum aviceps* | SH | 4 | | | | 6 | | 4 | | | | | | | | |
| *Polypedilum flavum* | SH | 6 | | 14 | | | 1 | | | | | 2 | 1 | 3 | | |
| *Polypedilum illinoense* | SH | 6 | | | | 2 | | | 1 | | | 2 | | | | |
| *Polypedilum laetum* | SH | 6 | | | | | | 3 | | | | | | | | |
| *Polypedilum scalaenum* | SH | 6 | | | 1 | | | | | | | | | | | |
| *Potthastia longimana* gr. | GC | 2 | | | | | | | | | | | | 1 | | |
| *Probezzia* sp. | PR | 6 | 1 | | | | | | | | | | | | | |
| *Rheopelopia* sp. | PR | 4 | | | | 2 | | | | | | | | | | |
| *Rheotanytarsus* | FC | 6 | 2 | | | | | 10 | | | | 2 | 3 | | 2 | 1 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Rheotanytarsus exiguus* gr. | FC | 6 | | 1 | | | 1 | 9 | | | 3 | 13 | 5 | 4 | 1 | |
| *Simulium* sp. | FC | 5 | | | | 1 | 2 | | | 2 | | | 1 | 1 | 1 | |
| *Simulium tuberosum* complex | FC | 4 | 2 | | | | | | | | 1 | | | | | |
| *Simulium venustum* complex | FC | 5 | | | | | | | | | | | | | | 1 |
| *Simulium vittatum* complex | FC | 9 | | | | | | | 9 | | | | | | | |
| *Stempellinella* sp. | GC | 2 | | | | | | 1 | | | | | | | | |
| *Symposiocladius lignicola* | SH | 5 | | 1 | | | | | | | | | | | | |
| *Tanytarsus* sp. | FC | 6 | | | | 4 | | 1 | 1 | 2 | | | | | | 1 |
| *Thienemannimyia* gr. | PR | 6 | | | | | | 1 | | | | | | | | |
| *Thienemannimyia* sp. | PR | 6 | | | 2 | | | | 5 | | | | | | 1 | |
| *Tipula* sp. | SH | 6 | | | | | | | | | | | | | 1 | |
| *Tribelos* sp. | GC | 7 | | | 1 | | | | | | | | | | | |
| *Tvetenia bavarica* gr. | GC | 5 | 3 | | | 2 | 7 | 7 | | | 1 | | 1 | 8 | 3 | |
| *Tvetenia* sp. | GC | 5 | | | | | | | | | | | | | | 1 |
| *Tvetenia vitracies* gr. | GC | 5 | | | | | | | | 1 | | | | | | 10 |
| *Xenochironomus* sp. | PR | 0 | | | | | | | | | | 1 | | | | |
| *Zavrelia* sp. | FC | 4 | | | | 2 | | | | | | | 1 | | | |
| **TOTAL** | | | **110** | **101** | **101** | **106** | **98** | **101** | **110** | **99** | **96** | **94** | **102** | **102** | **90** | **109** |

[1] Functional Feeding Group (FFG) 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 at stations in the Neponset River sub-basin between 6 and 8 July 1999. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (NE09), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

| STATION # | **NE09** | | **9BOB** | | **BB01** | | **BM01** | | **MB01** | | **NE12** | | **PB01** | | **SB01** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREAM | Hawes Brook | | Massapoag Brook | | Beaver Brook | | Beaver Meadow Brook | | Mill Brook | | E. Branch Neponset River | | Pequid Brook | | Steep Hill Brook tributary | |
| HABITAT SCORE | 131 | | 183 | | 179 | | 176 | | 143 | | 152 | | 181 | | 169 | |
| TAXA RICHNESS | 18 | *6* | 9 | *2* | 31 | *6* | 20 | *6* | 26 | *6* | 17 | *6* | 27 | *6* | 22 | *6* |
| BIOTIC INDEX | 4.93 | *6* | 5.03 | *6* | 4.35 | *6* | 4.87 | *6* | 5.36 | *6* | 5.68 | *6* | 4.92 | *6* | 4.83 | *6* |
| EPT INDEX | 7 | *6* | 5 | *2* | 6 | *4* | 6 | *4* | 5 | *2* | 4 | *0* | 7 | *6* | 5 | *2* |
| EPT/CHIRONOMIDAE | 7.89 | *6* | 5.19 | *4* | 0.78 | *0* | 4.33 | *4* | 0.43 | *0* | 2.52 | *2* | 1.19 | *0* | 2.33 | *2* |
| SCRAPERS/FILTERERS | 0.11 | *6* | 0.05 | *4* | 0.39 | *6* | 0.09 | *6* | 0.26 | *6* | 0.03 | *2* | 0.59 | *6* | 0.02 | *0* |
| % DOMINANT TAXON | 25% | *4* | 34% | *2* | 10% | *6* | 28% | *4* | 15% | *6* | 38% | *2* | 18% | *6* | 25% | *4* |
| TOTAL METRIC SCORE | | *34* | | *20* | | *28* | | *30* | | *26* | | *18* | | *30* | | *20* |
| % COMPARABILITY TO REFERENCE STATION | | | 59% | | 82% | | 88% | | 76% | | 53% | | 88% | | 59% | |
| BIOLOGICAL CONDITION -DEGREE IMPAIRMENT | **REFERENCE** | | **SLIGHTLY IMPACTED** | | **NON/ SLIGHTLY IMPACTED** | | **NON-IMPACTED** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY/** MODERATELY **IMPACTED** | | **NON-IMPACTED** | | **SLIGHTLY IMPACTED** | |

Table A3. Summary of RBP III data analysis for macroinvertebrate communities sampled at stations in the Neponset Rive sub-basin between 6 and 8 July 1999. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (5B01), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

| STATION # | **5B01** | | **BB01** | | **BM01** | | **MB01** | | **PB01** | | **SB01** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREAM | Traphole Brook | | Beaver Brook | | Beaver Meadow Brook | | Mill Brook | | Pequid Brook | | Steep Hill Brook tributary | |
| HABITAT SCORE | 168 | | 179 | | 176 | | 143 | | 181 | | 169 | |
| TAXA RICHNESS | 21 | *6* | 31 | *6* | 20 | *6* | 26 | *6* | 27 | *6* | 22 | *6* |
| BIOTIC INDEX | 2.67 | *6* | 4.35 | *2* | 4.87 | *2* | 5.36 | *2* | 4.92 | *2* | 4.83 | *2* |
| EPT INDEX | 6 | *6* | 6 | *6* | 6 | *6* | 5 | *4* | 7 | *6* | 5 | *4* |
| EPT/CHIRONOMIDAE | 9.43 | *6* | 0.78 | *0* | 4.33 | *2* | 0.43 | *0* | 1.19 | *0* | 2.33 | *2* |
| SCRAPERS/FILTERERS | 1.11 | *6* | 0.39 | *4* | 0.09 | *0* | 0.26 | *2* | 0.59 | *6* | 0.02 | *0* |
| % DOMINANT TAXON | 35% | *2* | 10% | *6* | 28% | *4* | 15% | *6* | 18% | *6* | 25% | *4* |
| TOTAL METRIC SCORE | | *32* | | *24* | | *20* | | *20* | | *26* | | *18* |
| % COMPARABILITY TO REFERENCE STATION | | | 75% | | 63% | | 63% | | 81% | | 56% | |
| BIOLOGICAL CONDITION -DEGREE IMPAIRMENT | **REFERENCE** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | | **NON/ SLIGHTLY IMPACTED** | | **SLIGHTLY IMPACTED** | |

Table A4. Summary of RBP III data analysis for macroinvertebrate communities sampled at stations in the Mystic River sub-basin on 9 July 1999. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (NE09), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

| STATION # | **NE09** | | **AR01** | | **MI01** | |
|---|---|---|---|---|---|---|
| STREAM | Hawes Brook | | Aberjona River | | Mill Brook | |
| HABITAT SCORE | 131 | | 132 | | 99 | |
| TAXA RICHNESS | 18 | *6* | 14 | *4* | 25 | *6* |
| BIOTIC INDEX | 4.93 | *6* | 6.13 | *4* | 7.50 | *2* |
| EPT INDEX | 7 | *6* | 2 | *0* | 0 | *0* |
| EPT/CHIRONOMIDAE | 7.89 | *6* | 10.33 | *6* | 0.00 | *0* |
| SCRAPERS/FILTERERS | 0.11 | *6* | 0.00 | *0* | 0.10 | *6* |
| % DOMINANT TAXON | 25% | *4* | 39% | *2* | 19% | *6* |
| TOTAL METRIC SCORE | | *34* | | *16* | | *20* |
| % COMPARABILITY TO REFERENCE STATION | | | 47% | | 59% | |
| BIOLOGICAL CONDITION -DEGREE IMPAIRMENT | **REFERENCE** | | **MODERATELY IMPACTED** | | **SLIGHTLY IMPACTED** | |

Table A5. Summary of RBP III data analysis for macroinvertebrate communities sampled at stations in the Weymouth/Weir River sub-basin on 8 July 1999. Shown are the calculated metric values, metric scores (in italics) based on comparability to the reference station (NE09), and the corresponding assessment designation for each biomonitoring station. Refer to Table 1 for a complete listing and description of sampling stations.

| STATION # | **NE09** | | **MR01** | | **SR01** | | **WR01** | |
|---|---|---|---|---|---|---|---|---|
| STREAM | Hawes Brook | | Monatiquot River | | Old Swamp River | | Weir River | |
| HABITAT SCORE | 131 | | 128 | | 147 | | 143 | |
| TAXA RICHNESS | 18 | *6* | 12 | *4* | 24 | *6* | 24 | *6* |
| BIOTIC INDEX | 4.93 | *6* | 5.48 | *6* | 5.19 | *6* | 5.14 | *6* |
| EPT INDEX | 7 | *6* | 3 | *0* | 4 | *0* | 6 | *4* |
| EPT/CHIRONOMIDAE | 7.89 | *6* | 13.00 | *6* | 1.35 | *0* | 1.73 | *0* |
| SCRAPERS/FILTERERS | 0.11 | *6* | 0 | *0* | 0.17 | *6* | 1.11 | *6* |
| % DOMINANT TAXON | 25% | *4* | 43% | *0* | 24% | *4* | 17% | *6* |
| TOTAL METRIC SCORE | | *34* | | *16* | | *22* | | *28* |
| % COMPARABILITY TO REFERENCE STATION | | | 47% | | 65% | | 82% | |
| BIOLOGICAL CONDITION -DEGREE IMPAIRMENT | **REFERENCE** | | **MODERATELY IMPACTED** | | **SLIGHTLY IMPACTED** | | **NON/ SLIGHTLY IMPACTED** | |

Table A6. Habitat assessment summary for macroinvertebrate biomonitoring stations sampled during the 1999 Boston Harbor 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 | NE09 | 5B01 | BB01 | BM01 | MB01 | NE12 | PB01 | SB01 | 9BOB | AR01 | MI01 | MR01 | SR01 | WR01 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRIMARY PARAMETERS (range is 0-20)** | | | | | | | | | | | | | | |
| INSTREAM COVER | 11 | 14 | 14 | 18 | 5 | 17 | 18 | 18 | 17 | 13 | 2 | 10 | 7 | 8 |
| EPIFAUNAL SUBSTRATE | 19 | 19 | 18 | 18 | 11 | 17 | 19 | 19 | 19 | 18 | 16 | 18 | 16 | 13 |
| EMBEDDEDNESS | 13 | 19 | 20 | 19 | 19 | 19 | 18 | 19 | 20 | 19 | 15 | 18 | 17 | 17 |
| CHANNEL ALTERATION | 13 | 19 | 19 | 13 | 19 | 10 | 20 | 13 | 18 | 14 | 14 | 7 | 16 | 16 |
| SEDIMENT DEPOSITION | 17 | 19 | 19 | 17 | 14 | 19 | 18 | 16 | 20 | 7 | 7 | 15 | 14 | 7 |
| VELOCITY-DEPTH COMBINATIONS | 9 | 9 | 10 | 17 | 7 | 16 | 11 | 17 | 15 | 13 | 8 | 10 | 8 | 8 |
| CHANNEL FLOW STATUS | 16 | 16 | 19 | 17 | 8 | 19 | 18 | 16 | 17 | 17 | 5 | 14 | 19 | 19 |
| **SECONDARY PARAMETERS (range is 0-10 for each bank)** | | | | | | | | | | | | | | |
| BANK VEGETATIVE PROTECTION | 9<br>8 | 10<br>8 | 10<br>10 | 9<br>10 | 10<br>10 | 9<br>10 | 10<br>10 | 9<br>10 | 9<br>10 | 8<br>8 | 10<br>6 | 6<br>10 | 10<br>10 | 10<br>10 |
| BANK STABILITY | 7<br>7 | 10<br>8 | 10<br>10 | 9<br>9 | 10<br>10 | 8<br>4 | 10<br>10 | 6<br>10 | 9<br>10 | 7<br>6 | 9<br>5 | 7<br>8 | 8<br>8 | 8<br>9 |
| RIPARIAN VEGETATIVE ZONE WIDTH | 1<br>1 | 10<br>7 | 10<br>10 | 10<br>10 | 10<br>10 | 1<br>3 | 9<br>10 | 6<br>10 | 9<br>10 | 1<br>1 | 1<br>1 | 1<br>4 | 7<br>7 | 9<br>9 |
| **TOTAL SCORE** | **131** | **168** | **179** | **176** | **143** | **152** | **181** | **169** | **183** | **132** | **99** | **128** | **147** | **143** |

Table A7. Fish population data collected by DWM at nine biomonitoring stations in the Neponset River sub-basin between 27 and 29 July 1999. Sampling stations were at: Hawes Brook (NE09); Traphole Brook (5B01); Massapoag Brook (9BOB); Beaver Brook (BB01); Beaver Meadow Brook (BM01); Mill Brook (MB01); East Branch Neponset River (NE12); Pequit Brook (PB01); and the unnamed tributary to Steep Hill Brook (SB01). Young-of-the-year fish are noted in parentheses. Refer to Table 1 for a complete listing and description of sampling stations.

| TAXON | | NE09 | 5B01 | 9BOB | BB01 | BM01 | MB01 | NE12 | PB01 | SB01 |
|---|---|---|---|---|---|---|---|---|---|---|
| Salmonidae | | | | | | | | | | |
| brown trout | *Salmo trutta* | - | 14(33) | - | 1 | - | - | - | - | - |
| brook trout | *Salvelinus fontinalis* | - | 12(17) | - | - | - | 22 | - | - | - |
| Cyprinidae | | | | | | | | | | |
| spottail shiner | *Notropis hudsonius* | - | - | - | - | - | - | 1 | - | - |
| fallfish | *Semotilus corporalis* | 11(12) | - | 1 | - | 1 | - | 13 | - | - |
| golden shiner | *Notemigonus crysoleucas* | - | - | 1 | | 1 | | | | |
| Catostomidae | | | | | | | | | | |
| white sucker | *Catostomus commersoni* | (12) | - | 2 | (1) | (15) | - | - | (1) | (6) |
| Percidae | | | | | | | | | | |
| yellow perch | *Perca flavescens* | - | - | - | - | (1) | - | - | - | - |
| tesselated darter | *Etheostoma olmstedi* | - | - | - | - | 1 | 10 | - | - | - |
| Ictaluridae | | | | | | | | | | |
| yellow bullhead | *Ameiurus natalis* | - | - | - | - | - | - | 2 | - | - |
| brown bullhead | *Ameiurus nebulosus* | - | - | 12 | - | 1(72) | - | - | 2(2) | - |
| Anguillidae | | | | | | | | | | |
| American eel | *Anguilla rostrata* | 6 | - | 3 | - | 3 | - | 5(1) | (1) | 2 |
| Esocidae | | | | | | | | | | |
| chain pickerel | *Esox niger* | - | - | - | - | - | 4 | - | - | (1) |
| redfin pickerel | *Esox americanus* | - | - | - | 1 | 1 | 6(2) | - | 2(1) | - |
| Centrarchidae | | | | | | | | | | |
| largemouth bass | *Micropterus salmoides* | (15) | - | 1(2) | (1) | (8) | (1) | (2) | (19) | 1(7) |
| bluegill | *Lepomis macrochirus* | 2(1) | - | 11 | - | - | - | 3 | 2(1) | |
| pumpkinseed | *Lepomis gibbosus* | - | - | 8 | - | 2 | - | 1 | - | 4(15) |
| redbreast sunfish | *Lepomis auritis* | - | - | - | - | - | - | 5 | - | - |
| black crappie | *Pomoxis nigromaculatus* | - | - | - | - | - | - | 1(2) | (5) | - |

# APPENDIX D – DEP 1999 GRANT AND LOAN PROGRAMS

Excerpted from the 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. 604(b) projects in the Boston Harbor Watershed include:

- 98-01/604 *Urban Watershed Management in the Mystic River Basin.* The project will provide recommendations for reducing pollutant runoff into Spy Pond based on a detailed analysis of land cover in watershed. Baseline water quality information, data gaps, and nonpoint source issues will be identified in the Horn Pond watershed. Dry and wet weather water quality sampling will be conducted in Horn Pond watershed. A detailed assessment of the drainage area that contributes runoff for the one large stormwater outfall in Horn Pond will be conducted. Recommendations will be provided to improve stormwater management in the Horn Pond watershed including opportunities for stormwater remediation and future grant funding.

**104(b) (3) WETLANDS AND WATER QUALITY GRANT PROGRAM**
This grant program is authorized under the wetlands and Clean Water Act Section 104(b)(3) of the federal Clean Water Act. The water quality proposals received by 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) cleanup waste sites. 104 (b) (3) grants in the Boston Harbor watershed include:

- 98-04/104 *Prioritizing Stormwater Enforcement Efforts; A Multi-Watershed Study.* Stormwater is believed to the most significant cause of water quality standard violations. In this study, stormwater will be sampled and analyzed for Fecal coliform and total coliform as well as four other indicators (E. Coli, Enterococci, clostridium perfringens and coliphages) in three watersheds; Charles, Merrimack and Neponset. The four indicators will be used to confirm that the source of high fecal coliform levels is not plant or soil related.

## 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; address activities that are identified in the Massachusetts NPS Management Program Plan.

- 98-07/319 *Reducing Stormwater in Ultra-Urban Watershed.* The overall objective of this project is to improve the water quality of Alewife Brook by treating and reducing stormwater discharges and developing recommendations for meeting stormwater goals in an ultra urban watershed. Elimination of combined sewer overflows (CSOs) to Alewife Brook is currently being completed. Modeling done by the MWRA has predicted that even with the elimination of the CSOs Alewife Brook will not meet Class B water quality standards due to storm water discharges.
- 99-05/319 *Telecom city.* The project is part of a larger effort to redevelop a 200+ acre Brownfield site along the Malden River where the cities of Malden, Medford and Everett meet. The focus of this project is to migrate stormwater impacts to banks, buffers and surface water quality within the Malden River Corridor by implementing stormwater BMP's, and to develop data on the effectiveness of those BMP's at a difficult urban redevelopment site. The proponent's goal is to put the "environmental portion" of the larger redevelopment project, such as public recreational open space, stormwater

controls and wetlands rehabilitation, in place before the proposed industrial redevelopment of the site begins and overrides environmental concerns.

- 01-06/319 *Memorial Pond Phase I Restoration.* (Neponset)
  The project is the first phase of a larger plan to rehabilitate Memorial Pond in Walpole. Storm water BMPs (sediment forebays followed by constructed wetlands or extended swales/detention ponds) will be built at two storm water discharges (Stone Street and East & Diamond Streets) that were identified in *Memorial Pond Investigation and Management Plan* (1999) as major sources of sediments and nutrients to the Pond. This will result in measurable reduction in sediment and nutrient loading to Memorial Pond prior to undertaking a planned dredging project to remove sediments and nuisance aquatic vegetation in the pond. Nonpoint source pollutant inputs will be addressed first to help ensure that repeated dredging is not required. The outlet to the pond will also be rebuilt to allow future drawdowns needed to control nuisance aquatic vegetation.
- 01-24/319 Storm *water Residuals Reuse Demonstration*
  Storm water runoff is negatively impacting the natural and recreational resources at Wollaston Beach. Chronic bacteria problems cause frequent swimming advisories and have a negative impact on surrounding marsh areas. Storm water from eight outfalls discharge directly onto Wollaston Beach. The City has developed a five-year capital plan to restore water quality at Wollaston Beach. The plan includes eliminating sources of pollution by upgrading sewer and storm drains. The project seeks to obtain a Beneficial Use Determination (BUD) for catch basin residuals. Disposal of catch basin residuals is a statewide problem that will grow more serious with the onset of Phase II Storm water requirements, and development of a BUD is seen as the first step toward solving the problem on a statewide basis. Anticipated results include development of guidelines for other cities and towns seeking to use a similar strategy for disposal of this material. Ideally, the quality of catch basin residuals can be related to land use surrounding the catch basin, enabling development of a set of standard land use-based protocols.

## MASSACHSUETTS WATERSHED INITIATIVE PROJECT

- 99-02/MWI *Boston Harbor Hydrologic and Water Quality Investigations.* The purpose of this project is to conduct hydrologic investigations and water quality sampling in support of assessment activities of the Boston Harbor Watershed Team. The information collected will be used to assess water quality conditions in the Mystic, Neponset and Weymouth and Weir River Basins of the Boston Harbor Watershed.
- 00-07/MWI *Boston Harbor Hydrologic and Water Quality Investigations.* This project will conduct water quality, biological and hydrologic investigations at selected locations in the Neponset and Mystic Rivers.
- 02-01/MWI *Alewife Brook Action Plan*
  This project will catalog information to assess water quality conditions in and near Alewife Brook and downstream impacts to the Mystic River and prepare an Action Plan that prioritizes issues and concerns and sets forth a schedule for action.
- 02-02/MWI *Boston Harbor Water Quality Monitoring*
  This project will conduct water quality monitoring in the Boston Harbor Watershed to assess water quality conditions and designated uses.

## 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.

- 99-04/SWT *Aaron Reservoir & Lily Pond Source Water Protection Project.* This project will develop a Surface Water Supply Protection Plan to protect the Aaron River Reservoir and Lily Pond watersheds. Lily Pond is a sole source supply of drinking water for Cohasset and serves over 7,000 residents. The development and implementation of this protection plan will significantly enhance the protection of the pond by providing full understanding of the sources and pathways of contamination, and provide a strategy to effectively prevent them from contaminating the water supply.

- 99-06/SWT *Cambridge Watershed Protection Business Partnership Development.* This project will inventory businesses in the Waltham area as well as the existing storm water structures; determine the amount of impervious area on the business' properties; and conduct educational programs detailing inexpensive storm water pollution prevention measures that could be applied to help protect.

## 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.

- One of Stoughton's largest water supplies is also closest to the industrial area of the town and may be threatened by contaminated groundwater. Numerous monitoring wells have already been installed in the area where possible sources of contamination may exist. This project will expand the monitoring program through the installation of additional monitoring wells to better understand the groundwater flow and to better evaluate the risk of the well becoming contaminated.

**99-04/WRBP Mill Brook Wetlands Restoration in the Mystic River Subwatershed**

**Drinking Water State Revolving Loan Fund** for Horn Pond Water Treatment Plant in the Mystic River Subwatershed—construction of a new 6.0 MGD water treatment plant which will include chemical storage and feed facilities to treat Horn Pond Wellfield

**Drinking Water State Revolving Loan Fund** for Broadway Treatment upgrade

**Clean Water State Revolving Loan Fund**—rehab of 72" stormwater outfall and construction of new outfall (K. Brander)

# APPENDIX E - DMF SHELLFISH DATA, BOSTON HARBOR WATERSHED

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). Shellfish growing area classifications by subwatershed are provided in Tables E3-E6. Designated shellfish growing areas (as of October 2000) may be viewed using the MassGIS datalayer available from MassGIS at http://www.state.ma.us/mgis/dsga.htm.

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 Boston Harbor Watershed 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 59,933.54 acres in the Boston Harbor Watershed (Table E2).

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

| Classification Type | Area (acres) |
|---|---|
| Approved | 1.887 |
| Conditionally Restricted | 2502.14 |
| Management Closure | 12870.147 |
| Prohibited | 44559.36 |

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

| Town | Classification Area Code | Classification Type | Area (Acres) |
|---|---|---|---|
| Boston | GBH4.0 | Prohibited | 1027.15 |
| Boston | GBH5.0 | Prohibited | 1128.711 |
| Boston | GBH5.10 | Prohibited | 12.012 |
| Boston | GBH5.11 | Prohibited | 42.108 |
| Boston | GBH5.2 | Conditionally Restricted | 99.9 |
| Boston | GBH5.3 | Conditionally Restricted | 105.987 |
| Boston | GBH5.4 | Conditionally Restricted | 70.179 |
| Boston | GBH5.6 | Prohibited | 14.968 |
| Boston | GBH5.8 | Prohibited | 37.167 |
| Boston | GBH5.9 | Prohibited | 12.704 |
| Boston | GBH6.0 | Prohibited | 1038.58 |
| Boston | MB13.0 | Management Closure | 76.79 |
| Boston | N27.0 | Prohibited | 0.016 |
| Boston | N28.0 | Prohibited | 603.809 |
| Chelsea | GBH4.0 | Prohibited | 175.787 |
| Everett | GBH4.0 | Prohibited | 101.483 |
| Revere | GBH4.0 | Prohibited | 32.174 |
| Revere | GBH5.8 | Prohibited | 16.479 |
| Revere | N26.0 | Prohibited | 447.195 |
| Revere | N26.2 | Prohibited | 97.183 |
| Winthrop | GBH5.0 | Prohibited | 400.129 |
| Winthrop | GBH5.1 | Conditionally Restricted | 107.075 |
| Winthrop | GBH5.12 | Prohibited | 12.362 |
| Winthrop | GBH5.2 | Conditionally Restricted | 82.489 |
| Winthrop | GBH5.5 | Conditionally Restricted | 80.593 |
| Winthrop | GBH5.6 | Prohibited | 3.132 |
| Winthrop | GBH5.8 | Prohibited | 29.262 |
| Winthrop | N25.0 | Prohibited | 114.169 |
| Winthrop | N26.0 | Prohibited | 211.966 |
| Winthrop | N26.2 | Prohibited | 100.103 |
| Winthrop | N27.0 | Prohibited | 857.57 |

Table E4. Neponset River Subwatershed DMF - Shellfish Project Classification Area Information as of October 2000.

| Town | Classification Area Code | Classification Type | Area (Acres) |
|---|---|---|---|
| Boston | GBH3.0 | Prohibited | 189.045 |
| Boston | GBH3.3 | Prohibited | 1.656 |
| Boston | GBH3.4 | Prohibited | 49.735 |
| Milton | GBH3.0 | Prohibited | 99.322 |
| Quincy | GBH3.0 | Prohibited | 46.226 |
| Quincy | GBH3.3 | Prohibited | 10.876 |
| Quincy | GBH3.4 | Prohibited | 79.716 |

Table E5. Weymouth & Weir Subwatershed DMF - Shellfish Project Classification Area Information as of October 2000.

| Town | Classification Area Code | Classification Type | Area (Acres) |
|---|---|---|---|
| Boston | GBH2.0 | Prohibited | 78.417 |
| Boston | GBH3.0 | Prohibited | 492.07 |
| Boston | GBH6.0 | Prohibited | 99.361 |
| Boston | MB13.0 | Management Closure | 0.13 |
| Braintree | GBH1.0 | Prohibited | 44.537 |
| Braintree | GBH1.21 | Prohibited | 43.119 |
| Cohasset | MB9.0 | Approved | 1.567 |
| Cohasset | MB9.1 | Prohibited | 0.413 |
| Hingham | GBH1.0 | Prohibited | 1736.51 |
| Hingham | GBH1.11 | Conditionally Restricted | 51.659 |
| Hingham | GBH1.14 | Conditionally Restricted | 69.361 |
| Hingham | GBH1.15 | Prohibited | 22.566 |
| Hingham | GBH1.17 | Prohibited | 31.82 |
| Hingham | GBH1.19 | Prohibited | 33.667 |
| Hingham | GBH1.28 | Prohibited | 19.363 |
| Hingham | GBH1.29 | Conditionally Restricted | 0.001 |
| Hingham | GBH1.5 | Conditionally Restricted | 0.877 |
| Hingham | GBH1.6 | Prohibited | 33.39 |
| Hingham | GBH1.7 | Conditionally Restricted | 79.288 |
| Hingham | GBH1.8 | Conditionally Restricted | 325.11 |
| Hingham | GBH1.9 | Conditionally Restricted | 51.615 |
| Hull | GBH1.0 | Prohibited | 2159.914 |
| Hull | GBH1.1 | Conditionally Restricted | 53.026 |
| Hull | GBH1.17 | Prohibited | 0.091 |
| Hull | GBH1.2 | Conditionally Restricted | 119.913 |
| Hull | GBH1.3 | Conditionally Restricted | 99.988 |
| Hull | GBH1.4 | Conditionally Restricted | 22.777 |
| Hull | GBH1.5 | Conditionally Restricted | 76.811 |
| Hull | GBH1.6 | Prohibited | 35.433 |
| Hull | GBH1.7 | Conditionally Restricted | 0.007 |
| Hull | GBH2.0 | Prohibited | 897.525 |
| Hull | GBH6.0 | Prohibited | 920.485 |
| Hull | GBH6.1 | Prohibited | 83.67 |
| Hull | MB12.0 | Prohibited | 6199.622 |
| Hull | MB13.0 | Management Closure | 4088.56 |
| Hull | MB9.0 | Approved | 0.32 |
| Hull | MB9.1 | Prohibited | 0.008 |
| Quincy | GBH1.0 | Prohibited | 940.104 |
| Quincy | GBH1.22 | Prohibited | 20.97 |
| Quincy | GBH1.23 | Conditionally Restricted | 72.691 |
| Quincy | GBH1.24 | Prohibited | 10.37 |
| Quincy | GBH1.25 | Conditionally Restricted | 99.484 |
| Quincy | GBH1.26 | Conditionally Restricted | 71.695 |
| Quincy | GBH1.27 | Management Closure | 58.404 |
| Quincy | GBH1.31 | Conditionally Restricted | 2.957 |
| Quincy | GBH2.0 | Prohibited | 3605.944 |
| Quincy | GBH2.1 | Conditionally Restricted | 192.025 |
| Quincy | GBH2.2 | Conditionally Restricted | 120.257 |

Table E5. (Continued) Weymouth & Weir Subwatershed DMF - Shellfish Project Classification Area Information as of October 2000.

| Town | Classification Area Code | Classification Type | Area (Acres) |
|---|---|---|---|
| Quincy | GBH2.3 | Prohibited | 156.68 |
| Quincy | GBH2.4 | Prohibited | 89.597 |
| Quincy | GBH2.5 | Conditionally Restricted | 126.525 |
| Quincy | GBH2.6 | Prohibited | 17.465 |
| Quincy | GBH2.7 | Prohibited | 11.602 |
| Quincy | GBH3.0 | Prohibited | 518.54 |
| Quincy | GBH3.1 | Prohibited | 49.755 |
| Quincy | GBH3.2 | Conditionally Restricted | 79.276 |
| Weymouth | GBH1.0 | Prohibited | 1953.289 |
| Weymouth | GBH1.10 | Conditionally Restricted | 83.554 |
| Weymouth | GBH1.11 | Conditionally Restricted | 0.028 |
| Weymouth | GBH1.13 | Conditionally Restricted | 74.279 |
| Weymouth | GBH1.14 | Conditionally Restricted | 0 |
| Weymouth | GBH1.15 | Prohibited | 49.753 |
| Weymouth | GBH1.16 | Prohibited | 26.258 |
| Weymouth | GBH1.18 | Prohibited | 56.805 |
| Weymouth | GBH1.20 | Conditionally Restricted | 26.203 |
| Weymouth | GBH1.21 | Prohibited | 124.044 |
| Weymouth | GBH1.29 | Conditionally Restricted | 53.885 |
| Weymouth | GBH1.9 | Conditionally Restricted | 2.625 |

Table E6. Boston Harbor Proper DMF - Shellfish Project Classification Area Information as of October 2000.

| Town | Classification Area Code | Classification Type | Area (Acres) |
|---|---|---|---|
| Boston | GBH2.0 | Prohibited | 1558.027 |
| Boston | GBH3.0 | Prohibited | 1354.887 |
| Boston | GBH6.0 | Prohibited | 3263.018 |
| Boston | MB13.0 | Management Closure | 8646.263 |
| Boston | N28.0 | Prohibited | 6393.052 |

# APPENDIX F. LANDFILLS IN THE BOSTON HARBOR WATERSHED

The following landfill data was obtained from the Massachusetts Department of Environmental Protection Bureau of Waste Prevention is available on the MA DEP website (http://www.state.ma.us/dep/bwp/dswm/dswmpubs.htm#swfd). This information is also available as a datalayer from Mass-GIS (http://www.state.ma.us/mgis/sw.htm). There are 99 landfills within the Boston Harbor Watershed, located through out the Mystic, Neponset, Weymouth and Weir, and Boston Harbor Proper subwatersheds.

Currently there are seven un-mapped landfills within the Boston Harbor watershed:

- Arlington Landfill, Concord Turnpike
- Burlington Landfill, Location unknown
- Cohasset Landfill, Forest Drive
- Dedham Landfill, Centre Street
- Holbrook Landfill, Smith Lane
- Stoneham Landfill, Dale Street / Garey Street
- Westwood Landfill, Route 109 / Saint Mary's

| Site Name | Address | | Capped (Y/N) | Liner | Status | Type | Year Opened | Year Permit Expired | Actual Date of Closure |
|---|---|---|---|---|---|---|---|---|---|
| Abington Landfill | Groveland St | Abington, Ma 02351 | Capped | N | Closed | Municipal | 1940 | 1975 | |
| Arlington Landfill | Keats Rd | Arlington, Ma 02174 | Not Capped | N | Inactive | Municipal | 0 | 1969 | |
| Arlington Landfill | Summer St/Draelon Rd | Arlington, Ma 02174 | Not Capped | N | Inactive | Municipal | 1959 | 1969 | |
| Arlington Landfill | Summer St/Reed Rd | | | | Inactive | Private | 0 | 1987 | |
| Arlington Landfill | Concord Tpk | Arlington, Ma 02174 | | N | Inactive | Municipal | 0 | 1947 | |
| Arlington Landfill | Berkley St | Arlington, Ma 02174 | Not Capped | N | Inactive | Municipal | 0 | 0 | |
| Avon Landfill | Page/Wales Sts | Avon, Ma 02322 | | N | Inactive | Municipal | 0 | 1975 | |
| Belmont Landfill | 1130 Concord Ave | Belmont, Ma 02178 | Capped | N | Closed | Private | 0 | 1974 | |

| Site Name | Address | | Capped (Y/N) | Liner | Status | Type | Year Opened | Year Permit Expired | Actual Date of Closure |
|---|---|---|---|---|---|---|---|---|---|
| Boston Landfill | Mt Vernon Rd/Mile/Columbia Pt | Dorchester, Ma | Not Capped | N | Inactive | Unknown | 0 | 0 | |
| Boston Landfill | Gardner St | West Roxbury, Ma 02132 | Not Capped | N | Inactive | Municipal | 1954 | 1985 | |
| Spectacle Island Landfill | Spectacle Island | Boston, Ma | Partially Capped | N | Inactive | Municipal | 1918 | 1959 | |
| Hallet Street Landfill | Hallet Street Extn | Dorchester, Ma | Not Capped | N | Inactive | State | 1948 | 1966 | |
| Neponset Avenue Landfill | Neponset Ave | Dorchester, Ma | Not Capped | N | Inactive | State | 1935 | 1949 | |
| Barry Quarry | 401-453 Cummings Hwy | Hyde Park, Ma 02131 | Not Capped | N | Inactive | Private | 1984 | 1990 | |
| Walworth Foundry Landfill | 1525 Washington St | Braintree, Ma 02184 | Not Capped | N | Inactive | Private | 1960 | 1979 | |
| Braintree Landfill | Brookside Rd | Braintree, Ma 02184 | | N | Inactive | Unknown | 0 | 0 | |
| Braintree Landfill | Ivory/Union Sts | Braintree, Ma 02184 | Capped | N | Closed | Municipal | 1950 | 1983 | 06/04/93 |
| Brockton Landfill | West Chestnut St | Brockton, Ma | Not Capped | N | Inactive | Municipal | 0 | 1968 | |
| Brockton Landfill | 413 Thatcher St | Brockton, Ma 02402 | | N | Inactive | Municipal | 1947 | 1989 | |
| Brockton Sludge Landfill | 303 Oak Hill Way | Brockton, Ma | | N | Active | Municipal | 0 | 2000 | |
| Brockton Landfill | Skinner St | Brockton, Ma | Not Capped | N | Inactive | Municipal | 0 | 0 | |
| Burlington Landfill | | | Not Capped | N | Inactive | Unknown | 0 | 1958 | |
| Burlington Landfill | Muller Rd | | | | Inactive | Municipal | 0 | 1958 | |
| Mooney Street Dump | 45 Mooney St | Cambridge, Ma 02138 | Not Capped | N | Inactive | Municipal | 1938 | 1955 | |
| WR Grace Sludge Landfill | Harvey St | Cambridge, Ma 02139 | Excavated | N | Closed | Private | 1960 | 1979 | |
| New St Landfill (Danehy Park) | New St | Cambridge, Ma 02139 | Capped | N | Closed | Municipal | 1946 | 1982 | 03/29/89 |
| Canton Landfill | Pine St | Canton, Ma 02021 | Capped | N | Closed | Municipal | 0 | 1989 | |
| Chelsea Landfill | Marginal St | Chelsea, Ma 02150 | Not Capped | N | Inactive | Unknown | 0 | 0 | |
| Chelsea Landfill | Webster St | Chelsea, Ma 02150 | | N | Inactive | Municipal | 0 | 1956 | |
| Cohasset Landfill | 81 Cedar St | Cohasset, Ma 02025 | Capped | N | Closed | Municipal | 1970 | 1990 | 06/07/96 |
| Cohasset Heights Demo Landfill | 234 Crocker Ln/Rte 3a | Cohasset, Ma 02025 | Partially Capped | Y | Inactive | Private | 1978 | 1998 | |
| Cohasset Landfill | Forest Drive | | | | Inactive | Municipal | 0 | 0 | |
| Dedham Landfill | Centre St | | | | Inactive | Unknown | 0 | 0 | |
| Dedham Landfill | Incinerator Rd/East St/Rte 1 | Dedham, Ma 02026 | Not Capped | N | Inactive | Municipal | 0 | 1976 | |
| Dover-Westwood Landfill | 55 Powissett St | Dover, Ma 02030 | Partially Capped | N | Inactive | Municipal | 0 | 1988 | |
| Dover Landfill | Dover Rd | | | | Inactive | Municipal | 0 | 0 | |
| Everett Landfill | 2835 Revere Bch Pkwy (Rte 16) | Everett, Ma 02149 | | N | Inactive | Municipal | 0 | 1963 | |

| Site Name | Address | | Capped (Y/N) | Liner | Status | Type | Year Opened | Year Permit Expired | Actual Date of Closure |
|---|---|---|---|---|---|---|---|---|---|
| Foxborough Landfill | East Belcher Rd | Foxborough, Ma 02035 | Not Capped | N | Inactive | Municipal | 0 | 1998 | 04/27/99 |
| Hingham Landfill | Hobart St | Hingham, Ma 02043 | Not Capped | N | Inactive | Municipal | 1962 | 2000 | 09/29/95 |
| Unconfirmed Site | Hobart St | Hingham, Ma 02043 | | N | Inactive | Unknown | 0 | 0 | |
| Cains Pit Landfill | Spring Ln (Sic Smith Ln) | Holbrook, Ma 02343 | Not Capped | N | Inactive | Private | 1968 | 1974 | |
| Holbrook Landfill | Maple Ave (N Franklin St) | Holbrook, Ma 02343 | Capped | N | Closed | Municipal | 1945 | 1995 | 05/23/96 |
| Holbrook Landfill | Smith Lane | | | | Inactive | Municipal | 0 | 0 | |
| Unconfirmed Site | Weymouth St | Holbrook, Ma 02343 | | N | Inactive | Unknown | 0 | 0 | |
| Hull Landfill | Pocassett St | | | | Inactive | Unknown | 0 | 0 | |
| Hull Landfill | Logan Ave | Hull, Ma 02045 | Partially Capped | Y | Active | Municipal | 0 | 2006 | 11/24/89 |
| Lexington Landfill | Hartwell Ave | Lexington, Ma 02173 | Not Capped | N | Inactive | Municipal | 1963 | 1980 | |
| Lexington Dump | Lincoln St | Lexington, Ma 02173 | Not Capped | N | Inactive | Municipal | 0 | 1963 | |
| Malden Landfill | Bow/Green St | Malden, Ma | Not Capped | N | Inactive | Unknown | 0 | 0 | |
| Malden Landfill | Maplewood St | Malden, Ma | | N | Inactive | Municipal | 0 | 1960 | |
| Medfield Landfill | N Meadows Rd (Fmr Grove St) | Medfield, Ma 02052 | Partially Capped | N | Inactive | Municipal | 0 | 1993 | |
| Medfield Sludge Landfill | 99 Bridge St | | | | Active | Municipal | 0 | 0 | |
| Medford Landfill | Wellington Circle | Medford, Ma | | N | Inactive | Unknown | 0 | 0 | |
| Medford Landfill | Riverside Ave | Medford, Ma | | N | Inactive | Municipal | 0 | 0 | |
| Melrose Landfill | Penny Rd/Broadway (Rte 99) | Melrose, Ma | Not Capped | N | Inactive | Municipal | 1960 | 1976 | |
| Milton (ACE) Landfill | 750 Randolph Ave (Rte 28) | Milton, Ma 02186 | Not Capped | N | Inactive | Private | 1961 | 1998 | |
| Unquity Road Dump (MDC) | Unquity Rd | Milton, Ma 02186 | Not Capped | N | Inactive | State | 1949 | 1994 | |
| Norwell Landfill | | | | | Inactive | Unknown | 0 | 0 | |
| Norwell Landfill | Pine St/Circuit St | Norwell, Ma 02061 | Capped | N | Closed | Municipal | 0 | 1976 | 12/17/76 |
| Norwell Landfill | Mt Hope St | | | | Inactive | Unknown | 0 | 1976 | |
| Norwood (PCB) Landfill | Dean St/Rte 1 | Norwood, Ma | | N | Inactive | Unknown | 0 | 0 | |
| Norwood Landfill | Winter/Cemetery Sts | Norwood, Ma 02062 | Partially Capped | N | Inactive | Municipal | 1945 | 1996 | |
| Bird Granular Dump | Rte 1/Norwood Park South | Norwood, Ma | Partially Capped | N | Inactive | Private | 1930 | 1971 | 11/18/82 |
| BFI Quincy Landfill | Willard St/Ricciutti Dr | Quincy, Ma 02169 | Capped | N | Closed | Private | 0 | 1987 | 07/31/87 |
| MWRA WWTP - Nut Island | 147 Sea Ave | | | | Inactive | Municipal | 0 | 0 | |
| Quarry Hills Soils Landfill | Riccuitti Dr | Quincy, Ma 02169 | Not Capped | Y | Active | Private | 1998 | 2003 | |
| Granite Rail Quarry Landfill | Ricciutti Dr | Quincy, Ma | | N | Inactive | Unknown | 0 | 0 | |

| Site Name | Address | | Capped (Y/N) | Liner | Status | Type | Year Opened | Year Permit Expired | Actual Date of Closure |
|---|---|---|---|---|---|---|---|---|---|
| Louis Kmito & Son Landfill | 2 Johnson Dr | Randolph, Ma 02368 | Capped | Y | Closed | Private | 1932 | 1995 | 11/05/92 |
| Unconfirmed Site | Johns St | | | | Inactive | Unknown | 0 | 0 | |
| Unconfirmed Site | Charles St | Reading, Ma | | N | Inactive | Unknown | 0 | 0 | |
| Reading Landfill | Walkers Brook Dr (Johns St) | Reading, Ma 01867 | Not Capped | N | Inactive | Municipal | 0 | 1984 | |
| North Revere Landfill | Morris St | Revere, Ma 02151 | Capped | N | Closed | Private | 1978 | 1984 | 06/21/94 |
| Rockland Landfill | Lower Beech St | Rockland, Ma 02370 | Capped | N | Closed | Municipal | 1976 | 1995 | 08/15/97 |
| Old Rockland Landfill | Pleasant St/VFW Dr | Rockland, Ma 02370 | | N | Inactive | Private | 0 | 1976 | |
| Sharon Landfill | Mountain St | Sharon, Ma 02067 | Capped | N | Closed | Municipal | 1900 | 1992 | |
| Stoneham Landfill | Hall Rd/Brookbridge Rd | Stoneham, Ma | | N | Inactive | Municipal | 0 | 1970 | |
| Stoneham Landfill | Dale St/Garey St | Stoneham, Ma | | N | Inactive | Municipal | 0 | 1946 | |
| Stoughton Landfill | Page St | Stoughton, Ma 02072 | Capped | N | Closed | Municipal | 0 | 1976 | 07/16/76 |
| Wakefield Landfill | 371 Salem St | Wakefield, Ma | | N | Inactive | Unknown | 0 | 0 | |
| Walpole Demolition Landfill | Norfolk/West St | | | | Inactive | Municipal | 0 | 0 | |
| Unconfirmed Site | Birch St | Walpole, Ma | | N | Inactive | Unknown | 0 | 0 | |
| Unconfirmed Site | Robbins Rd | Walpole, Ma | | N | Inactive | Unknown | 0 | 0 | |
| Walpole Landfill | Lincoln Rd | Walpole, Ma 02081 | | N | Inactive | Municipal | 1967 | 1978 | |
| Bird Incorporated Landfill | Norfolk St | Walpole, Ma 02081 | Not Capped | N | Inactive | Private | 1968 | 1997 | |
| Walpole Dump | 1701-1709 Main St (Rte 1a) | Walpole, Ma 02081 | Not Capped | N | Inactive | Municipal | 1958 | 1975 | |
| Unconfirmed Site | Norfolk/West Sts | Walpole, Ma | | | Inactive | Unknown | 0 | 0 | |
| SCA Landfill | Arlington/Coolidge Hill | Watertown, Ma | | N | Inactive | Private | 0 | 0 | |
| Watertown Landfill | Highland Ave/Onley St | Watertown, Ma | Not Capped | N | Inactive | Municipal | 0 | 1961 | |
| Watertown Bemis Dump | Pleasant St | Watertown, Ma | | N | Inactive | Municipal | 0 | 1965 | |
| Watertown Landfill | 166 Grove St | Watertown, Ma | Capped | N | Closed | Municipal | 0 | 1975 | |
| Watertown Landfill | Bemis St | | | | Inactive | Municipal | 0 | 0 | |
| B F Goodrich Landfill | Coolidge Ave | Watertown, Ma 02172 | | N | Inactive | Private | 1964 | 1982 | |
| Westwood Landfill | Rte 109/St Marys | Westwood, Ma 02090 | | N | Inactive | Municipal | 0 | 0 | |
| Weymouth Landfill | Main/Washington Sts | Weymouth, Ma 02189 | Not Capped | N | Inactive | Municipal | 1924 | 1949 | |
| Weymouth Landfill | 95 Wharf St | Weymouth, Ma 02189 | Not Capped | N | Inactive | Municipal | 1949 | 1977 | |
| Winchester Landfill | 115 Swanton St/Mckay Ave | Winchester, Ma 01890 | Not Capped | N | Inactive | Municipal | 0 | 1976 | |
| Unconfirmed Site | Morton St/Short Island Beach | | | | Inactive | Unknown | 0 | 0 | |

| Site Name | Address | | Capped (Y/N) | Liner | Status | Type | Year Opened | Year Permit Expired | Actual Date of Closure |
|---|---|---|---|---|---|---|---|---|---|
| Winthrop Landfill | Argyle St | Winthrop, Ma | Not Capped | N | Inactive | Municipal | 0 | 1975 | |
| Woburn Landfill | Merrimac St/New Boston | Woburn, Ma 01801 | Not Capped | N | Inactive | Municipal | 1966 | 1986 | |

# APPENDIX G – SUMMARY OF WMA PERMITTING INFORMATION, BOSTON HARBOR WATERSHED

**Table G1.** List of WMA registered and permitted average annual water withdrawals in the Boston Harbor Watershed (LeVangie, D. 2001. Water Management Act Database. Massachusetts Department of Environmental Protection, Bureau of Resource Protection, Database Manager. Boston, MA.).

| Segment | Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source | Well/Source Name | Withdrawal Location |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3010000 | Arlington Water Dept. | | | -01P | MWRA | |
| | | | 3026000 | Belmont Water Dept. | | | -01P | MWRA | |
| | | | 3035000 | Boston Water & Sewer Comm | | | -01P | MWRA | |
| | | | 3040000 | Braintree Water Dept. | | | -01P | MWRA | |
| | | | | Braintree Water Dept. | | | -01T | Great Pond WTP | Blue Hills |
| MA 74-07 | | 34904001 | 3040000 | Braintree Water Dept. | 3.87 | 0 | -01S | Great Pond | Blue Hills |
| MA 74-07 | | 34904001 | 3040000 | Braintree Water Dept. | 3.87 | 0 | -02S | Richardi Reservoir | Blue Hills |
| MA 74-07 | | | | Braintree Water Dept. | | | -03S | Farm River | Blue Hills |
| MA 74-07 | | | | Braintree Water Dept. | | | -04S | Upper Reservoir- Great Pond | Blue Hills |
| | | | | Braintree Water Dept. | | | -01G | Lakeside Dr. G. P. Well | Blue Hills |
| | | | 304001 | Del's Poultry Farm | | | -01G | | Braintree |
| | | | 3048000 | Burlington Water Dept. | | | -04G | Wyman Tubular Wells #8 | Lexington |
| | | | 3049000 | Cambridge Water Dept. | | | -02T | Fresh Pond WTP | Lexington |
| | | | | Cambridge Water Dept. | | | -02S | Fresh Pond Reservoir | Lexington |
| | | | 3050000 | Canton Water Dept. | | | -01P | MWRA | |
| | | | | Canton Water Dept. | | | -01G | Washington St. G.P. Well #1 | Blue Hills |
| | | | | Canton Water Dept. | | | -02G | Henry's Spring dug well | Blue Hills |
| MA 73-20 | | | | Canton Water Dept. | | | -03G | Springdale Dug & Tub well | Norwood |
| MA 73-05 | | | | Canton Water Dept. | | | -04G* | Dedham St. G.P. Well #2 | Norwood |
| MA 73-05 | | | | Canton Water Dept. | | | -05G* | Dedham St. G.P. Well #3 | Norwood |

*indicates permitted withdrawal for less than 365 days, ** indicates registered withdrawal for less than 365 days, G – ground water, S – surface water, P-Public, T-Transient

**Table G1. Continued.** List of WMA registered and permitted average annual water withdrawals in the Boston Harbor Watershed (LeVangie 2001).

| Segment | Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source | Well/Source Name | Withdrawal Location |
|---|---|---|---|---|---|---|---|---|---|
| | 9P31905001 | | 3050000 | Canton Water Dept. | 0 | 2.43 | -06G | Pecunit G.P. Well #4 | Norwood |
| | 9P31905001 | | | Canton Water Dept. | 0 | 2.43 | -07G | Forest Ave. G.P. Well #5 | Norwood |
| | | | | Canton Water Dept. | | | -08G | Forest Ave G. P. Well #6 | Norwood |
| MA 73-05 | | | | Canton Water Dept. | | | -09G | Neponset G.P. Well #7 | Norwood |
| MA 73-05 | 9P31905001 | | 3050000 | Canton Water Dept. | 0 | 2.43 | -10G* | Forest Ave. G.D> Well #10 | Norwood |
| | | | | | | | -0AG | South Arm Well | Norwood |
| | | | 3057000 | Chelsea Water Dept. | | | | MWRA | |
| | | | 3073000 | Dedham/Westwood Wat. Dist | | | -01T | White Lodge GWTP | Norwood |
| MA 73-02 | 9P31907301 | 31907301 | 3073000 | Dedham/Westwood Wat. Dist | 2.62 | 0.49 | -06G* | White Lodge G.P. Well #1 | Norwood |
| MA 73-02 | 9P31907301 | 31907301 | 3073000 | | 2.62 | 0.49 | -07G* | White Lodge G.P. Well #2 | Norwood |
| MA 73-02 | 9P31907301 | 31907301 | 3073000 | Dedham/Westwood Wat. Dist | 2.62 | 0.49 | -08G* | White Lodge G. P. Well #3 | Norwood |
| MA 73-02 | 9P31907301 | 31907301 | 3073000 | Dedham/Westwood Wat. Dist | 2.62 | 0.49 | -09G* | White Lodge G. P. Well #4 | Norwood |
| MA 73-02 | | | | Dedham/Westwood Wat. Dist | | | -13G* | White Lodge G. P. Well #5 | Norwood |
| | 9P231907801 | | 3078006 | Dover Water Co. | | 0.14 | -01G | Walpole St. Wells | Medfield |
| MA 73-07 | 9P231907801 | | 3078006 | Dover Water Co. | | 0.14 | -04G* | Draper RD. Well #1 | Medfield |
| MA 73-07 | 9P231907801 | | 3078006 | Dover Water Co. | | 0.14 | -05G* | Draper Rd. Well #2 | Medfield |
| | | | 3078007 | Dover Water Works | | | -01P | Dover Water Co. Supply | |
| | | | 3093000 | Everett Water Dept. | | | -01P | MWRA | |
| | | | 3131000 | MA Am. Wat. CO (Hingham) | | | -02T | Free St. #2 Filter Plant | Weymouth |
| | | | | MA Am. Wat. CO (Hingham) | | | -03T | Fulling Mill Filter Plant | Weymouth |
| | | | | MA Am. Wat. CO (Hingham) | | | -04T | George W. Johnstone WTP | Weymouth |
| | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -01S | Accord Pond | Weymouth |

*indicates permitted withdrawal for less than 365 days, ** indicates registered withdrawal for less than 365 days, G – ground water, S – surface water, P-Public, T-Transient

**Table G1. Continued.** List of WMA registered and permitted average annual water withdrawals in the Boston Harbor Watershed (LeVangie 2001).

| Segment | Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source | Well/Source Name | Withdrawal Location |
|---|---|---|---|---|---|---|---|---|---|
| MA 74-02 | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -02S | Accord Brook | Cohasset |
| MA 74-02 | | | | MA Am. Wat. CO (Hingham) | | | -03S | Fulling Mill Coll Basins | Weymouth |
| MA 74-02 | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -01G | Free St. G.P. Well #1 | Weymouth |
| MA 74-02 | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -02G | Free St. G.P. Well #2 | Weymouth |
| MA 74-02 | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -03G | Scotland St. G.P. Well | Cohasset |
| MA 74-02 | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -04G | Downing St. G.P. Well | Weymouth |
| MA 74-02 | | 31913101 | 3131000 | MA Am. Wat. CO (Hingham) | 3.51 | 0 | -05G | Free St. G.P. Well #3 | Weymouth |
| MA 74-02 | | | | MA Am. Wat. CO (Hingham) | | | -08G | Free St. Well #4 | Weymouth |
| | | | 3131003 | Nino's Steak and Chops | | | -01G | | Hingham |
| | | | 3133000 | Holbrook Water Dept. | | | -01P | Randolph/Holbrook Supply | |
| | | | 3165000 | Malden Water Div. | | | -01P | MWRA | |
| MA 73-09 | | 3197501 | 3175000 | Medfield Water Dept. | 0.92 | 0 | -03G* | Elm St. G.P. Well #3 | Medfield |
| MA 73-09 | | 3197501 | 3175000 | Medfield Water Dept. | 0.92 | 0 | -04G* | Elm St. G.P. Well #4 | Medfield |
| | | | 3176000 | Medford Water Dept. | | | -01P | MWRA | |
| | | | 3178000 | Melrose Water Dept. | | | -01P | MWRA | |
| | | | 3189000 | Milton Water Dept | | | -01P | MWRA | |
| | | | 3189001 | Copeland Properties, Inc. | | | -02G | | Milton |
| | | | | Copeland Properties, Inc. | | | -01G | | Milton |
| | | | 3220000 | Norwood Water Dept. | | | -01P | MWRA | |
| | | | | Norwood Water Dept. | | | -01T | Ellis GWTP | Norwood |
| | | | | Norwood Water Dept. | | | -01G | Ellis G.P. Well #1 | Norwood |
| | | | | Norwood Water Dept. | | | -02G | Ellis G.P. Well #2 | Norwood |
| | | | | Norwood Water Dept. | | | -03G | Buckmaster Pond G.P. Well | Norwood |
| | | | | Norwood Water Dept. | | | -04G | Ellis Tubular Wells | Norwood |

*indicates permitted withdrawal for less than 365 days, ** indicates registered withdrawal for less than 365 days, G – ground water, S – surface water, P-Public, T-Transient

**Table G1. Continued.** List of WMA registered and permitted average annual water withdrawals in the Boston Harbor Watershed (LeVangie 2001).

| Segment | Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source | Well/Source Name | Withdrawal Location |
|---|---|---|---|---|---|---|---|---|---|
| | | | 3423000 | Quincy Water Dept | | | -01P | MWRA | |
| | | | 3244000 | Randolph water Dept | | | -01P | Randolph/Holbrook Supply | |
| | | | 3244001 | Randolph/Holbrook Wat. Dist | | | -01P | MWRA | |
| | | | | Randolph/Holbrook Wat. Dist | | | -01T | Great Pond WTP | Blue Hills |
| MA 74-07 | | 31913301 | 3133000 | Randolph/Holbrook Wat. Dist | 3.27 | 0 | -01S | Great Pond | Blue Hills |
| | | | | Randolph/Holbrook Wat. Dist | | | -02S | Blue Hill River | Blue Hills |
| | | | | Randolph/Holbrook Wat. Dist | | | -01G | South St. G.P. Well # 3 | Blue Hills |
| | | | | Randolph/Holbrook Wat. Dist | | | -02G | South St. G.P. Well # 2 | Blue Hills |
| | | 31913301 | 3133000 | Randolph/Holbrook Wat. Dist | 3.27 | 0 | -03G | South St. G.P. Well # 1 | Blue Hills |
| MA 74-12 | | 31913301 | 3133000 | Randolph/Holbrook Wat. Dist | 3.27 | 0 | -04G | Donna Rd. Tubular Wells | Blue Hills |
| | | | | | | | -0AG | Donna Rd. Well Site | |
| | | | 3274000 | Somerville Water Dept. | | | -01P | MWRA | |
| | | | 3284000 | Stoneham Water Dept | | | -01P | MWRA | |
| | | | 3307000 | Walpole Water Dept | | | -01T | Mine Brook GWTP | Medfield |
| | | | | Walpole Water Dept | | | -02T | School Meadow Brook WTF | Norwood |
| MA 73-10 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -01G* | Mine Brk G.P. Well # 1 | Medfield |
| MA 73-09 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -02G* | Mine Brk. Well # 2 | Medfield |
| MA 73-09 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -03G* | Mine Brk Well # 3 | Medfield |
| | | | | Walpole Water Dept | | | -04G | Washington St. # 1 Tub Well WF | Norwood |
| MA 73-06 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -05G* | Washington G.P. Well # 3 | Mansfield |
| MA 73-06 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -06G* | Washington G. P. Well # 2 | Norwood |
| | | | | Walpole Water Dept | | | -07G | South St. G.P. Well | Wrentham |

*indicates permitted withdrawal for less than 365 days, ** indicates registered withdrawal for less than 365 days, G – ground water, S – surface water, P-Public, T-Transient

**Table G1. Continued.** List of WMA registered and permitted average annual water withdrawals in the Boston Harbor Watershed (LeVangie 2001).

| Segment | Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source | Well/Source Name | Withdrawal Location |
|---|---|---|---|---|---|---|---|---|---|
| MA 73-06 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -08G* | Washington G.P. Well # 5 | Norwood |
| MA 73-06 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -09G* | Washington G.P. Well #6 | Mansfield |
| MA 73-06 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -10G* | Washington G.P. Well # 4 | Norwood |
| MA 73-10 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -11G* | Mine Brk G.P. Well # 5 | Medfield |
| MA 73-01 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -12G* | Neponset P.S. #1 (well 1) | Norwood |
| MA 73-01 | 9P31930702 | 31930701 | 3307000 | Walpole Water Dept | 2.25 | 1.09 | -13G* | Neponset P.S. # 1 (well 2) | Norwood |
| | | | 3336000 | Weymouth Water Dept. | | | -01T | Great Pond WTP | Weymouth |
| | | | | Weymouth Water Dept. | | | -02T | Bilodeau (Winter St.) GWTP | Weymouth |
| | | 31933601 | 3336000 | Weymouth Water Dept. | 4.51 | 0 | -01S | Great Pond | Weymouth |
| | | | | Weymouth Water Dept. | | | -02S | Old Swamp Riv. / South Cove | Weymouth |
| | | 31933601 | 3336000 | Weymouth Water Dept. | 4.51 | 0 | -03S | Whitmans Pond | Weymouth |
| MA 74-04 | | 31933601 | 3336000 | Weymouth Water Dept. | 4.51 | 0 | -01G | Circuit Ave. G.P. Well | Weymouth |
| MA 74-04 | | 31933601 | 3336000 | Weymouth Water Dept. | 4.51 | 0 | -02G | Main St. G.P. Well | Weymouth |
| MA 74-03 | | | | Weymouth Water Dept. | | | -03G | Libbey Park G.P. Well | Weymouth |
| MA 74-04 | | | | Weymouth Water Dept. | | | -04G | Winter St. G.P. Well # 1 | Weymouth |
| MA 74-04 | | 31933601 | 3336000 | Weymouth Water Dept. | 4.51 | 0 | -05G | Winter St. G.P. Well # 2 | Weymouth |
| | | | 3344000 | Winchester Water Dept. | | | -01P | MWRA (Spot Pond) | |
| | | | | Winchester Water Dept. | | | -01T | WTP | Boston North |
| MA 71-01 | | 31934402 | 3344000 | Winchester Water Dept. | 1.06 | 0 | -01S | North Reservoir | Boston North |
| MA 71-02 | | | | Winchester Water Dept. | | | -02S | Middle Reservoir | Boston North |
| MA 71-02 | | 31934402 | 3344000 | Winchester Water Dept. | 1.06 | 0 | -03S | South Reservoir | Boston North |
| | | | | Winchester Water Dept. | | | -01G | Pond Brook Tubular Wells | Lexington |
| | | | 3347000 | Woburn Water Dept | | | -01P | MWRA | |

*indicates permitted withdrawal for less than 365 days, ** indicates registered withdrawal for less than 365 days, G – ground water, S – surface water, P-Public, T-Transient

**Table G1. Continued.** List of WMA registered and permitted average annual water withdrawals in the Boston Harbor Watershed (LeVangie 2001).

| Segment | Permit | Registration | PWSID | System Name | Registered Volume (MGD) | 20 Year Permitted Volume (MGD) | Source | Well/Source Name | Withdrawal Location |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Woburn Water Dept | | | -01S | Horn Pond | Lexington |
| MA 71-01 | | 31934703 | 3347000 | Woburn Water Dept | 4.07 | 0 | -01G | GP Well A2 | Lexington |
| MA 71-01 | | 31934703 | 3347000 | Woburn Water Dept | 4.07 | 0 | -02G | GP Well D | Lexington |
| MA 71-01 | | | | Woburn Water Dept | | | -03G | GP Well C2 | Lexington |
| MA 71-01 | | 31934703 | 3347000 | Woburn Water Dept | 4.07 | 0 | -04G | GP Well B | Lexington |
| MA71-01 | | | | Woburn Water Dept | | | -05G | DUG Well | Lexington |
| MA71-01 | | 31934703 | 3347000 | Woburn Water Dept | 4.07 | 0 | -06G | GP Well F | Lexington |
| MA71-01 | | 31934703 | 3347000 | Woburn Water Dept | 4.07 | 0 | -07G | GP Well E | Lexington |
| MA71-01 | | | | Woburn Water Dept | | | -08G | GP Well G | Lexington |
| MA71-01 | | | | Woburn Water Dept | | | -09G | GP Well H | Lexington |
| MA71-01 | | | | Woburn Water Dept | | | -10G | GP Well I | Lexington |
| | | | 6000000 | MWRA | | | -05S | Spot Pond | Boston North |
| | | | | | | | | | |
| | | | | | | | | | |
| MA73-19 | | | 4266000 | | | | -03G | GP Well # 4 | Norwood |
| | | | 4219000 | | | | -02G | GP Well # 2 | Cohasset |
| | | | | | | | -03G | GP Well # 3 | Cohasset |
| | | | | | | | -05G | GP Well # 5 | Cohasset |
| | | | | | | | -11G | GP Well # 10 | Cohasset |
| | | | 4285000 | | | | -06G | Pratts Court Well | Norwood |

*indicates permitted withdrawal for less than 365 days, ** indicates registered withdrawal for less than 365 days, G – ground water, S – surface water, P-Public, T-Transient