2005
Fish Toxics Monitoring
Public Request and
Year 2 Watershed
Surveys

white sucker ***Catostomus commersoni***

Massachusetts Department of Environmental Protection
Divisions of Watershed Management
and Environmental Analysis

Robert J. Maietta
Jane Ryder
Richard Chase
Environmental Analysts
Division of Watershed Management

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Introduction

Public Request Surveys (Interagency Committee on Freshwater Fish Toxics Monitoring and Assessment)

Due in part to an increasing public demand for fish toxics data, a formal protocol for the public to request fish toxics monitoring surveys of the Commonwealth's waterbodies was initiated in 1993/94. While public requests for fish testing had been fulfilled prior to this time, increased numbers of requests beyond the scope of the resources available, made formal prioritization necessary. The protocol is the result of a collaborative effort between the Massachusetts Department of Environmental Protection (MassDEP), the Massachusetts Department of Public Health (MDPH), and the Massachusetts Department of Fish and Game (MDFG). It consists of a Memorandum of Understanding (MOU) (Appendix B), a form for requesting fish testing (Appendix C), and the criteria used for ranking testing requests (Appendix D).

To summarize, completed request forms are sent to the MassDEP Division of Watershed Management (DWM) in Worcester. Representatives of the aforementioned agencies make up the Interagency Committee on Freshwater Fish Toxics Monitoring and Assessment (Interagency Committee). The Interagency Committee meets each year in February to prioritize all requests received between February 1st of the previous year and February 1st of the current year. Variables used to prioritize requests include fishing pressure (determined by Division of Fisheries and Wildlife (DFW) and the requester) and the presence of known or potential point and non-point sources of pollution (determined by MassDEP, DFW, and the requester). The number of requests fulfilled during any given year is determined by the amount of field and laboratory resources available in that year. All requesters are notified regarding the status of their particular request. If a request is denied, re-application in the future is allowed. Request forms are available through each of the agencies involved in the MOU, at the following locations:

Massachusetts Department of Environmental Protection

Division of Watershed Management **627 Main Street, 2nd Floor** **Worcester, MA 01608** **(508) 792-7470**	**Division of Environmental Analysis** **Senator William X. Wall Experiment Station** **37 Shattuck Street** **Lawrence, MA 01843** **(978) 682-5237**
Office of Research and Standards **One Winter Street** **Boston, MA 02108** **(617) 292-5510**	

Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
250 Washington Street, 7th Floor
Boston, MA 02108-4619
(617) 624-5757

Massachusetts Department of Fish and Game
Division of Fisheries and Wildlife (DFW)
Field Headquarters
One Rabbit Hill Road
Westborough, MA 01581
(508) 792-7270

Year 2 Watershed Surveys

Massachusetts has adopted a watershed approach to planning and implementing water resource protection activities throughout the state. In 1993, the twenty-seven major watersheds and coastal drainage areas in Massachusetts were placed on a rotating five-year schedule for monitoring, assessment, TMDL development, surface water permitting and non-point source pollution control. The rotating watershed cycle allows for the synchronization of these water quality planning and management activities within each watershed. During Year 1 of the rotating basin schedule, all pertinent data and information relative to water resource management are gathered and reviewed to identify data gaps and the need for additional information. This process culminates in the development of a plan for obtaining this information during Year 2. At a minimum, a Quality Assurance Project Plan (QAPP) is formulated for all environmental monitoring activities to be performed. The scope of the monitoring effort varies depending upon the resources available and the prevailing water quality issues within each watershed. Input from outside agencies and the public is actively solicited in order to gain further insight with respect to water quality goals and use-objectives. During Year 2 of this cycle the DWM performs fish toxics monitoring surveys as part of their larger "biological monitoring" program.

Objective and Scope

The objective of Public Request and Watershed Surveys is to screen edible fillets of fishes for a variety of contaminants (i.e. metals, polychlorinated biphenyls (Aroclors and toxic congeners), and organochlorine pesticides). All data are sent to the MDPH and the MassDEP Office of Research and Standards (ORS) for risk assessment and advisory issuance if appropriate.

PCB Aroclors analyzed for include Aroclors 1232, 1242, 1248, 1254, and 1260. PCB toxic congeners analyzed for include BZ #s 8, 18, 28, 44, 52, 66, 77, 81, 101, 105, 114, 118, 123, 126, 128, 138, 153, 156, 157, 167, 169, 170, 180, 187, 189, 195, 206, and 209. Organochlorine pesticides analyzed for include: Chlordane, Toxaphene, a-BHC, b-BHC, d-BHC, Lindane, Hexachlorocyclopentadiene, Trifluralin, Hexachlorobenzene, Heptachlor, Heptachlor Epoxide, Methoxychlor, DDD, DDE, DDT, and Aldrin. All organics analyses include lipid determination. Metals analyzed for include: cadmium, lead, mercury, arsenic, and selenium. All analyses for variables listed above are performed at the Senator William X. Wall Experiment Station (WES). Additional variables are addressed on a site-specific basis.

In order to assess the level of contamination present in fish of different trophic guilds and habitat types, fish species targeted include at a minimum; largemouth bass, *Micropterus salmoides,* and/or chain pickerel, *Esox niger,* (predators); yellow perch, *Perca flavescens,* and/or white perch, *Morone americana,* (water column invertivores/omnivores); and bullhead, *Ameiurus* sp. and/or common carp, *Cyprinus carpio,* (bottom feeding omnivores). Average sized fish (above legal length limit when applicable) are analyzed as composite samples. Additional species or substitute species are chosen on a site-by-site basis.

During 2005, a total of nine locations were sampled. Seven were sampled at the request of MassDEP watershed coordinators and two were sampled as a result of recommendations from the Interagency Committee.

Waterbody	Watershed	Town	USGS Quadrangle
Fort Meadow Reservoir PALIS#[1] 82042	Concord	Marlborough Hudson	MARLBOROUGH, MASSACHUSETTS
Indian Head River SARIS#[2] 9456800	South Coastal	Hanover Pembroke	HANOVER, MASSACHUSETTS
Round Pond PALIS#[1] 83018	Shawsheen	Tewksbury	READING, MASSACHUSETTS
Sampson Pond PALIS#[1] 95125	Buzzards Bay	Carver	WAREHAM, MASSACHUSETTS-
New Bedford Reservoir PALIS#[1] 95110	Buzzards Bay	Acushnet	NEW BEDFORD NORTH, MASSACHUSETTS-
Deerfield River SARIS#[2] 3312900	Deerfield	Charlemont Buckland	ASHFIELD, MASSACHUSETTS-
Ipswich River @ Wenham Swamp SARIS#[2] 9253500	Ipswich	Topsfield Hamilton	IPSWICH, MASSACHUSETTS
Millers River SARIS#[2] 3522150	Millers	Orange	ORANGE, MASSACHUSETTS-
Otter River SARIS#[2] 3523800	Millers	Templeton	ATHOL, MASSACHUSETTS

[1] PALIS# = Pond and Lake Identification System number (Ackerman 1989)

[2] SARIS#=Stream Classification Inventory of Rivers and Streams (Halliwell, Kimball, and Screpetis 1982)

Field Methods

Waterbodies were sampled using an electrofishing boat or backpack electrofisher. Electrofishing was performed by maneuvering the boat through the littoral zone and shallow water habitat of a given waterbody, and collecting most fish shocked. Fish collected by electrofishing were stored in a live well or bucket filled with site water until the completion of sampling. After removal from the live well or bucket, fish to be included in the sample were dispatched, stored on ice, and transported to the Massachusetts Department of Environmental Protection (MassDEP) Division of Watershed Management (DWM) laboratory in Worcester. In all cases, live fish, which were not included as part of the sample were released.

Field Results

Fort Meadow Reservoir: Electrofishing at Fort Meadow Reservoir in Marlborough and Hudson on 5/6/05 resulted in the collection of three largemouth bass, three yellow perch, three bluegill *Lepomis macrochirus*, and three white sucker *Catostomus commersoni*.

Indian Head River : Electrofishing at Indian Head River (Luddoms Ford Impoundment at Curtis Crossing) in Hanover and Pembroke on 5/18/05 resulted in the collection of four largemouth bass, three black crappie *Pomoxis nigromaculatus*, three white perch, three white sucker, and three bluegill.

Round Pond: Electrofishing at Round Pond in Tewksbury on 6/1/05 resulted in the collection of three largemouth bass, three yellow perch, three brown bullhead *A. nebulosus*, three pumpkinseed *Lepomis gibbosus*, and two chain pickerel. Additional species observed included American eel *Anguilla rostrata*, bluegill, black crappie, and golden shiner *Notemigonus crysoleucas*.

Sampson Pond: Electrofishing at Sampson Pond in Carver on 6/7/05 resulted in the collection of three largemouth bass, three yellow perch, three brown bullhead, three pumpkinseed, and three white perch. Additional species observed included American eel, bluegill, black crappie, golden shiner, and chain pickerel.

New Bedford Reservoir: Electrofishing at New Bedford Reservoir in Acushnet on 6/9/05 resulted in the collection of three largemouth bass, three yellow perch, three black crappie, three bluegill, and three American eel. Additional species observed included common carp *Cyprinus carpio*, chain pickerel, pumpkinseed, and golden shiner.

Deerfield River: Electrofishing in the Deerfield River in Charlemont and Buckland on 6/17/05 resulted in the collection of three white sucker. Additional species observed included smallmouth bass

Ipswich River: Electrofishing in the Ipswich River (Wenham Swamp) in Topsfield and Hamilton on 7/1/05 resulted in the collection of three yellow perch, three white sucker, three pumpkinseed, two chain pickerel, and two American eel.

Millers River: Electrofishing in the Millers River in Orange on 7/11/05 resulted in the collection of five white sucker, three chain pickerel, three yellow perch, three bluegill, and two brown bullhead.

Otter River: Backpack electrofishing in the Otter River (Templeton) on 7/12/05 resulted in the collection of two white suckers, three fallfish *Semotilus corporalis*, and three pumpkinseed.

Laboratory Methods

Fish brought to the MassDEP DWM laboratory in Worcester were processed using protocols designed to assure accuracy and prevent cross-contamination of samples. Specimen lengths and weights were recorded. In addition, a visual examination was performed and the presence of anomalies and/or parasites was noted. Scales, spines, or fin ray samples were obtained for use in age determination. Species, length, and weight data can be found in Appendix A Tables 1 and 2. Fish were filleted (skin off) on glass cutting boards and prepared for freezing. In the case of select Indian Head River samples, fillets and offal were weighed to the nearest gram. All equipment used in the filleting process was rinsed in tap water and then rinsed twice in de-ionized water before and/or after each sample. Samples targeted for % lipid, PCB and organochlorine pesticide analyses were wrapped in aluminum foil. Samples targeted for metals analysis were placed in VWR high density polyethylene (HDPE) cups with covers. Composite samples were composed of two or three fillets or offal from like-sized individuals of the same species. Samples prepared at DWM in Worcester 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 was 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 were analyzed using a Perkin Elmer, Zeeman 5100 PC, Platform Graphite Furnace, Atomic Absorption Spectrophotometer (MA DEP 2000, MA DEP 2002a).

PCB Aroclor, PCB congener, and organochlorine pesticide analyses were performed on a gas chromatograph equipped with an electron capture detector "according to the modified AOAC 983.21 procedure for the analysis of PCB Aroclors, Congeners, and Organochlorine Pesticides."(MA DEP 2002b). Additional information on analytical technique used at WES is available from the laboratory.

Laboratory Results

Forty-nine samples were delivered to WES for analysis. Five samples were analyzed for mercury only. All fish tissue data passed WES QC acceptance limits for metals, however, a number of selenium data points (15 of 44 or 34%) were qualified due to the analyte concentrations being greater than the Method Detection Limit but less than the Reporting Detection Limit (>MDL but< RDL).

Lead (method detection limits (MDLs) 0.10 and 0.050 mg/kg), was detected in three of the forty four samples analyzed. Detectable concentrations were only found in the offal samples from the Indian Head River and ranged between 0.49 and 0.66 mg/kg.

Cadmium (MDLs 0.050 and 0.10 mg/kg) was below MDL in all samples analyzed (n=44), and arsenic (MDL 0.080 mg/kg), was below detection in all but one sample analyzed (n=44). Arsenic (0.12 mg/kg) was detected in a two fish fillet composite of chain pickerel from the Ipswich River.

Selenium and mercury (MDLs 0.050 and 0.10 mg/kg for selenium and MDL of 0.0020 mg/kg for mercury) were detected in all samples analyzed. As noted above, 34% of selenium data points were qualified due to "Analyte concentrations being greater than the MDL (Method Detection Limit) but less than the RDL (Reporting Detection Limit)". Concentrations ranged from 0.12 mg/kg to 0.87 mg/kg.for selenium and 0.028 mg/kg – 2.1 mg/kg for mercury. Mercury concentrations varied greatly between waterbodies and fish species analyzed. Mean mercury concentration and range by waterbody follow. Whole fish mercury concentrations were calculated using the following formula:

$$\frac{([mg/kg]_{filet} \times [kg]_{filet}) + ([mg/kg]_{offal} \times [kg]_{offal})}{kg_{filet} + kg_{offal}}$$

Waterbody	mean total Hg (mg/kg wet weight)	Range (mg/kg (min-max))
Fort Meadow Reservoir	0.14 (n=4) fillets	0.072–0.25
Round Pond	0.21 (n=5) fillets	0.028–0.41
Sampson Pond	0.24 (n=5) fillets	0.052–0.50
New Bedford Reservoir	0.37 (n=5) fillets	0.22-0.52
Deerfield River	0.21 (n=1) fillets	N/A
Ipswich River (Wenham Swamp)	0.54 (n=5) fillets	0.39–0.69
Millers River	0.37 (n=9) fillets	0.23-0.62
Otter River	0.19 (n=4) fillets	0.15–0.26
Indian Head River	1.4 (n=8) fillets	0.57–2.1
Indian Head River	0.85 (n=3) whole fish	0.34–1.62

PCB Aroclors and congeners were detected in eighteen of the forty-four samples analyzed (41%). DDT and or it's metabolites (DDE and DDD) were detected in seventeen of the forty-four samples analyzed (38%). Nine of the positive DDE or DDD results (52%) were "qualified" by the following: "analyte concentration >MDL but ,<RDL" (See Discussion for more detail).The remaining organochlorine pesticides with the exception of one sample found to contain chlordane and one sample found to contain dieldrin, (both qualified as noted for DDT), were below MDLs. (See Discussion for more detail). Complete PCB Aroclor, toxic congener, and organochlorine pesticide analysis can be found in Appendix A Tables 1 and 2.

Quality Control

Complete results of the metals analysis can be found in Appendix A Tables 1 and 2. Lab duplicate precision estimates for metals (Hg, Pb, Cd, As and Se) were acceptable at 20% RPD or less. Lab accuracy estimates for metals (all analytes) using lab-fortified matrix samples were generally acceptable ranging from 71-124 % recovery. QC sample recoveries for metals were acceptable ranging from 74-110%. Lab accuracy estimates for metals (all analytes) using lab fortified blanks were acceptable ranging from 87 to 107 % recovery. Quality assurance and quality control data for metals are available upon request or from the WES.

All lab organics blanks showed non-detectable concentrations. The lab fortified matrix and lab fortified blank sample recoveries for PCB Aroclors 1242 and 1254, chlordane, heptachlor, DDE, DDD, DDT, and aldrin were within the acceptable range of 60-140%. Duplicate samples of PCB Congener #(s) 118, 180, 101, 138, 153, 187, PCB Aroclor 1260, and DDE, had RPDs within the acceptable range of 0 - 35 %. Duplicates with RPDs of greater than 35 % for DDD, DDE, dieldrin,

PCB Congeners #s 156, 138, and 170 were either accepted due to results being “below reporting limit”, accepted due to samples not being “completely homogenized”, or in the case of dieldrin, qualified in the absence an acceptable “method validation”. Complete quality assurance and quality control data for organics is available upon request or directly from WES.

Discussion

Selenium concentrations were generally consistent with those found during past surveys, and do not appear to be a public health concern. This assessment is based on the following;

- selenium criteria used by Australia (1.0 mg/kg) and New Zealand (2.0 mg/kg) (Tetra Tech Inc. 1986).
- literature which suggests that selenium deficiency may constitute as significant a threat to health as selenium poisoning (Eisler 1985),
- the fact that the MDPH has yet to issue a fish consumption advisory with regard to selenium

It should also be noted that in 2004 the USEPA has published *Draft Selenium Aquatic Life Criterion* including a whole-body fish tissue concentration which is proposed as a “freshwater chronic criterion” (USEPA 2004). The criterion is 7.91 ug/g dry weight with a contingency which recommends re-testing in winter if any summer or fall values exceed 5.85 ug/g dry weight.

Arsenic has only occasionally been detected in freshwater fish samples from Massachusetts. Although there is no current U.S.Food and Drug Administration (FDA) “Action Level” or MDPH “trigger level” for arsenic, concentrations which have been historically detected do not appear to be posing a public health threat. This assertion is supported in part by the fact that MDPH’s review of historical arsenic data sets has not resulted in any type of fish consumption advisory with regard to arsenic. Arsenic was detected in only one sample (0.12 mg/kg) analyzed during 2005. Arsenic criteria used by other countries range from 0.1 ppm in Venezuela to 10 ppm in Hong Kong. The majority of countries listed as having “legal limits” use criteria that are greater than 1.0 ppm (Tetra Tech 1986).

Cadmium is rarely detected in the edible fillets of freshwater fishes in Massachusetts. Cadmium was below the MDL in all samples analyzed in 2005. A number of countries have limits for cadmium in seafood. New Zealand has a limit of 1.0 mg/kg and Australia has a range of limits between 0.2 and 5.5 mg/kg. (Tetra Tech 1986). Based on the 2005 Fish Toxics Monitoring data set, cadmium does not appear to be of concern.

Although lead is rarely detected in the edible fillets of fishes from Massachusetts waters, lead was present in all three offal samples in 2005 (ranging from 0.49 to 0.66 mg/kg). The MDPH and MassDEP ORS are in the process of assessing the 2005 lead data, however, avoiding the consumption of “whole fish” should greatly minimize any risk posed by lead. A number of countries have limits for lead in fish and fishery products. New Zealand has a limit of 2.0 mg/kg and Australia has a range of limits between 1.5 and 5.5 mg/kg (Tetra Tech 1986).

Mercury continues to be both widespread and detectable in freshwater fishes. Thirty-three percent of the samples analyzed had mercury concentrations which were at or above the MDPH trigger level of 0.5 mg/kg (13 % were also above USFDA Action level of 1.0 mg/kg). Mercury is discussed in the individual waterbody descriptions which follow.

PCB Aroclors, PCB toxic congeners, and organochlorine pesticides are occasionally found in freshwater fishes from Massachusetts. They are usually found in fishes from waterbodies that have received historical discharges or are associated with known waste sites. As such, they are mostly found in rivers, although the presence of PCBs and organochlorine pesticides in fishes from lakes and ponds can not be entirely ruled out. USFDA "Action Levels" are presently available for mercury (1.0 mg/kg methyl mercury), PCBs (2.0 mg/kg), chlordane, aldrin, and dieldrin (0.3 mg/kg for each individually), and for DDT and its metabolites DDE and DDD (5.0 mg/ kg combined). In addition, the MDPH has "trigger levels" for mercury (0.5 mg/kg total mercury), PCBs (1.0 mg/kg total Aroclors) DDT (and its metabolites (0.06 mg/kg) and chlordane (0.06 mg/kg).

PCB Aroclors and congeners as well as organochlorine pesticides (DDT and its metabolites) were found in a number of samples analyzed in 2005 and as a result, the MDPH has issued advisories when appropriate. The advisories are documented in the individual waterbody descriptions which follow.

PCB toxic congener analysis allows for a detailed look at the PCB compounds that exhibit dioxin-like toxicity. MassDEP's ORS and the MDPH are in the process of looking more closely at evaluating PCB toxic congeners potential impact with regard to fish consumption. Currently all PCB advisories are issued based on total PCB Aroclor concentrations.

Fort Meadow Reservoir: Fort Meadow Reservoir is a 284 acre (115 ha) mesotrophic pond located in the towns of Marlborough and Hudson (Ackerman 1989). The shoreline is approximately 80 percent developed with residences. Land use within the ponds immediate watershed is primarily medium density residential and forested with a mix of industrial, commercial, and open land.

Mercury was well below the MDPH "trigger level" of 0.5 mg/kg in all fish sampled (including largemouth bass, a top level predator). Arsenic, lead, and cadmium were below MDLs in all four samples analyzed. Selenium was detected in all four samples but does not appear to be of concern (See Discussion section).

While concentrations of PCBs (Aroclor1260, and a number of congeners) and DDE were found in one sample of white sucker, these compounds were below any MDPH or USFDA criteria. Chlordane concentrations in white sucker exceeded the MDPH "trigger level" of 0.06 mg/kg. Although the data point was "qualified" (analyte concentration great than Method Detection Limit but less than Reporting Detection Limit), the MDPH issued the following advisory:

"1.Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any white sucker from this waterbody."

"2. The general public should not consume white sucker from this waterbody."

It is unclear where chlordane, PCBs and DDT (and/or it's metabolites) might be originating, but, given the amount of development within the Fort Meadow Pond watershed, pesticides such as DDT and chlordane could well be from historic household use. Concentrations do not appear to be indicative of an ongoing source of these contaminants.

Round Pond: Round Pond is a 25 acre (10 ha) pond located in the Shawsheen River Watershed in the town of Tewksbury (Ackerman 1989). The pond's watershed, which is less than 0.5 mi^2,

contains a mix of forested and residential land uses. The shoreline is approximately 20% developed with residences. There is no formal public access to Round Pond.

Mercury was well below the MDPH "trigger level" of 0.5 mg/kg in all fish sampled (including largemouth bass and chain pickerel, both top level predators). Arsenic, lead, and cadmium were below MDLs in all five samples analyzed. Selenium was detected in all five samples, however all selenium data were qualified and do not appear to be of concern (See Discussion section).

PCB Aroclors, Congeners, and organochlorine pesticides were below MDLs in most samples analyzed. The composite of brown bullhead was found to contain a trace amount of DDE ("result qualified due to the analyte concentration being "greater than Method Detection Limit but less than Reporting Detection Limit"). The detected concentration does not appear to be indicative of an ongoing source of DDE, and is below the MDPH trigger level.

Sampson Pond: Sampson Pond is a 310 acre (125 ha.) mesotrophic pond located within the Buzzards Bay Watershed in the town of Carver. The shoreline of Sampson Pond is approximately 10 to 20% developed with seasonal and year round residences. The lake's immediate watershed is mostly forested and agricultural (cranberry bogs), with a small amount of residential land interspersed.

Mercury equaled the MDPH "trigger level" of 0.5 mg/kg in white perch. All other fish analyzed were below the mercury trigger level. It's interesting and somewhat surprising, to see white perch with higher concentrations of mercury than largemouth bass. However, it should be noted that the white perch analyzed were large specimens, and white perch greater than 200 mm, are known to become highly piscivorous (Smith 1985). Arsenic, lead, and cadmium were below MDLs in all samples analyzed. Selenium was detected in all five samples analyzed. One selenium data point was qualified and remainder of the selenium results do not appear to be of concern (See Discussion section). Trace amounts of DDE were found in largemouth bass and white perch. In addition, PCB congeners 138 and 156, DDT metabolites (DDE and DDD), and dieldrin were detected in a sample of brown bullhead.

Most concentrations of were below MDPH trigger levels, however, the DDE and DDD in bullhead and the mercury in white perch resulted in the following advisory:

1.Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any brown bullhead or white perch from this waterbody.

2. The general public should limit consumption of brown bullhead and white perch to two meals per month.

It is unclear where the PCBs and organochlorine pesticides might be originating, but, given the low concentrations and the agricultural land uses in the watershed, historic use of the pesticides or atmospheric deposition are two distinct possibilities. Concentrations do not appear to be indicative of an ongoing source of these contaminants.

New Bedford Reservoir: New Bedford Reservoir is a 219 acre (88.6 ha) waterbody located in the town of Acushnet within the Buzzards Bay Watershed. The shoreline is approximately fifteen percent developed with residences. Land use within the ponds immediate watershed is a mix of forests, cranberry bogs, wetlands and medium density residential.

Mercury exceeded the MDPH “trigger level” of 0.5 mg/kg in only largemouth bass. Arsenic, lead, and cadmium were below MDLs in all five samples analyzed. Selenium was detected in all samples but four of the data points were qualified. Selenium does not appear to be of concern (See Discussion section). PCB Aroclor 1260, a number of PCB congeners, DDD, and DDE were detected in a sample of American eel. Most concentrations were below MDPH trigger levels, however, the DDE and DDD concentrations in American eel exceeded the MDPH trigger level. Elevated DDE and DDD as well as high mercury concentrations resulted in the following advisory:

1. Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any American eel or largemouth bass from this waterbody.

2. The general public should limit consumption of American eel and largemouth bass to two meals per month.

It is unclear where PCBs and/or organochlorine pesticides like DDT might be originating, but, given the agricultural land use in the watershed, historic use of the pesticides or atmospheric deposition are two distinct possibilities. Concentrations do not appear to be indicative of an ongoing source of these contaminants.

Deerfield River: The sampled location on the Deerfield River is the impoundment located upstream from the power dam just northeast of Route 2 in Buckland and Charlemont. Land use in the Deerfield River watershed upstream from the sampling location is primarily forested and agricultural. Residential and commercial land uses make up less than four percent of the total (Duerring, et. al. 2004).

Mercury was well below the MDPH “trigger level” of 0.5 mg/kg in white sucker. Unfortunately no fish which are considered predators (worst case for mercury) were collected. Arsenic, lead, and cadmium were below MDL in white sucker. Selenium was detected but does not appear to be of concern (See Discussion section). PCB Aroclors, Congeners, and most organochlorine pesticides were below MDLs in white sucker. The sucker sample contained trace concentrations of DDE, however, DDE was below the MDPH “trigger level” of 0.06 mg/kg.

Ipswich River (Wenham Swamp): Wenham Swamp is an extensive wetland area on the Ipswich River which contains a mix of both forested and non-forested wetlands habitat types. There is a low head dam located approximately 2.2 km downstream, however, it is unclear if this dam affects water levels in Wenham Swamp. Although land use in the Ipswich River watershed upstream from the sampling location includes a diverse mixture of residential, forested, industrial, commercial, agricultural, and other land use types, low to medium residential and forested are the two dominant land uses.

Mercury exceeded the MDPH “trigger level” of 0.5 mg/kg in three of the five samples analyzed. Arsenic, lead, and cadmium were below MDLs in most samples analyzed. Arsenic was detected in a two fish composite of chain pickerel. Selenium was detected in all five samples however one data point was qualified. Arsenic and selenium do not appear to be of concern (See Discussion section). Trace concentrations of PCB congeners and DDE were detected in American eel and trace concentrations of DDE were also detected in white sucker. DDE concentrations were below the MDPH trigger level.

Elevated mercury concentrations resulted in the following advisory:

1. Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this waterbody.

2. The general public should limit consumption of all fish from this waterbody to two meals per month.

Millers River: Chosen as the result of a request by the Millers River Monitoring Coordinator, the Millers River was sampled upstream from Route 122 in the town of Orange. The Millers River watershed in the vicinity of the sampling station contains a diverse mix of land uses including forested, residential, commercial, industrial and agricultural. It should be noted that this location is downstream of the Otter River confluence.

MassDEP has sampled the Millers River on a number of occasions including 1985, 1987, 1988, and 2000. Due to the presence of PCBs in white sucker and other species, fish consumption advisories are currently in place on this segment of the Millers River. It is believed that the PCBs in Millers River fish originated in the Otter River.

Mercury was below the MDPH "trigger level" of 0.5 mg/kg in all but one individual white sucker. Arsenic, lead, and cadmium were below MDL in all samples. Selenium was detected but does not appear to be of concern (See Discussion section). PCB Aroclors and/or congeners were detected in all five individual white suckers and a composite of brown bullhead. It should be noted that PCB Aroclors did not exceed the MDPH trigger level or the USFDA Action level. One sucker sample contained trace concentrations of DDE, however, DDE was below the MDPH "trigger level" of 0.06 mg/kg.

Although the 2005 data may not in and of themselves warrant a fish consumption advisory, after reviewing these data, the MDPH made no changes to the existing advisory which states the following due to historic PCB data.

1.Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this waterbody.

2. The general public should limit consumption of American eel and brown trout to two meals per month.

3. The general public should limit consumption of non-affected fish from this waterbody to two meals per month.

Additional follow-up sampling is warranted to evaluate whether PCBs concentrations in white sucker are indeed declining or whether the sample was somehow not indicative of the true conditions in the Millers River.

Otter River: Also chosen as the result of a request by the Millers River Monitoring Coordinator, the Otter River was sampled just downstream of the village of Baldwinville in the town of Templeton. The Otter River watershed in the vicinity of the sampling station contains a mix of land uses including forested, residential, and industrial.

MassDEP has previously sampled the Otter River in 1988 and 2000. A fish consumption advisory is currently in place on this segment of the Otter River due to presence of PCBs in fish tissue.

Mercury was well below the MDPH "trigger level" of 0.5 mg/kg in the four samples analyzed. Arsenic, lead, and cadmium were below MDL in all samples. Selenium was detected but does not appear to be of concern (See Discussion section). PCB Aroclors and/or congeners were detected in all samples, however, it should be noted that PCB Aroclors did not exceed the MDPH trigger level or the USFDA Action level. In addition, a trace amount of DDE ("result qualified due to the analyte concentration being "greater than Method Detection Limit but less than Reporting Detection Limit") was detected in an individual white sucker sample. The detected concentration does not appear to be indicative of an ongoing source of DDE, and is below the MDPH trigger level.

Although the 2005 data may not in and of themselves warrant a fish consumption advisory, fish were on the small side and after reviewing the data, the MDPH made no changes to the existing advisory which states the following due to PCB contamination.

1.Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this waterbody.

2. The general public should limit consumption of brown bullhead and white sucker to two meals per month.

3. The general public should limit consumption of non-affected fish from this waterbody to two meals per month.

In light of the fact that four of five white suckers sampled in 2000 contained PCBs which exceeded the MDPH trigger level and the two sampled in 2005 did not, additional follow-up sampling is certainly warranted. It should be noted that the white sucker sampled in 2005 were slightly smaller than those sampled in 2000.

Indian Head River: The Indian Head River was sampled in the impoundment located at Ludhams Ford (Curtis Crossing) in Hanover and Pembroke. This location was originally sampled by MassDEP in 1995 as follow-up to finding high mercury in fishes from Factory Pond (1994 located just upstream). Mercury concentrations in the six samples analyzed in 1995 ranged from 0.828 to 1.52 mg/Kg wet weight. At that time PCB or pesticides were not detected.

As part of the ongoing site investigations/cleanup at a MassDEP Bureau of Waste Site Cleanup (BWSC) site known as National Fireworks Inc., consultants working in conjunction with this effort re-sampled Ludhams Ford Impoundment as well as a number of other locations within the Indian Head River watershed. Preliminary results indicated that mercury concentrations in fish samples from Ludhams Ford Impoundment were lower than previously measured by MassDEP. In light of this discrepancy, DWM re-sampled Ludhams Ford Impoundment in May 2005 in an effort to clarify current conditions with regard to mercury in fish tissue. In addition, offal was also sampled in 2005 for use in the BWSC ecological risk assessment .

Although the shoreline of the impoundment and banks of the Indian Head River are relatively un-impacted by residences, the watershed contains a mix of low to medium density residential, forested, and industrial land uses.

Mercury exceeded the MDPH "trigger level" of 0.5 mg/kg in all edible fillet samples analyzed (n=8). Numbers were highly elevated in largemouth bass, and black crappie. Arsenic, lead, and cadmium were below MDLs in all edible fillet samples analyzed (n=3). Selenium was detected in the three fillet samples, however, one data point was qualified. Selenium does not appear to be of concern (See Discussion section). Trace concentrations of PCB congeners and DDE were detected in black crappie fillets and trace concentrations of DDE were also detected in white perch fillets. DDE concentrations were below the MDPH trigger level. Elevated mercury concentrations detected in 2005 did nothing to affect the current advisory which follows:

1. The general public should not consume any fish from this waterbody.

The "Fireworks" site located upstream from the Indian Head Impoundment at Ludhams Ford and is likely the most significant source of mercury to the Indian Head River.

Conclusions

The 2005 Public Request and Watershed Surveys data sets support previous findings that mercury is a widespread problem, and that, although individual ponds or regions may be at higher risk, it is primarily a problem in predatory or piscivorous species. It is presumed that the mercury present in freshwater fish is due mainly to atmospheric deposition (near and far field emissions from incinerators and coal burning power plants) and possibly bedrock sources. Reducing direct human health risks associated with eating freshwater fish can best be accomplished through educating the public with regard to both fish bioaccumulation patterns as well as the implications of various levels of fish consumption.

It should be noted that, although the Fish Toxics Monitoring Program addresses the human health risk associated with the consumption of freshwater fishes, the mercury problem also poses threats with regard to ecological risks to piscivorous wildlife (Eisler 1987). Studies have shown that mercury poses a health risk to eagles, loons, and ospreys as well as many other species. Reductions with regard the amount of mercury in the municipal waste stream and the emissions noted above should reduce the environmental consequences of this contaminant. It is unclear how rapidly mercury concentrations will respond to recent changes in air emissions standards, however, recent studies of sediment cores from lakes suggest that mercury deposition rates may be on the decrease. (MassDEP 2006). It is impossible to predict how long it will take before concentrations in fish drop to a point where human and/or ecological health risks will reach acceptable levels.

The 2005 data set supports the assertion that PCBs remain essentially a problem in rivers and lakes that have received historic PCB discharges, and that high concentrations of organochlorine pesticides continue to be rare in edible fillets of freshwater fishes. It is apparent however that high lipid fishes and fish offal samples from all fishes can certainly bioaccumulate significant levels of PCB Aroclors and toxic congeners as well as DDT and it's metabolites. The MassDEP ORS and the MDPH continue to evaluate the potential impact of PCB toxic congeners with regard to fish consumption and the potential harm associated with eating whole fish and/or fish offal.

The DWM will continue to screen for contaminants in freshwater fishes as part of Public Request and Year 2 watershed surveys. DWM will also continue to cooperate with other state and federal agencies in an effort to better understand not only the distribution of fish tissue contaminants, but also temporal changes that may be taking place with regard to fish tissue contaminant levels.

This report has been forwarded to the departments participating on the Interagency Committee, the individuals requesting work, and the EOEA Watershed Team Leaders in the watersheds where screening or monitoring was conducted. Additional copies of this report are available from the MassDEP, Division of Watershed Management, 627 Main Street 2nd Floor, Worcester, MA 01608.

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APPENDIX A

Table 1. Analytical Results for 2005 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
Fort Meadow Reservoir, Marlborough/Hudson, Concord River Watershed													
FMP05-1	5/06/05	LMB	427	1040	2005001 (2005058-001)	<0.10	<0.10	0.25	<0.080	0.61	0.15	ND	DDE-0.0095M
FMP05-2	5/06/05	LMB	392	850									
FMP05-3	5/06/05	LMB	390	700									
FMP05-4	5/06/05	YP	259	180	2005002 (2005058-002)	<0.10	<0.10	0.097	<0.080	0.50	0.21	ND	ND
FMP05-5	5/06/05	YP	259	180									
FMP05-6	5/06/05	YP	249	180									
FMP05-7	5/06/05	B	210	140	2005003 (2005058-003)	<0.10	<0.10	0.16	<0.080	0.54	0.15	ND	ND
FMP05-8	5/06/05	B	218	140									
FMP05-9	5/06/05	B	205	120									
FMP05-10	5/06/05	WS	470	1200	2005004 (2005058-004)	<0.10	<0.10	0.072	<0.080	0.54	2.2	A1260-0.060 M BZ#114-0.0022M BZ#170-0.0027M BZ#180-0.0059 BZ138-0.0088 BZ#153-0.0050 BZ#187-0.0036M	Chlor-0.089 M DDE-0.029
FMP05-11	5/06/05	WS	404	790									
FMP05-12	5/06/05	WS	515	1400									
Round Pond, Tewksbury, Shawsheen River Watershed					2005013 RPF05-1-3 (2005089-001)	<0.10	<0.10	0.41	<0.080	0.19M	0.07	ND	ND
RPF05-1	6/01/05	LMB	408	910									
RPF05-2	6/01/05	LMB	380	720									
RPF05-3	6/01/05	LMB	427	1040									
RPF05-4	6/01/05	YP	258	220	2005014 RPF05-4-6 (2005089-002)	<0.10	<0.10	0.13	<0.080	0.23M	0.22	ND	ND
RPF05-5	6/01/05	YP	267	230									
RPF05-6	6/01/05	YP	271	290									
RPF05-7	6/01/05	BB	323	390	2005015 RFP05-7-9 2005089-003	<0.10	<0.10	0.028	<0.080	0.12M	0.68	ND	DDE-0.0056M
RPF05-8	6/01/05	BB	33.0	430									
RPF05-9	6/01/05	BB	323	410									
RPF05-7	6/01/05	P	193	170	2005016 RFP05-10-12 2005089-004	<0.10	<0.10	0.15	<0.080	0.24M	0.16	ND	ND
RPF05-8	6/01/05	P	201	200									
RPF05-9	6/01/05	P	182	150									

Table 1. Continued Analytical Results for 2005 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
Round Pond, Tewksbury, Shawsheen River Watershed					2005017 RPF05-13+14 (2005089-005)	<0.10	<0.10	0.35	<0.080	0.13M	0.08	ND	ND
RPF05-13	6/01/05	CP	445	480									
RPF05-14	6/01/05	CP	491	660									
Sampson Pond, Carver, Buzzards Bay Watershed					2005018 SPF05-1-3 (2005104-001)	<0.10	<0.10	0.26	<0.080	0.40	0.15	ND	DDE-0.0064M
SPF05-1	6/07/05	LMB	386	760									
SPF05-2	6/07/05	LMB	385	680									
SPF05-3	6/07/05	LMB	375	750									
SPF05-4	6/07/05	BB	379	650	2005019 SPF05-4-6 (2005104-002)	<0.10	<0.10	0.052	<0.080	0.26M	2.3	BZ#156-0.0012M BZ#138-0.0021M	DDD-0.019 DDE-0.041 Dieldrin-0.015Q
SPF05-5	6/07/05	BB	411	990									
SPF05-6	6/07/05	BB	364	690									
SPF05-7	6/07/05	WP	288	320	2005020 SPF05-7-9 (2005104-003)	<0.10	<0.10	0.50	<0.080	0.76	0.15	ND	DDE-0.027
SPF05-8	6/07/05	WP	284	270									
SPF05-9	6/07/05	WP	295	320									
SPF05-10	6/07/05	YP	213	110	2005021 SPF05-10-12 (2005104-004)	<0.10	<0.10	0.28	<0.080	0.58	0.10	ND	ND
SPF05-11	6/07/05	YP	229	120									
SPF05-12	6/07/05	YP	206	90									
SPF05-13	6/07/05	P	199	190	2005022 RPF05-13-15 (2005104-005)	<0.10	<0.10	0.13	<0.080	0.70	0.14	ND	ND
SPF05-14	6/07/05	P	213	200									
SPF05-15	6/07/05	P	207	200									
New Bedford Reservoir, Acushnet, Buzzards Bay Watershed					2005023 NBF05-1-3 (2005105-001)	<0.10	<0.10	0.52	<0.080	0.20M	0.05	ND	ND
NBF05-1	6/09/05	LMB	406	940									
NBF05-2	6/09/05	LMB	384	790									
NBF05-3	6/09/05	LMB	365	630									
NBF05-4	6/09/05	BC	244	190	2005024 NBF05-4-6 (2005105-002)	<0.10	<0.10	0.46	<0.080	0.23M	0.17	ND	ND
NBF05-5	6/09/05	BC	230	180									
NBF05-6	6/09/05	BC	210	140									
NBF05-7	6/09/05	YP	250	220	2005025 NBF05-7-9 (2005105-003)	<0.10	<0.10	0.22	<0.080	0.30M	0.16	ND	ND
NBF05-8	6/09/05	YP	246	200									
NBF05-9	6/09/05	YP	245	200									

Table 1. Continued Analytical Results for 2005 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
NBF05-10	6/09/05	B	209	200	2005026 NBF05-10-12 (2005105-004)	<0.10	<0.10	0.25	<0.080	0.23M	0.09	ND	ND
NBF05-11	6/09/05	B	207	220									
NBF05-12	6/09/05	B	220	210									
NBF05-13	6/09/05	AE	515	280									
NBF05-14	6/09/05	AE	432	170									
Deerfield River, Charlemont/Shelburne, Deerfield River Watershed					(2005151-001)	<0.050	<0.050	0.21	<0.080	0.43	3.3	ND	DDE-0.020
DRF05-1	6/17/05	WS	492	1260									
DRF05-2	6/17/05	WS	460	1060									
DRF05-3	6/17/05	WS	481	1270									
Ipswich River @ Wenham Swamp, Topsfield/Hamilton, Ipswich River Watershed					2005027 NBF05-13-15 (2005105-005) IRF05-1-3 (2005141-001)	<0.10 <0.050	<0.10 <0.050	0.39 0.55	<0.080 <0.080	0.26M 0.24	16 2.1	A1260-0.047M BZ#105-0.0041 BZ#128-0.0026M BZ#138-0.014 ND BZ153-0.031 BZ#187-0.0035M	DDD-0.030 DDE-0.073 DDE-0.012M
IRF05-1	7/01/05	WS	449	1040									
IRF05-2	7/01/05	WS	417	940									
IRF05-3	7/01/05	WS	417	970									
IRF05-4	7/01/05	YP	261	280	IRF05-4-6 (2005141-002)	<0.050	<0.050	0.65	<0.080	0.26	0.22	ND	ND
IRF05-5	7/01/05	YP	275	280									
IRF05-6	7/01/05	YP	281	300									
IRF05-7	7/01/05	P	209	230	IRF05-7-9 (2005141-003)	<0.050	<0.050	0.39	<0.080	0.32	0.51	ND	ND
IRF05-8	7/01/05	P	176	120									
IRF05-9	7/01/05	P	178	140									
NBF05-15	6/09/05	AE	397	130									
IRF05-10	6/01/05	CP	415	490	RPF05-10+11 (2005141-004)	<0.050	<0.050	0.69	0.12	0.13M	0.17	ND	ND
IRF05-11	6/01/05	CP	370	310									
IRF05-12	7/01/05	AE	495	240	IRF05-12+13 (2005141-005)	<0.050	<0.050	0.41	<0.080	0.36	20	BZ#180-0.0018M BZ#138-0.0084 BZ#187-0.0074	DDE-0.039 Dieldrin. 0.0076Q
IRF05-13	7/01/05	AE	488	210									

Table 1. Continued Analytical Results for 2005 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
Millers River, Orange, Millers River Watershed					MRF05-1 (2005151-001)	<0.050	<0.050	0.62	<0.080	0.41	1.1	BZ#138-0.0069	DDE-0.0098M
MRF05-1	7/11/05	WS	429	780									
MRF05-2	7/11/05	WS	465	870	MRF05-2 (2005151-002)	<0.050	<0.050	0.41	<0.080	0.30	0.70	BZ#180-0.0039 BZ#138-0.0084	ND
MRF05-3	7/11/05	WS	421	760	MRF05-3 (2005151-003)	<0.050	<0.050	0.42	<0.080	0.19	1.4	A1254-0.36 A1260-0.11 BZ#105-0.028 BZ#118-0.051 BZ#156-0.0049 BZ#170-0.0044 BZ#180-0.0098 BZ#28-0.029 BZ#44-0.026 BZ#66-0.072 BZ#101-0.032 BZ#128-0.0079 BZ#138-0.024 BZ#153-0.036 BZ#187-0.0098 BZ#195-0.0015M	ND
MRF05-4	7/11/05	WS	435	820	MRF05-4 (2005151-004)	<0.050	<0.050	0.33	<0.080	0.31	0.70	A1254-0.11 BZ#105-0.021 BZ#118-0.030 BZ#44-0.017 BZ#66-0.034 BZ#101-0.022 BZ#138-0.010 BZ#-0.023	ND
MRF05-5	7/11/05	WS	430	680	MRF05-5 (2005151-005)	<0.050	<0.050	0.43	<0.080	0.25	1.0	A1254-0.24 A1260-0.027M BZ#105-0.023 BZ#118-0.028 BZ#180-0.0025M BZ#28-0.059 BZ#44-0.035 BZ#52-0.027 BZ#66-0.062 BZ#101-0.029 BZ#138-0.012 BZ#153-0.024	DDE-0.0067M
MRF05-6	7/11/05	CP	371	310	MRF05-6-8 (2005151-006)	<0.050	<0.050	0.38	<0.080	0.20	0.11	ND	ND
MRF05-7	7/11/05	CP	411	470									
MRF05-8	7/11/05	CP	385	310									

Table 1. Continued Analytical Results for 2005 Fish Toxics Monitoring Public Request and Year 2 Watershed Surveys. Results reported in wet weight, are from composite samples of fish fillets (skin off).

Sample ID	Collection Date	Species Code[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
MRF05-9	7/11/05	YP	240	160	MRF05-9-11 (2005151-007	<0.050	<0.050	0.26	<0.080	0.26	0.14	ND	ND
MRF05-10	7/11/05	YP	238	180									
MRF05-11	7/11/05	YP	219	140									
MRF05-12	7/11/05	B	211	190	MRF05-12-14 (2005151-008)	<0.050	<0.050	0.23	<0.080	0.32	0.23	ND	ND
MRF05-13	7/11/05	B	184	150									
MRF05-14	7/11/05	B	180	130									
MRF05-15	7/11/05	BB	259	220									

Otter River, Templeton, Millers River Watershed													
ORF05-1	7/12/05	WS	349	430	ORF05-1 (2005151-010)	<0.050	<0.050	0.26	<0.080	0.18	0.84	BZ#28-0.020 BZ#44-0.015 BZ#52-0.020 BZ#101-0.019 BZ#138-0.0084	DDE-0.0080M
ORF05-2	7/12/05	WS	360	530	ORF05-2 (2005151-011)	<0.050	<0.050	0.17	<0.080	0.26	0.55	A1242-0.19 A1254-0.16 BZ#105-0.022 BZ#118-0.030 BZ#28-0.035 BZ#44-0.029 BZ#52-0.027	ND
					MRF05-15+16 (2005151-009)	<0.050	<0.050	0.26	<0.080	0.15M	0.12	BZ#66-0.026 BZ#101-0.025 BZ#138-0.0089 BZ#153-0.021	ND
ORF05-3 ORF05-4 ORF05-5	7/12/05 7/12/05 7/12/05	FF FF FF	223 220 195	110 110 70	ORF05-3-5 (2005151-012	<0.050	<0.050	0.19	<0.080	0.24	1.1	A1242-0.15 A1254-0.12 A1260-0.031M BZ#105-0.022 BZ#118-0.031 BZ#28-0.033 BZ#44-0.024 BZ#52-0.033 BZ#66-0.044 BZ#101-0.025 BZ#138-0.0099 BZ#153-0.023	ND
MRF05-16	7/11/05	BB	235	170									

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Sample ID	Collection Date	Species Code[1]	Length (mm)	Weight (g)	Sample ID (laboratory sample #)	Cd (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	As (mg/kg)	Se (mg/kg)	% Lipids (%)	PCB Aroclors and Congeners (µg/g)	Pesticides (µg/g)
ORF05-6 ORF05-7 ORF05-8	7/12/05 7/12/05 7/12/05	P P P	122 120 120	40 30 30	ORF05-6-8 (2005151-013)	<0.050	<0.050	0.15	<0.080	0.19	0.16	A1242-0.045M A1254-0.074 BZ#105-0.020 BZ#118-0.026 BZ#28-0.022 BZ#44-0.014 BZ#52-0.026 BZ#66-0.032 BZ#101-0.021 BZ#138-0.0064	ND

[1] Species Code	Common Name	*Scientific name*	Data Qualifiers as reported by WES
AE	American eel	*Anguilla rostrata*	H = USEPA holding time exceeded (Cd, Pb, and Se 6 - months)
B	bluegill	*Lepomis macrochirus*	M = analyte concentration greater than Method Detection Limit but less than Reporting Detection Limit
BB	brown bullhead	*Ameiurus nebulosus*	ND = analyzed for, but not detected above Method Detection Level
BC	black crappie	*Pomoxis nigromaculatus*	**<** = not detected or the analytical result is at or below the established Method Detection Limit
CP	chain pickerel	*Esox niger*	Q= qualified because no method validation has been determined for this compound.
FF	fallfish	*Semotilus corporalis*	
LMB	largemouth bass	*Micropterus salmoides*	
P	pumpkinseed	*Lepomis gibbosus*	
WP	white perch	*Morone Americana*	
WS	white sucker	*Catostomus commersoni*	
YP	yellow perch	*Perca flavescens*	

Table 2. Analytical Results for 2005 Indian Head River Fish Toxics Monitoring Survey. Results reported in wet weight, are from composite or individual samples of fish fillets (skin off) or offal (the remainder of the fish).

Species Code[1]	Length mm	Total Weight g	Sample Weight g	Sample Type[2]	Sample ID (laboratory sample #)	Cd[3] mg/kg	Pb[3] mg/kg	Hg[3] mg/kg	As mg/kg	Se[3] mg/kg	Lipids (%)	PCB Aroclors and Congeners[3] ug/g	Persticides[3] ug/g
Indian Head River Hanover/Pembroke South Coastal Watershed													
LMB	515	1720		EF	2005005 IHRF05-1 (2005079-001)			2.0					
LMB	366	720		EF	2005006 IHRF05-2 (2005079-002)			1.6					
LMB	344	600		EF	2005007 IHRF05-3 (2005079-003)			1.4					
LMB	378	900		EF	2005008 IHRF05-4 (2005079-004)			1.5					
WS WS WS	521 474 510	500 1160 1300		EF	2005009 IHRF05-5-7 (2005079-005C)			1.2					
WP WP WP	240 244 230	180 200 160	138.1	EF	2005010 IHRF05-8-10 (2005079-006)	<0.10	<0.10	0.86	<0.080	0.41	0.42		DDE-0.013 M
			412.7	OF	2005010A IHRF05-8-10A (2005079-009)	<0.10	0.51	0.51	<0.080	0.87	2.7	A1260-0.12 BZ#118-0.025 BZ#170-0.0039 BZ#180-0.0073 BZ#44-0.014 BZ#138-0.012 BZ#153-0.027 BZ#187-0.0098	DDD-0.038 DDE-0.10
BC BC BC	239 255 274	200 200 330	183.9	EF	2005011 IHRF05-11-13 (2005079-007)	<0.10	<0.10	2.1	<0.080	0.23 M	0.15	BZ#180-0.0040 BZ#138-0.0069 BZ#187-0.0074	DDE-0.0091 M
			542.4	OF	2005011A IHRF05-11-13A (2005079-010)	<0.10	0.49	0.94	<0.080	0.42	0.91	A1260-0.10 BZ#118-0.024 BZ#170-0.0034 BZ#180-0.0083 BZ#101-0.021 BZ#138-0.012 BZ#153-0.028 BZ#187-0.0088	DDD-0.011 M DDE-0.052
B B B	239 255 274	200 200 330	97.1	EF	2005012 IHRF05-14-16 (2005079-008)	<0.10	<0.10	0.57	<0.080	0.26 M	0.17	ND	ND
			322.9	OF	2005012A IHRF05-14-16A (2005079-011)	<0.10	0.66	0.27	<0.080	0.34	2.8	A1260-0.056M BZ#118-0.026 BZ#170-0.0035M BZ180-0.0069 BZ#101-0.019 BZ#138-0.011 BZ#153-0.026 BZ#187-0.0084	DDD-0.032 DDE-0.094 DDT-0.0091

Table 2. Continued. Analytical Results for 2005 Indian Head River Fish Toxics Monitoring Survey. Results reported in wet weight, are from composite or individual samples of fish fillets (skin off) and/or offal (the remainder of the fish).

[1] Species Code	Common Name	*Scientific name*	[2] Sample Type
LMB	largemouth bass	*Micropterus salmoides*	Individual fillets
WS	white sucker	*Catostomus commersoni*	Composite fillets
WP	white perch	*Morone americana*	Composite fillets and offal
BC	black crappie	*Pomoxis nigromaculatus*	Composite fillets and offal
B	bluegill	*Lepomis macrochirus*	Composite fillets and offal

Table 3. 2005 Fish Toxics Analytical Methods, Project Quantitation Limits, Method Detection and Reporting Detection Limits.

Analyte/Compound	Units	Project Quantitation Limit (PQL)	Achievable Laboratory Method Detection Limit (MDL)	Laboratory Reporting Detection Limit (RDL)	Method
Lipid Concentration	%	N/A	N/A	N/A	Modified AOAC 983.21
Arsenic	ug/g wet	Unknown	0.080	0.080	EPA 200.9
Cadmium	ug/g wet	Unknown	0.20	0.60	EPA 200.7
Lead	ug/g wet	Unknown	0.20	0.60	EPA 200.7
Mercury	ug/g wet	0.5	0.020	0.060	EPA 245.6
Selenium	ug/g wet	Unknown	0.20	0.60	EPA 200.7
PCB Aroclor 1232	µg/g wet	1.0 (total)	0.019	0.057	Modified AOAC 983.21
PCB Aroclor 1242	µg/g wet	1.0 (total)	0.019	0.057	Modified AOAC 983.21
PCB Aroclor 1248	µg/g wet	1.0 (total)	0.038	0.11	Modified AOAC 983.21
PCB Aroclor 1254	µg/g wet	1.0 (total)	0.013	0.039	Modified AOAC 983.21
PCB Aroclor 1260	µg/g wet	1.0 (total)	0.022	0.066	Modified AOAC 983.21
Chlordane	µg/g wet	0.3	0.046	0.14	Modified AOAC 983.21
Toxaphene	µg/g wet	Unknown	0.045	0.14	Modified AOAC 983.21
a-BHC	µg/g wet	Unknown	0.0054	0.016	Modified AOAC 983.21
b-BHC	µg/g wet	Unknown	0.0055	0.017	Modified AOAC 983.21
Lindane	µg/g wet	Unknown	0.0056	0.017	Modified AOAC 983.21
d-BHC	µg/g wet	Unknown	0.012	0.036	Modified AOAC 983.21
Hexachlorocyclopentadiene	µg/g wet	Unknown	0.038	0.11	Modified AOAC 983.21
Hexachlorobenzene	µg/g wet	Unknown	0.018	0.054	Modified AOAC 983.21
Trifluralin	µg/g wet	Unknown	0.032	0.096	Modified AOAC 983.21
Heptachlor	µg/g wet	0.3	0.0078	0.023	Modified AOAC 983.21
Heptachlor Epoxide	µg/g wet	Unknown	0.027	0.081	Modified AOAC 983.21
Methoxychlor	µg/g wet	Unknown	0.018	0.054	Modified AOAC 983.21
DDD	µg/g wet	5.0 (total)	0.0051	0.015	Modified AOAC 983.21
DDE	µg/g wet	5.0 (total)	0.0055	0.017	Modified AOAC 983.21
DDT	µg/g wet	5.0 (total)	0.0064	0.019	Modified AOAC 983.21
Aldrin	µg/g wet	5.0 (total)	0.0057	0.017	Modified AOAC 983.21
PCNB	% recovery	NA	NA	NA	Modified AOAC 983.21
PCB Congener BZ # 8	µg/g wet	Unknown	0.0010	0.0030	Modified AOAC 983.21
PCB Congener BZ # 18	µg/g wet	Unknown	0.0016	0.0048	Modified AOAC 983.21
PCB Congener BZ # 28	µg/g wet	Unknown	0.0033	0.0099	Modified AOAC 983.21
PCB Congener BZ # 44	µg/g wet	Unknown	0.0010	0.0030	Modified AOAC 983.21
PCB Congener BZ # 52	µg/g wet	Unknown	0.0022	0.0066	Modified AOAC 983.21
PCB Congener BZ # 66	µg/g wet	Unknown	0.0022	0.0066	Modified AOAC 983.21
PCB Congener BZ # 101	µg/g wet	Unknown	0.0022	0.0066	Modified AOAC 983.21
PCB Congener BZ # 128	µg/g wet	Unknown	0.0012	0.0036	Modified AOAC 983.21
PCB Congener BZ # 138	µg/g wet	Unknown	0.0017	0.0051	Modified AOAC 983.21
PCB Congener BZ # 153	µg/g wet	Unknown	0.0014	0.0042	Modified AOAC 983.21
PCB Congener BZ # 187	µg/g wet	Unknown	0.0022	0.0066	Modified AOAC 983.21
PCB Congener BZ # 195	µg/g wet	Unknown	0.0011	0.0033	Modified AOAC 983.21

Table 3. Continued. 2005 Fish Toxics Analytical Methods, Project Quantitation Limits, Method Detection and Reporting Detection Limits.

Analyte/Compound	Units	Project Quantitation Limit (PQL)	Achievable Laboratory Method Detection Limit (MDL)	Laboratory Reporting Detection Limit (RDL)	Method
PCB Congener BZ # 206	µg/g wet	Unknown	0.0012	0.0036	Modified AOAC 983.21
PCB Congener BZ # 209	µg/g wet	Unknown	0.0014	0.0042	Modified AOAC 983.21
PCB Congener BZ # 81	µg/g wet	Unknown	0.0010	0.0030	Modified AOAC 983.21
PCB Congener BZ # 77	µg/g wet	Unknown	0.0046	0.014	Modified AOAC 983.21
PCB Congener BZ # 123	µg/g wet	Unknown	0.0013	0.0039	Modified AOAC 983.21
PCB Congener BZ # 118	µg/g wet	Unknown	0.0012	0.0036	Modified AOAC 983.21
PCB Congener BZ # 114	µg/g wet	Unknown	0.0013	0.0039	Modified AOAC 983.21
PCB Congener BZ # 105	µg/g wet	Unknown	0.0013	0.0039	Modified AOAC 983.21
PCB Congener BZ # 126	µg/g wet	Unknown	0.0032	0.0096	Modified AOAC 983.21
PCB Congener BZ # 167	µg/g wet	Unknown	0.0012	0.0036	Modified AOAC 983.21
PCB Congener BZ # 156	µg/g wet	Unknown	0.0011	0.0033	Modified AOAC 983.21
PCB Congener BZ # 157	µg/g wet	Unknown	0.0012	0.0036	Modified AOAC 983.21
PCB Congener BZ # 180	µg/g wet	Unknown	0.0012	0.0036	Modified AOAC 983.21
PCB Congener BZ # 169	µg/g wet	Unknown	0.0006	0.0018	Modified AOAC 983.21
PCB Congener BZ # 170	µg/g wet	Unknown	0.0013	0.0039	Modified AOAC 983.21
PCB Congener BZ # 189	µg/g wet	Unknown	0.0013	0.0039	Modified AOAC 983.21
Phenol	µg/g wet	Unknown	N/A	250	EPA 8270C
2-Chlorophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
NDPA	µg/g wet	Unknown	N/A	250	EPA 8270C
2-Nitrophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
Dichlorophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
Napthalene	µg/g wet	Unknown	0.050	2.5	EPA 8270C
4-Chloro-3-methylphenol	µg/g wet	Unknown	N/A	250	EPA 8270C
Hexachlorcyclopentadiene	µg/g wet	Unknown	N/A	2.5	EPA 8270C
Trichlorophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
Dimethyl phthalate	µg/g wet	Unknown	N/A	2.5	EPA 8270C
Acenaphathylene	µg/g wet	Unknown	0.060	2.5	EPA 8270C
Acenaphthene	µg/g wet	Unknown	0.070	2.5	EPA 8270C
2,4-Dinitrophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
4-Nitrophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
Florene	µg/g wet	Unknown	0.080	2.5	EPA 8270C
Diethylphthalate	µg/g wet	Unknown	N/A	2.5	EPA 8270C
Pentachlorophenol	µg/g wet	Unknown	N/A	250	EPA 8270C
Phenanthrene	µg/g wet	Unknown	0.12	2.5	EPA 8270C
Anthracene	µg/g wet	Unknown	0.13	2.5	EPA 8270C
Dibutylphthalate	µg/g wet	Unknown	N/A	2.5	EPA 8270C
Fluoranthene	µg/g wet	Unknown	0.17	2.5	EPA 8270C
Pyrene	µg/g wet	Unknown	0.15	2.5	EPA 8270C
Butylbenzylphthalate	µg/g wet	Unknown	N/A	2.5	EPA 8270C
Bis(2-ethylhexyl)adipate	µg/g wet	Unknown	N/A	2.5	EPA 8270C

Table 3. Continued. 2005 Fish Toxics Analytical Methods, Project Quantitation Limits, Method Detection and Reporting Detection Limits.

Analyte/Compound	Units	Project Quantitation Limit (PQL)	Achievable Laboratory Method Detection Limit (MDL)	Laboratory Reporting Detection Limit (RDL)	Method
Benzo(a)anthracene	µg/g wet	Unknown	0.14	2.5	EPA 8270C
Chrysene	µg/g wet	Unknown	0.14	2.5	EPA 8270C
Bis(2-ethylhexyl)phthalate	µg/g wet	Unknown	N/A	2.5	EPA 8270C
Benzo(b)fluoranthene	µg/g wet	Unknown	0.13	2.5	EPA 8270C
Benzo(k)fluoranthene	µg/g wet	Unknown	0.14	2.5	EPA 8270C
Benzo(a)pyrene	µg/g wet	Unknown	0.11	2.5	EPA 8270C
Indeno(1,2,3-cd)pyrene	µg/g wet	Unknown	0.14	2.5	EPA 8270C
Dibenzo(ah)anthracene	µg/g wet	Unknown	0.13	2.5	EPA 8270C
Benzo(ghi)perylene	µg/g wet	Unknown	0.13	2.5	EPA 8270C

Notes:
1) "**NA**"= Not Applicable, no data provided
2) "**Unknown**" = no information available or no Data Quality Objective defined at this time.
3) Analyte MDL/RDL values are based on most recent analyses by WES (2004), and as all Detection Limit values, subject to change.
4) Methods
-EPA 200.7 – Metals and Trace Elements
-EPA 200.9 – Trace Elements
-EPA 245.6 – Mercury in Tissues by Cold Vapor
-EPA 8270C – Semivolatile Organic Compounds by GC/MS Cap Col
-Modified AOAC 983.21 - Organochlorine Pesticide and Polychlorinated Biphenyl Residues in Fish, Gas Chromatographic Method, Method 983.21. In Association of Official Analytical Chemists (AOAC) Official Methods of Analysis, 15th ed., AOAC, Arlington, VA.

Appendix B

Interagency Committee on Freshwater Fish Toxics Monitoring and Assessment

MEMORANDUM OF UNDERSTANDING
April 1994

MEMBERSHIP: The Committee is comprised of representatives from the following Departments and programs:

- Department of Environmental Protection -
  Office of Watershed Management (OWM)
  Division of Water Pollution Control (DWPC)
  Office of Research and Standards (ORS)
  Division of Environmental Analysis (DEA)
- Department of Public Health
  Environmental Toxicology Program (ETP)
  Physician Education Unit (PEU)
  Community Assessment Unit (CAU)
  Environmental Laboratory (EL)
- Department of Fisheries, Wildlife and Environmental Law Enforcement
  Division of Fisheries and Wildlife (DFW)

INTRODUCTION: The freshwater fish toxics testing efforts of Massachusetts are headed by the MA Department of Environmental Protection (DEP) in cooperation with the MA Department of Public Health (DPH), the Department of Fisheries, Wildlife and Environmental Law Enforcement (DFWELE). The DPH leads efforts to determine the public health impacts of consuming contaminated fish from various locations. These collaborative efforts ensure the state's ability to conduct limited testing and evaluation of contaminants in fish tissue for purposes of protecting public health and the environment. This Memorandum of Understanding (MOU) is limited to the freshwater environment.

PURPOSE: This Memorandum of Understanding is issued by the Interagency Committee to formalize and communicate its goals, objectives and responsibilities for monitoring and assessing toxic contaminants in fresh water fish in Massachusetts.

AUTHORITY: Specific legal mandates do not exist for testing freshwater fish for toxic contaminants. This work, however, is viewed as desirable by the three agencies relative to their respective authorities and mandates, including but not limited to, protecting public health, controlling toxic substances in the environment and protecting wildlife resources. This committee does not have responsibility to direct testing of fish for contaminants at hazardous material sites, but does participate in the process as part of the Superfund programs.

OBJECTIVES: The primary objective of the MOU is to establish a formal interagency mechanism to facilitate the communication, coordination and

dissemination of information pertaining to contaminants in freshwater fish. The objectives of the fish monitoring efforts are described below. Monitoring and assessment activities are planned annually and are based on the agencies' respective available resources. Therefore, in any given year, the scope of the monitoring and assessment efforts may or may not fulfill some or all of the following objectives.

- To determine the public health impacts from human consumption of contaminated fish species from various freshwater bodies in the Commonwealth.
- To develop appropriate technical support documents and public health advisories.
- To develop outreach strategies and environmental education programs for health care professionals, local health agencies and the potentially exposed target populations.
- To coordinate posting efforts with appropriate local, state and federal agencies.
- To provide information useful in managing and controlling toxic pollutants.
- To provide fish monitoring data for use as part of the overall assessment of the health of ecosystems.
- To respond to public requests for fish testing through a standardized questionnaire and ranking process to identify priority sites to be tested.
- To establish and maintain a statewide toxics-in-fish database for use by state and federal agencies, research and educational institutions and other interested parties.
- To conduct research and development projects to enhance fish monitoring activities and the overall health of the fish populations and associated ecosystems of the Commonwealth.

RESPONSIBILITIES: Each of the three agencies named in this MOU have responsibilities unique to its mission. Specific responsibilities that relate to current activities are described below:

- All members of the Interagency Committee participate in the overall planning of the Massachusetts fish toxics program, including the prioritization of testing sites, publication of fish toxics data and their use in assessing the health of ecosystems in Massachusetts.
- The Director of the Office of Research and Standards chairs and coordinates the activities of the Interagency Committee.
- DPH-ETP will formalize a protocol for evaluating the public health risks of consuming contaminated fish. DEP-ORS will work closely with DPH on this protocol to ensure that DEP's risk analysis program is considered.
- DPH-ETP will develop a standard interim protocol for development of fish advisories by spring of 1994. DPH is responsible for decisions regarding the need for public health advisories and for implementing them.

- DPH-ETP in conjunction with DPH-CAU will identify & notify human populations whose health may be affected due to consumption of contaminated fish.
- DPH-ETP in conjunction with DPH-PEU will provide relevant health information to health professionals (Boards of Health, medical community, etc.) and the public regarding potential hazards related to consumption of contaminated fish.
- DEP-OWM will plan and conduct annual fish sampling efforts in conjunction with DFWELE-DFW. DEP-OWM will collect and prepare fish samples, manage data and report results to the committee.
- DEP-OWM will utilize monitoring results for decisions on NPDES permits, for managing nonpoint pollution sources and to provide information for the Chapter 21E site discovery program in cases where oil and hazardous material contaminant levels are found in fish.
- DEP-DWPC will use monitoring results for determining compliance with Surface Water Quality Criteria and water use impairments.
- DFW is responsible for managing and regulating fishing as well as protecting, maintaining, and restorating the Commonwealth's freshwater fish populations.
- DEP-DEA provides QA/QC technical support to the OWM and the Interagency Committee dealing with fish sampling and sample management.
- DEP-DEA analyzes fish and related samples for toxic chemicals and other contaminants, and provides the validated data to the OWM and the Interagency Committee. DPH-EL will provide review and comment on analytical laboratory issues.
- In cooperation with the OWM and the Interagency Committee, DEP-DEA & ORS conduct and publish research dealing with the development and improvement of methods for the analysis of toxic and other contaminants in fish and other aquatic organisms; this includes evaluation of methods for assessing the exposure of fish populations to toxicants (e.g., approaches involving biomarkers and toxicity testing).
- DEP-DEA & ORS advise the OWM and the Interagency Committee on all matters related to the laboratory analysis of fish samples.

MEETINGS: Meetings are scheduled as needed. Meetings in the fall and early winter months generally focus on planning annual sampling activities. Spring meetings generally focus on the evaluations of laboratory analyses and appropriate agency responses.

This MOU will be reviewed and revised as necessary on an annual basis. The following signatures indicate that the three participating agencies view their work duties as set forth in this Memorandum of Understanding as being part of their respective responsibilities for controlling toxic contaminants in the environment, protecting the public health and protecting wildlife resources.

Tom Powers
Acting Commissioner
Department of Environmental Protection

David Mulligan
Commissioner
Department of Public Health

Wayne F. MacCallum
Director
Division of Fisheries & Wildlife
Department of Wildlife & Environmental Law Enforcement

Appendix C

FORM FOR REQUESTING FISH TESTING

The following information will be reviewed by representatives of the Departments of Environmental Protection, Public Health and Fisheries and Wildlife to reach a decision regarding the need for the state to conduct freshwater fish toxics testing. Please answer these questions to the extent possible.

1. Name of the pond/lake river:_____

2. Location (city/town):_____

3. Why do you think that testing is necessary?_____

_____

_____

_____

4. If known, what type of testing is requested? Please state what chemical(s) or compounds are suspected:

_____

_____

5. Do you know of any private testing that has been done at this location? If so, please submit the results, including the quality assurance and control data:_____

_____

_____

_____

_____

6. Do you and your family fish at this location? (Please check one):

Yes___ No___

7. Please estimate how many fish meals you and your family consume over the course of a year of fish caught at this location? (Please check one):

   None (0)____ One (1) Meal a Month _____ 2-4 Meals a Month_____

8. What kind of fish do you eat from this location?:_____

   _____

   _____

   _____

   _____

9. Please not below any additional information you think might be useful in reviewing this request (Example: known or suspected pollution source):

   _____

   _____

   _____

   _____

   _____

   _____

   Your Name: _____

   Address: _____

   Telephone: _____

Thank you for taking the time to provide us with the above information. We will consider your request and will respond to you in mid to late February.

Please return this form to:

Robert Maietta
Department of Environmental Protection
Division of Watershed Management
627 Main Street, 2nd Floor
Worcester, MA 01608

Appendix D

CRITERIA FOR RANKING FISH TOXICS TESTING REQUESTS

Criteria for evaluating and ranking requested fish toxics studies have been developed for the purpose of ensuring that the state's fish toxics testing efforts are aimed at the situations that are most critical for protecting public health and the environment. In addition to prioritizing state efforts, the criteria and ranking scheme provide that all requested studies will be evaluated consistently.

A requested fish testing study will fall into one of four possible categories, where Category A is the highest priority and Category D is the lowest. Table 1 is followed by specific definitions of the criteria used.

TABLE 1

CATEGORY A		
	1.	The location is **heavily-fished**, and
	2.	Have **strong evidence** which indicates a potential for fish contamination.
CATEGORY B		
B1	1.	The location is **moderately-fished**, and
	2.	Have **strong evidence** which indicates a potential for fish contamination.
B2	1.	The location is **heavily-fished**, and
	2.	Have **some evidence** which indicates a potential for fish contamination.
CATEGORY C		
C1	1.	The location is **lightly-fished**, and
	2.	Have **strong evidence** which indicates a potential for fish contamination.
C2	1.	The location is **moderately-fished**, and
	2.	Have **some evidence** which indicates a potential for fish contamination.
C3	1.	The location is **heavily-fished**, and
	2.	Have **no evidence** which indicates a potential for fish contamination.
CATEGORY D		
D1	1.	The location is **lightly-fished**, and
	2.	Have **some or no evidence** which indicates a potential for fish contamination.
D2	1.	The location is **moderately-fished**, and
	2.	Have **no evidence** which indicates a potential for fish contamination.

DEFINITION OF CRITERIA

A. Criteria to estimate the frequency of exposure to fish that is consumed from a *single* location over the course of a year.

1. **Heavily-fished** - the location is one where the amount of fish caught comprise a substantial fraction of diets of individuals. A substantial fraction of the diet is classified when it is estimated that the number of fish meals exceeds four per month or when in the range of two to four meals per month.
2. **Moderately-fished** - the location is one where the amount of fish caught comprise some fairly consistent fraction of diets of individuals and is at a moderate level. A moderate level of fish consumption is classified when the number of fish meals is estimated at one a month throughout the year.
3. **Lightly-fished** - information indicates that fishing and consumption of fish from the location is rare or null.

B. Criteria to estimate the weight of evidence for a potential fish contamination problem at a given location.

1. **Strong evidence** – exists when there is knowledge that

    a. known sources release chemicals into the location (sources include point and/or nonpoint sources), and

    b. the chemicals are ones that tend to bioaccumulate/biomagnify in fish (ex. mercury, PCBs) and have been associated with human health effects traced to the consumption of contaminated fish.

    c. In addition to the above or in combination with either (a) or (b), the fish populations at the location have been shown to indicate evidence of toxic exposure, for example, fish are contaminated or are exposed to toxics associated with fish tumors, lesions, abnormal growth, or reproductive effects.

2. **Some evidence** – exists when there is knowledge that

    a. known sources release chemicals into the location (sources include point and/or nonpoint sources), and

    b. the chemicals are ones that do not bioaccumulate/biomagnify extensively in fish (ex. heavy metals) and have not been commonly associated with human health effects traced to the consumption of contaminated fish.

    c. The fish populations at the location have not been shown to indicate evidence of toxic exposure to toxics associated with fish tumors, lesions, abnormal growth, or reproductive effects.