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Contaminant Sampling to Facilitate Dam Removals/Habitat Restoration in New England

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Table of Contents

LIST OF TABLES 4
LIST OF FIGURES 4
APPENDICES 4
LIST OF ACRONIMS/ABBREVIATIONS 5
1.0 Abstract 6
2.0 Introduction 6
3.0 Methods and Materials 7
4.0 Results 8
4.1 MASSACHUSETTS 8
4.2 NEW HAMPSHIRE 9
4.3 Rhode Island 9
4.4 VERMONT 10
5.0 Discussion and Management Recommendations 11
6.0 Acknowledgements 12
7.0 Literature Cited 12

LIST OF TABLES

Table 1. Summary results for the nine sites sampled as part of this study 8

LIST OF FIGURES

Figure 1. Eel River Bog and Sampling Locations 14
Figure 2. Eel River Dam and Sampling Locations 15
Figure 3. Merrimack Village Dam and Sampling Locations 16
Figure 4. Kenyon Dam and Sampling Locations 17
Figure 5. Lower Shannock Dam and Sampling Locations 18
Figure 6. Dufresne Pond Dam and Sampling Locations 19
Figure 7. East Burke Dam and Sampling Locations 20
Figure 8. Island Corps Dam and Sampling Locations 21
Figure 9. Lower Eaton Dam and Sampling Locations 22

APPENDICES

Appendix I. USFWS STANDARD OPERATING PROCEDURES (SOPs) FOR SEDIMENT SAMPLING BEHIND DAMS
Appendix II. Contaminant Levels in Sediments at the Eel River Bog, MA
Appendix III. Contaminant Levels in Sediments at the Eel River Dam, MA
Appendix IV. Contaminant Levels in Sediments at the Merrimack Village Dam, NH
Appendix V. Contaminant Levels in Sediments at the Kenyon Dam, RI
Appendix VI. Contaminant Levels in Sediments at the Lower Shannock Dam, RI
Appendix VII. Contaminant Levels in Sediments at the Dufresne Pond Dam, VT
Appendix VIII. Contaminant Levels in Sediments at the East Burke Dam, VT
Appendix IX. Contaminant Levels in Sediments at the Island Corps Dam, VT
Appendix X. Contaminant Levels in Sediments at the Lower Eaton Dam, VT

LIST OF ACRONIMS/ABBREVIATIONS

ACF	Analytical Control Facility
BHC	benzenehexachloride
DDD	dichlorodiphenyldicloroethane
DDE	dichlorodiphenyldicloroethylene
DDT	dichlorodiphenyltricloroethane
DEQ	Division of Environmental Quality (USFWS)
HCB	hexachlorobenzene
mg/kg	milligrams per kilogram (or parts-per-million)
ug/kg	micrograms per kilogram (or parts-per-billion)
OC	organochlorine
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEC	probable effect concentration
PEL	probable effects level
ppb	parts-per-billion
ppm	parts-per-million
QA/QC	quality assurance/quality control
SOP	standard operating procedure
TEC	threshold effect concentration
TEL	threshold effect level
USFWS	U.S. Fish and Wildlife Service
Zn	zinc

1.0 Abstract

In a screening level survey of sediments impounded by New England dams that were being investigated for possible removal, only one of nine sites had contaminant levels below threshold effect levels for metals, organochlorines, and polynuclear aromatic hydrocarbons. One additional site had levels that exceeded threshold effect levels, but did not exceed probable effect levels. The remaining seven sites exceeded probable effect levels in at least one of the three contaminant groups. It is important to conduct contaminant testing early in the process so that any sediment abatement measures can be factored into the total cost of the project.

Keywords: New England, impoundment, dam, contaminants, sediment, metals, organochlorines, polynuclear aromatic hydrocarbons, Regional ID: 5F39, DEQ ID: 20035004, Congressional Districts: MA (9), New Hampshire (1), Rhode Island (2), Vermont (1).

2.0 Introduction

It is well documented that dams significantly change the physical, chemical, and biological properties of riverine ecosystems (Baxter 1977, Devine 1995, Ligon et al. 1995, Chatterjee 1997). Awareness of the ecological costs of impounded rivers combined with the diminished economic returns/liabilities of these aging structures has made dam removal a viable management option. Post-removal studies have demonstrated the positive environmental benefits of dam removal (Hill et al. 1993, Dadswell 1996). These results can occur quite quickly. Stanley and Luebke (2002) reported that within one year of dam removal, macroinvertebrate assemblages in formally impounded reaches did not significantly differ from those in either the upstream reference site or in other unimpounded reaches below the dam site.

Recognizing the opportunity to restore anadromous fish and endangered freshwater mussel habitats, the New England Field Office participates on a number of state task forces examining individual dams for possible removal. The dams in New England being considered for removal are associated with known 19th and 20th century industrial sites, with the potential for the impounded sediments to contain contaminant levels high enough to pose a risk to aquatic life during the re-mobilization of sediments following dam removal. The state of Connecticut experienced this problem when one of its dam removal projects resulted in contamination of downstream surficial sediments after a dam was removed (Rick Jacobson, Connecticut Department of Environmental Protection, personal communication). Because of this concern, a contaminant survey of impounded sediments is normally required on all dams prior to removal. This requirement has been problematic. Although funds exist for removal actions, it has been difficult to obtain funds for pre-removal assessment activities, with resultant delays of up to two years. Our objective was to conduct a screening level environmental contaminant assessment of impounded sediments from nine dams in New England targeted for potential removal to ensure that contaminant levels were below thresholds that would harm aquatic life.

3.0 Methods and Materials

Site selection was accomplished by consulting the various federal, state, and non-governmental agencies involved with dam removal activities in New England. These organizations have conducted technical and political assessments to determine the most feasible removal projects. Sites were selected based on owner interest, engineering constraints, projected cost, and overall resource benefits.

A Standard Operating Procedure (Appendix I) was developed to guide sample collection. Five sampling points were selected based on the SOP criteria.[1] Samples were taken using an Ekman, Ponar, or Wildco stainless steel corer, depending on the sediment conditions. All samples were analyzed using USFWS ACF approved QA/QC methodologies and laboratories. Analytes included Total Organic Carbon (TOC), grain size analysis, percent moisture, a metals scan, an organochlorine (OC) scan, and a polynuclear aromatic hydrocarbon (PAH) scan.[2] The analytical results were compared to two different sediment quality guidelines (Buchman 1999 and MacDonald et al. 2000) to determine risk to aquatic biota. The two threshold effect levels were the Threshold Effect Concentration (TEC) and the Threshold Effects Level (TEL), and the two probable effect levels were the Probable Effect Concentration (PEC) and the Probable Effects Level (PEL).

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[1] There were five deviations from the SOP. At three sites (Merrimack Village Dam, Kenyon Dam, and Lower Shannock Dam), the first sample was not taken below the dam due to safety/access issues. At Eel River Dam, only 4 sediment samples were collected due to the small size of the impoundment. At East Burke Dam, the sample numbers were inadvertently reversed with sample #5 collected below the dam and sample #1 collected at the head of the impoundment.

[2] Because of the agricultural history of the site, an organophosphate/carbamate scan was included for the Eel River Bog sediments.

4.0 Results

Summary

At only one of nine sites (East Burke) did we document no exceedence of the selected sediment quality guidelines. At one additional site (Merrimack Village), threshold levels were reached, but probable effect levels were not. At all of the other sites, probable effect levels were reached in at least one of the contaminant groups (Table 1).

Table 1. Summary results for the nine sites sampled as part of this study. **Y** denotes that at least one of the samples exceeded the sediment quality guidelines.

	Metals		Organochlorines		PAHs	
Site	**TEC/TEL**	**PEC/PEL**	**TEC/TEL**	**PEC/PEL**	**TEC/TEL**	**PEC/PEL**
Massachusetts						
Eel River Bog	N	N	**Y**	**Y**	N	N
Eel River Dam	**Y**	N	**Y**	**Y**	**Y**	**Y**
New Hampshire						
Merrimack Village	N	N	**Y**	N	**Y**	N
Rhode Island						
Kenyon	**Y**	N	**Y**	N	**Y**	**Y**
Lower Shannock	**Y**	N	**Y**	N	**Y**	**Y**
Vermont						
Dufresne Pond	**Y**	**Y**	N	N	**Y**	N
East Burke	N	N	N	N	N	N
Island Corp	**Y**	N	N	N	**Y**	**Y**
Lower Eaton	**Y**	**Y**	N	N	**Y**	N

4.1 MASSACHUSETTS

Eel River Bog (Figure 1, Appendix II**)**
Waterbody: Eel River **Date Sampled:** 09/25/06

Metals: All results were below threshold effect levels.

Organics: Total DDE, Total DDT, and endrin sediment levels exceeded threshold effect levels in at least one sample. Total DDD, p,p-DDE, and dieldrin sediment levels exceeded probable effect levels in at least one sample.

PAHs: All results were below threshold effect levels.

Organophosphates/carbamates: All results were below threshold effect levels.

Eel River Dam (Figure 2, Appendix III)
Waterbody: Eel River **Date Sampled:** 09/25/06

Metals: Arsenic, cadmium, and lead sediment levels exceeded threshold effect levels in at least one sample.

Organics: Total PCB sediment levels exceeded threshold effect levels in at least one sample. P,p-DDD, Total DDD, p,p-DDE, Total DDE, p,p-DDT, Total DDT, and dieldrin sediment levels exceeded probable effect levels in at least one sample.

PAHs: Anthracene, fluoranthene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, and Total PAH sediment levels exceeded threshold effect levels in at least one sample. Phenanthrene and pyrene sediment levels exceeded probable effect levels in at least one sample.

4.2 NEW HAMPSHIRE

Merrimack Village Dam (Figure 3, Appendix IV)
Waterbody: Souhegan River **Date Sampled:** 10/10/03

Metals: All results were below threshold effect levels.

Organics: Total PCB sediment levels exceeded threshold effect levels in at least one sample.

PAHs: Pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, and Total PAH sediment levels exceeded threshold effect levels in at least one sample.

4.3 Rhode Island

Kenyon Dam (Figure 4, Appendix V)
Waterbody: Pawcatuck River **Date Sampled:** 08/17/06

Metals: Cadmium and lead sediment levels exceeded threshold effect levels in at least one sample.

Organics: Total DDD, p,p-DDE, Total DDE, and Total PCB sediment levels exceeded threshold effect levels in at least one sample.

PAHs: Anthracene, fluoranthene, pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[a]pyrene, dibenz[a,h]anthracene, and Total PAH sediment levels exceeded threshold effect levels in at least one sample. Phenanthrene sediment levels exceeded probable effect levels in at least one sample.

Lower Shannock Dam (Figure 5, Appendix VI)
Waterbody: Pawcatuck River **Date Sampled:** 10/12/04

Metals: Cadmium chromium, lead, and mercury sediment levels exceeded threshold effect levels in at least one sample.

Organics: P,p-DDD, Total DDD, and Total DDE sediment levels exceeded threshold effect levels in at least one sample. Total PCB sediment levels exceeded probable effect levels in at least one sample.

PAHs: Anthracene, benzo[b]fluoranthene, and dibenz[a,h]anthracene sediment levels exceeded threshold effect levels in at least one sample. Naphthalene, fluorine, phenanthrene, fluoranthene, pyrene, benz[a]anthracene, chrysene, benzo[a]pyrene, and Total PAH sediment levels exceeded probable effect levels in at least one sample.

4.4 VERMONT

Dufresne Pond Dam (Figure 6, Appendix VII)
Waterbody: Batten Kill River **Date Sampled:** 09/07/05

Metals: Cadmium, nickel, and zinc sediment levels exceeded threshold effect levels in at least one sample. Mercury sediment levels exceeded probable effect levels in at least one sample.

Organics: All results were below threshold effect levels.

PAHs: Phenanthrene, pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, and benzo[a]pyrene exceeded threshold effect levels in at least one sample.

East Burke Dam (Figure 7, Appendix VIII)
Waterbody: East Branch of the Passumpsic River **Date Sampled:** 05/13/04

Metals: All results were below threshold effect levels.

Organics: All results were below threshold effect levels.

PAHs: All results were below threshold effect levels.

Island Corp Dam (Figure 8, Appendix IX)
Waterbody: Saxtons River **Date Sampled:** 09/29/04

Metals: All results were below threshold effect levels.

Organics: All results were below threshold effect levels.

PAHs: Phenanthrene, anthracene, chrysene, benzo[b]fluoranthene, benzo[a]pyrene, and dibenz[a,h]anthracene sediment levels exceeded threshold effect levels in at least one sample. Pyrene and benz[a]anthracene sediment levels exceeded probable effect levels in at least one sample.

Lower Eaton Dam (Figure 9, Appendix X)
Waterbody: First Branch, White River **Date Sampled:** 10/12/04

Metals: Cadmium and nickel sediment levels exceeded threshold effect levels in at least one sample. Copper sediment levels exceeded probable effect levels in at least one sample.

Organics: All results were below threshold effect levels.

PAHs: Phenanthrene, pyrene**,** benz[a]anthracene, benzo[b]fluoranthene, and benzo[a]pyrene sediment levels exceeded threshold effect levels in at least one sample.

5.0 Discussion and Management Recommendations

One of the most important points to make about this study is to point out what it does not do. It was never our intention to conduct sampling in such a way as to fully characterize the extent of contamination at any one site. Our methods were selected to provide a **screening** level assessment of contaminant levels in surficial sediments. This study does not, and can not, answer questions such as how extensive is the contamination, how deep are the sediments contaminated, or are levels high enough to impact aquatic life if the sediments are allowed to be transported downstream? Our intent was that any exceedence of sediment quality criteria would trigger additional sampling at the individual sites to answer these more specific questions. We readily admit that threshold effect values are quite conservative in their prediction of risk to aquatic life, and that site-specific variables determine whether a contaminant will be bioavailable. An example of this process took place at the Merrimack Village Dam. PAH and PCB exceedence of threshold effect levels triggered additional sediment collection for toxicity testing. A 10-day survival and growth test using the freshwater amphipod *Hyalella azteca* was performed using sediment collected from two sites in the impoundment. Mean survival rates were 86% and 94% as compared to the lab control of 88%. Growth rates were slightly higher as compared to the control organisms (Gomez and Sullivan 2004). Based on these results, the issue of sediment toxicity was resolved and the project moved forward. The project timeline anticipates that removal of this dam will occur during low flow conditions in the summer of 2008.

Since dams act as effective barriers to sediment transport in river systems, we anticipated that we would find contaminated sediments at the majority of our sites. Our results confirm this not unexpected result, but they also reinforce the need to test for contaminants at each site where dam removal is being considered so as to preclude

inadvertently spreading the contaminated sediment downstream. There are times when a barrier to sediment transport has protected downstream habitat. A detailed review of the data from the Eel River Dam (Appendix III) reveals that while sediment samples from the impoundment had levels of DDT and its metabolites well above the probable effect levels, the downstream sample had only one constituent (p,p-DDE) above the threshold effect levels. Projects where sediment contaminant levels are elevated do not preclude removal of dam structures, but they do necessitate consideration of sediment abatement measures as part of the project planning process to accurately reflect the total cost of dam removal.

6.0 Acknowledgements

We would like to thank the USFWS, Division of Environmental Quality for funding this project, Dr. Tim Fannin, Regional EC Coordinator for his assistance and encouragement, and biologists Lisa Cavallaro, Eric Derleth, Melissa Grader, Tony Tur, and Jim Turek for assistance with sample collection.

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Figure 1. Eel River Bog and Sampling Locations

Figure 2. Eel River Dam and Sampling Locations

Figure 3. Merrimack Village Dam and Sampling Locations

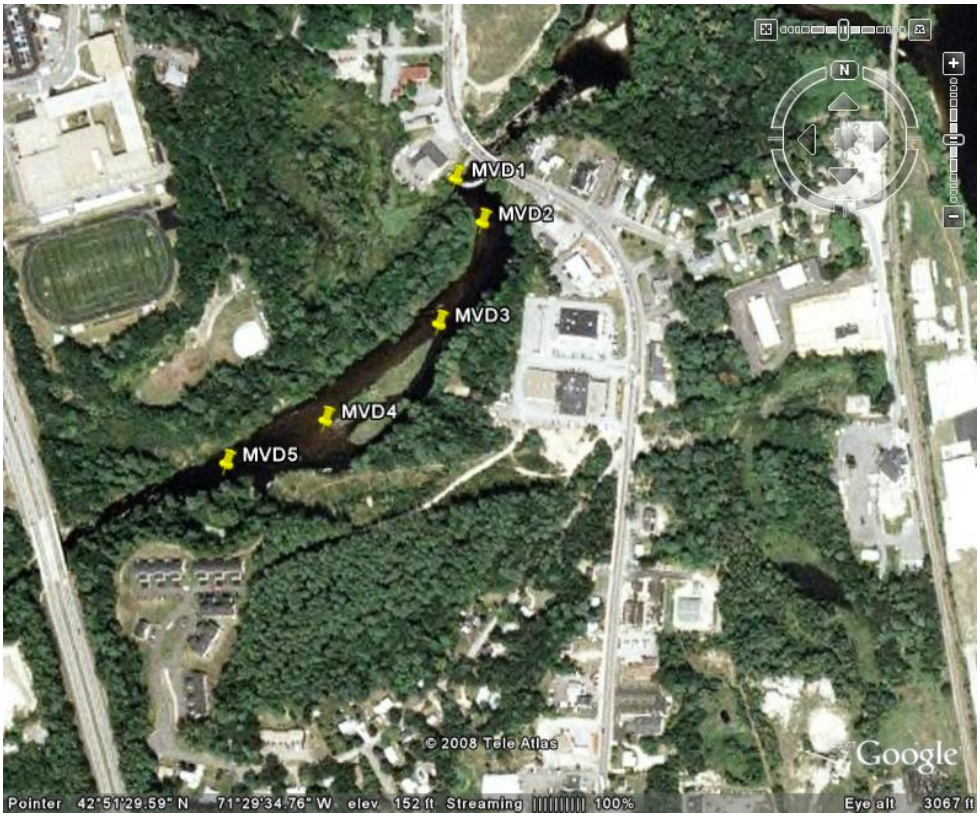

Figure 4. Kenyon Dam and Sampling Locations

Figure 5. Lower Shannock Dam and Sampling Locations

Figure 6. Dufresne Pond Dam and Sampling Locations

Figure 7. East Burke Dam and Sampling Locations

Figure 8. Island Corps Dam and Sampling Locations

Figure 9. Lower Eaton Dam and Sampling Locations

Appendix I. USFWS Standard Operating Proceedures (SOPs) for sediment sampling behind dams.

USFWS STANDARD OPERATING PROCEDURES (SOPs) FOR SEDIMENT SAMPLING BEHIND DAMS

Scope: These SOPs are intended to describe procedures for a **screening-level** survey of contaminants in sediments behind dams where the pool is relatively small. These procedures are not intended for large impoundments, where contamination issues have already been identified, or where the primary objective is to determine both historical and current contaminant levels. More extensive sampling will be needed for these particular situations. It is important to note that no sampling plan survives in it's entirety after a day in the field. It **is** important to document the reasons for deviating from protocol in field notebooks for future reference if issues of data quality arise later.

Additional References: The primary reference for sediment sampling protocols is:

Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual (EPA-823-B-01-002). 2001. It is available online at http://www.epa.gov/waterscience/cs/collection.html

Additional references include:
US EPA ERT SOP #2006: Sampling Equipment Decontamination. 1994.
US EPA ERT SOP #2016: Sediment Sampling. 1994.

Where to Sample: Because the projects that we typically examine are relatively small, we have been taking samples at five different locations (adapted from NH DES)

- one (1) directly downstream of the dam
- one (1) in the impoundment as close to the dam face as safety allows
- two (2) in the impoundment
- one (1) at the head of the impoundment

At every sampling station, it is important to attempt to sample in depositional areas whenever possible. Depositional zones typically contain fine-grained sediment deposits which are targeted because fine-grained sediments are a more likely repository for pollutants. If practical, try and space the impoundment samples equal distance apart (i.e. if the sample at the dam represents the end of the impoundment, space the other three samples at 1/3 and 2/3 and at the head of the impoundment). If you have inputs to the impoundment other than the river (like an intermittent stream), you should take additional samples.

At each sampling station, you will need to take multiple grabs in order to collect enough sediment and to get a representative sample of the area (this is called a composite sample). Our standard procedure is to take one sample from the bow of the boat and one from each side. Because sampling stirs up bottom sediments, it's important to take samples starting from downstream and moving upstream so as not to potentially contaminate subsequent samples.

What to Sample With: There are two general types of sediment collection devices; core samplers and grab samplers. If one of the objectives of the study is to look at historical verses recent contamination or there is a need to characterize contamination in deeper sediments, than a coring device should be employed. For the purposes of our screening-level surveys, we typically use grab samplers. It is important to come prepared with a variety of tools. Each sampler has its own strengths and weaknesses. If the sediments are soft and fined-grained, an Eckman works well. If the impoundment is not deep, the preferred configuration is an Eckman mounted on a pole (as opposed to a rope deployment). The biggest drawback to the Eckman is that it does not work well in anything but soft sediments. The sampler that we use most often is a petit ponar (a standard ponar is too heavy for hand deployment). It has the weight to punch through sediment that the Eckman will just bounce off of. There will be sites where even the ponar bounces off the bottom without a sample. In that case, we resort to collecting samples using a hand auger as long as the water depth is shallow enough.

In addition to the sampling devices, you will need to have equipment to hold the sediment, homogenate it, and fill your sampling jars. All spoons, trowels, mixing bowls, and buckets should be made of stainless steel. Don't forget your personal protective equipment. Nitrile gloves should be worn whenever sampling equipment is handled.

What to Sample For (and How Much Sample is Needed): This question is site specific. It's important to know information about the site history in order to determine the probability of encountering different classes of contaminants. If the impoundment is surrounded by active agricultural lands, pesticide residues will be an important component. If the area has an industrial past, metals (and potentially PCBs) will be important. Urban sites and sites near roads or railroads might have PAH issues. In addition to the chemical constituents, each sample should also be tested for grain size and Total Organic Carbon (TOC).

How much sample is needed depends on the tests that you will be conducting. Refer to the EPA Technical Manual (Table 2-3) for specific requirements. It is important to make sure that you place your samples in the appropriate sample container. We always use pre-cleaned containers (ICHEM is one vendor). Refer to the EPA Technical Manual (Table 4-1) for specific requirements. As an example, this is our list for each sampling site for a "typical" impoundment:

Analyte	Volume	Container
Metals Scan	500 ml	Plastic
Organochlorine Scan	500 ml	Glass

TOC	250 ml	Glass
Grain Size	250 ml	Plastic
PAH	500 ml	Amber Glass[1]

[1]PAHs are photoreactive. You could also wrap the glass jar in aluminum foil.

Decontamination: Section 3.4 of the EPA Technical Manual describes decontamination procedures. One thing to note is that we **strongly** disagree with the statement that "*site water rinse of equipment in between stations is normally sufficient*". All sampling gear (including spoons, trowels, mixing bowls, and buckets) need to be decontaminated between each sampling station. Our decontamination procedure consists of the following:

(1) soap and water wash (use a non-phosphate soap like Liqui-Nox)
(2) tap water rinse
(3) distilled water rinse
(4) acetone rinse
(5) distilled water rinse
(6) nitric acid rinse
(7) distilled water rinse

Make sure that you're collecting the rinsate in containers and not just dumping it on the ground. Also, remember to don a new pair of gloves for each new sampling site. Finally, once you've arrived at the next sampling site, give each of the sampling tools a final rinse by dipping it in the reservoir two or three times before you use it.

Prior to Field Collection:

It's advantageous to have all the sampling gear decontaminated and wrapped in aluminum foil prior to setting out for the field. It makes collecting the first sample that much easier (no need for decon before the first sample). It also makes it easier in the field if the appropriate number and type of sampling jars are pre-labeled and organized. Don't forget to put waterproof tape over the labels! All field gear (GPS, camera, field notebooks, PPE, etc.) need to be assembled and organized (don't forget extra batteries). Make sure to include coolers for samples in the field gear list. Finally, we've found it useful to make up field data sheets (on Rite-in-the-Rain paper). This ensures that we don't forget to record pieces of data during sampling.

Documentation:

Refer to the EPA Technical Manual (Recommendation Box #3: page 3-16). A common mistake is to record too little information. If a sample result comes back from the lab and the results are very different from other samples from the same impoundment, your field notes will be invaluable.

Final Tidbits:

As much as possible, try and remove all the non-sediment debris from your sample (sticks, leaves, plant material, biota, etc.) before you begin filling your jars (don't forget to wear gloves!). It is important to homogenize the sample as thoroughly as is possible. Keep stirring until the sediment appears uniform throughout. If the sediment is fine-grained, let the sample sit for a few minutes after homogenization before decanting the water on top to allow the fine particles to settle. For ALL samples, decant the mixing bowl/bucket slowly so as not to lose the fines (a turkey baster works pretty well for this task). If you have samples in glass containers and you plan to freeze then upon returning to the office, DO NOT fill them to the top! The jars will break in the freezer. Leave enough room for the sediment to expand (3/4 full).

After you've filled each jar with sample, perform a final decant to remove as much remaining water as you can without loosing the fine material. Use site water to clean off the jar threads so that the jar lids seal well. Rinse the outside of the jar with site water and place the sample in a ziplock bag that has the sample number written on the outside (in case the label falls off the jar). Place the samples in a cooler with wet ice as soon as you can after collection.

Feel free to contact me with any questions that you have

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Appendix II. Contaminant Levels in Sediments at the Eel River Bog, Massachusetts.

Analyte *(1)*	Sediment Concentrations at Eel River Bog					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ERB1	**ERB2**	**ERB3**	**ERB4**	**ERB5**	**TEC**	**PEC**	**TEL**	**TEL**	**PEL**	**UET**	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	3.0	3.1	3.2	4.5	3.3	9.79	33	10.8	5.9	17	17	M
Cadmium	0.4	0.5	0.4	0.4	0.4	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	3.0	4.2	4.3	4.5	3.8	43.4	111	36.3	37.3	90	95	H
Copper	3.8	4.4	6.5	2.0	2.0	31.6	149	28.0	35.7	197	86	I
Lead	BDL	BDL	BDL	BDL	7.0	35.8	128	37	35	91.3	127	H
Mercury	BDL	BDL	BDL	BDL	BDL	0.18	1.06		0.17	0.49	0.56	M
Nickel	BDL	BDL	BDL	BDL	BDL	22.7	48.6	19.5	18	35.9	43	H
Zinc	7.3	9.6	9.2	6.6	5.0	121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**0.6**	**0.7**	**1.0**	**1.8**	**0.3**
Grain Size Analysis (%)					
% Sand	**96.0**	**95.7**	**97.6**	**94.3**	**95.9**
% Silt	**2.0**	**2.3**	**<1**	**4.4**	**2.0**
% Clay	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**
Percent Moisture (%)	**28.3**	**27.3**	**27.2**	**29.5**	**26.8**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix II (continued). Contaminant Levels in Sediments at the Eel River Bog, Massachusetts.

Analyte *(1)*	Sediment Concentrations at Eel River Bog					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ERB1	ERB2	ERB3	ERB4	ERB5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	16.2	74.5	10.4	93.1	6.47				3.54	8.51	60	I
Sum-DDD	**18.83**	**84.04**	**12.12**	**105.7**	**7.53**	4.88	28					I
p,p-DDE	**8.25**	**16.7**	**5.78**	**14.6**	**6.00**				1.42	6.75	50	I
Sum-DDE	**8.25**	**16.935**	**5.78**	**14.773**	**6.05**	3.16	31.3					I
p,p-DDT	1.43	12.1	1.11	1.19	0.972						<50	I
Sum-DDT	1.763	**12.705**	1.74	1.78	1.22	4.16	62.9					I
Aldrin	9.77	12.2	126	167	272						40	I
alpha-BHC	0.0434	0.0423	0.036	BDL	0.0622							
beta-BHC	BDL	BDL	BDL	0.388	BDL							
delta-BHC	BDL	BDL	BDL	0.0487	0.0669							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	0.231	0.507	0.535	0.244	0.198	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	1.2	BDL	0.14	0.22	0.19							
Dieldrin	**21.5**	**21.1**	**1440**	**113**	**141**	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	0.178	BDL	0.339	0.152							
Endrin	0.0615	0.204	**8.7**	0.951	1.23	2.22	207		2.67	62.4	500	I
HCB	BDL	0.153	0.173	0.111	0.0949						100	
Heptachlor	0.25	0.0948	0.104	0.0877	0.0529						10	I
Heptachlor epoxide	0.0615	0.147	0.424	0.0643	BDL	2.47	16		0.6	2.74	30	I
Mirex	0.102	BDL	BDL	BDL	BDL							
cis-Nonachlor	0.049	0.0583	0.455	0.172	0.179							
trans-Nonachlor	0.0615	0.0656	0.114	BDL	0.042							
Oxychlordane	BDL	BDL	BDL	0.659	0.165							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	6.71	18.8	29.1	21.8	12.8	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL
11.1 A detected concentration exceeded the PEC/PEL
BDL Below Detection Limit

Appendix II (continued). Contaminant Levels in Sediments at the Eel River Bog, Massachusetts.

Analyte *(1)*	Sediment Concentrations at Eel River Bog					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ERB1	ERB2	ERB3	ERB4	ERB5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	BDL	4.87	BDL	13.5	3.9	176	561	15			600	I
2-Methylnaphthalene	BDL	6.34	BDL	5.11	2.3							
Acenaphthalene	BDL	2.43	BDL	BDL	BDL						160	M
Acenaphthene	BDL	BDL	BDL	5.69	BDL						290	M
Fluorene	BDL	BDL	BDL	9.51	BDL	77.4	536	10			300	M
Phenanthrene	4.7	12.4	3.5	76.7	10.2	204	1,170	19	42	515	800	I
Anthracene	BDL	2.8	BDL	8.5	BDL	57	845	10			260	M
Fluoranthene	8.2	18.7	3.9	30.4	12.5	423	2,230	31	111	2,355	1,500	M
Pyrene	6.63	15.6	3	13.8	9.57	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	2.91	5.17	BDL	4.62	3.48	108	1,050	16	32	385	500	I
Chrysene	4.21	11.1	2.32	9.9	7.02	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	5.93	12	2.88	10.3	8.8	27	13,400					
Benzo[k]fluoranthene	BDL	3.64	BDL	BDL	2.3			27			13,400	B
Benzo[a]pyrene	2.87	6.01	BDL	BDL	3.45	150	1,450	32	32	782	700	I
Benzo[e]pyrene	2.74	5.92	BDL	3.68	3.94							
Indeno[1,2,3-cd]pyrene	2.84	6.46	2.14	4.62	4.33			17			330	M
Dibenz[a,h]anthracene	BDL	BDL	BDL	BDL	BDL	33		10			100	M
Total Selected PAHs	41.0	113.4	17.7	196.3	71.8	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix III. Contaminant Levels in Sediments at the Eel River Dam, Massachusetts.

Analyte *(1)*	Sediment Concentrations at Eel River Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ERD1	**ERD2**	**ERD3**	**ERD4**		**TEC**	**PEC**	**TEL**	**TEL**	**PEL**	**UET**	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	8.4	**15.0**	**17.0**	4.5		9.79	33	10.8	5.9	17	17	M
Cadmium	**1.0**	**1.8**	**2.7**	**0.9**		0.99	4.98	0.58	0.60	3.53	3	I
Chromium	6.3	18.0	26.0	7.7		43.4	111	36.3	37.3	90	95	H
Copper	12.0	27.0	31.0	10.0		31.6	149	28.0	35.7	197	86	I
Lead	10.0	**40.0**	**50.0**	22.0		35.8	128	37	35	91.3	127	H
Mercury	BDL	BDL	0.1	BDL		0.18	1.06		0.17	0.49	0.56	M
Nickel	BDL	9.0	10.0	BDL		22.7	48.6	19.5	18	35.9	43	H
Zinc	39.0	67.0	99.0	28.0		121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**0.8**	**10.3**	**17.3**	**1.6**	
Grain Size Analysis (%)					
% Sand	**95.9**	**77.8**	**22.2**	**90.8**	
% Silt	**2.0**	**14.6**	**50.8**	**6.0**	
% Clay	**2.1**	**7.0**	**27.0**	**3.1**	
Percent Moisture (%)	**37.8**	**76.0**	**86.6**	**63.9**	

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix III (continued). Contaminant Levels in Sediments at the Eel River Dam, Massachusetts.

Analyte *(1)*	Sediment Concentrations at Eel River Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ERD1	ERD2	ERD3	ERD4		TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	7.83	**166**	**271**	**198**					3.54	8.51	60	I
Sum-DDD	9.89	**193.2**	**313.9**	**240.1**		4.88	28					I
p,p-DDE	**6.21**	**51.6**	**83.9**	**48.6**					1.42	6.75	50	I
Sum-DDE	6.377	**52.92**	**85.24**	**50.15**		3.16	31.3					I
p,p-DDT	2.21	5.57	**65.4**	6.29							<50	I
Sum-DDT	2.499	**6.63**	**67.77**	**7.15**		4.16	62.9					I
Aldrin	2.84	7.48	16.2	7.92							40	I
alpha-BHC	0.0783	0.199	0.215	0.0523								
beta-BHC	0.0968	0.375	0.268	0.22								
delta-BHC	BDL	0.0773	BDL	BDL								
gamma-BHC (Lindane)	0.0527	0.181	0.704	0.325		2.37	4.99		0.94	1.38	9	I
gamma Chlordane	0.112	0.318	0.598	0.377		3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	0.353	6.08	15.6	5.44								
Dieldrin	2.56	**13**	**43.7**	**12.8**		1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	BDL	BDL								
Endrin	BDL	BDL	BDL	BDL		2.22	207		2.67	62.4	500	I
HCB	0.048	0.131	0.251	0.0523							100	
Heptachlor	0.11	0.101	0.215	0.224							10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL		2.47	16		0.6	2.74	30	I
Mirex	0.228	BDL	BDL	0.119								
cis-Nonachlor	0.047	0.256	0.484	0.228								
trans-Nonachlor	0.085	BDL	0.176	0.119								
Oxychlordane	0.108	BDL	0.229	0.218								
Toxaphene	BDL	BDL	BDL	BDL								
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	28.2	**64.5**	**95.4**	**66.1**		59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL/UET

BDL Below Detection Limit

Appendix III (continued). Contaminant Levels in Sediments at the Eel River Dam, Massachusetts.

Analyte *(1)*	Sediment Concentrations at Eel River Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ERD1	ERD2	ERD3	ERD4		TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	49.7	40.2	40.6	22.9		176	561	15			600	I
2-Methylnaphthalene	101	40.1	39	21.6								
Acenaphthalene	35.5	52.6	88.4	73.7							160	M
Acenaphthene	80.3	11.5	14.3	9.66							290	M
Fluorene	153	42.1	58.5	40.9		77.4	536	10			300	M
Phenanthrene	658	428	777	506		204	1,170	19	42	515	800	I
Anthracene	176	76.4	132	102		57	845	10			260	M
Fluoranthene	704	609	1090	799		423	2,230	31	111	2,355	1,500	M
Pyrene	556	525	901	681		195	1,520	44	53	875	1,000	I
Benz[a]anthracene	311	182	331	257		108	1,050	16	32	385	500	I
Chrysene	266	301	561	441		166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	377	422	775	495		27	13,400					
Benzo[k]fluoranthene	83.6	109	179	126				27			13,400	B
Benzo[a]pyrene	197	184	327	259		150	1,450	32	32	782	700	I
Benzo[e]pyrene	208	178	329	251								
Indeno[1,2,3-cd]pyrene	132	162	292	216				17			330	M
Dibenz[a,h]anthracene	33.9	36.1	66.8	52.9		33		10			100	M
Total Selected PAHs	**4122.0**	**3399.0**	**6001.6**	**4354.7**	0.0	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix IV. Contaminant Levels in Sediments at the Merrimack Village Dam, New Hampshire.

Analyte *(1)*	Sediment Concentrations at Merrimack River Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	MVD1	MVD2	MVD3	MVD4	MVD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	2.9	2.3	4.2	2.4	6.4	9.79	33	10.8	5.9	17	17	M
Cadmium	BDL	BDL	BDL	BDL	0.3	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	6.0	5.1	8.3	4.3	14.0	43.4	111	36.3	37.3	90	95	H
Copper	3.1	2.0	4.5	2.0	6.8	31.6	149	28.0	35.7	197	86	I
Lead	7.0	7.0	10.0	BDL	10.0	35.8	128	37	35	91.3	127	H
Mercury	BDL	BDL	BDL	BDL	BDL	0.18	1.06		0.17	0.49	0.56	M
Nickel	BDL	BDL	BDL	BDL	7.0	22.7	48.6	19.5	18	35.9	43	H
Zinc	30.0	23.0	35.0	19.0	60.0	121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**0.4**	**1.9**	**0.8**	**0.7**	**0.0**
Grain Size Analysis (%)					
% Sand	**95.4**	**97.3**	**85.2**	**99.6**	**68.7**
% Silt	**3.6**	**2.1**	**12.2**	**0.3**	**24.8**
% Clay	**1.0**	**0.6**	**2.6**	**1.0**	**6.6**
Percent Moisture (%)	**28.8**	**22.3**	**35.4**	**12.6**	**52.9**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix IV (continued). Contaminant Levels in Sediments at the Merrimack Village Dam, New Hampshire.

Analyte *(1)*	Sediment Concentrations at Merrimack River Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	MVD1	MVD2	MVD3	MVD4	MVD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	0.166	0.132	0.378	BDL	0.588				3.54	8.51	60	I
Sum-DDD	0.41	0.231	0.813	0	1.15	4.88	28					I
p,p-DDE	0.644	0.264	1.47	BDL	2.17				1.42	6.75	50	I
Sum-DDE	0.644	0.264	1.539	0	2.24	3.16	31.3					I
p,p-DDT	0.089	0.099	0.275	BDL	0.621						<50	I
Sum-DDT	0.089	0.099	0.275	0.00	0.74	4.16	62.9					I
Aldrin	BDL	BDL	BDL	BDL	BDL						40	I
alpha-BHC	BDL	BDL	BDL	BDL	BDL							
beta-BHC	BDL	BDL	BDL	BDL	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	BDL	0.055	0.153	BDL	BDL	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	0.244	BDL	0.227	BDL	0.305							
Dieldrin	BDL	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	0.175	BDL	BDL							
Endrin	BDL	BDL	BDL	BDL	BDL	2.22	207		2.67	62.4	500	I
HCB	BDL	BDL	BDL	BDL	BDL						100	
Heptachlor	BDL	BDL	BDL	BDL	BDL						10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL	BDL	2.47	16		0.6	2.74	30	I
Mirex	BDL	BDL	BDL	BDL	BDL							
cis-Nonachlor	BDL	BDL	0.069	BDL	0.076							
trans-Nonachlor	0.122	BDL	0.195	BDL	0.338							
Oxychlordane	BDL	BDL	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	17.2	4.76	**44.1**	BDL	**51.6**	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix IV (continued). Contaminant Levels in Sediments at the Merrimack Village Dam, New Hampshire.

Analyte *(1)*	MVD1	MVD2	MVD3	MVD4	MVD5	TEC Threshold Effect Concentr.	PEC Probable Effect Concentr.	TEL Lowest ARCs *H.azteca*	TEL Threshold Effects Level	PEL Probable Effects Level	UET Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	2.1	1.7	5.6	0.5	9.2	176	561	15			600	I
2-Methylnaphthalene	1.1	0.7	2.8	0.3	4.9							
Acenaphthalene	6.7	5	16.9	0.8	30.5						160	M
Acenaphthene	1.1	1.2	3.4	BDL	6.4						290	M
Fluorene	2.4	1.9	6.1	0.3	11.8	77.4	536	10			300	M
Phenanthrene	37.6	29.4	72.6	5.9	175	204	1,170	19	42	515	800	I
Anthracene	7.7	5.4	20.3	1.2	36.9	57	845	10			260	M
Fluoranthene	79.3	61.7	140	11	332	423	2,230	31	111	2,355	1,500	M
Pyrene	64.6	52.6	114	9.1	**276**	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	29.9	27.8	60.5	4.2	**156**	108	1,050	16	32	385	500	I
Chrysene	48.5	45	91.3	5.9	**296**	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	**58.8**	**52.3**	**106**	7.8	**380**	27	13,400					
Benzo[k]fluoranthene	21.5	18.7	38.2	2.8	107			27			13,400	B
Benzo[a]pyrene	41.5	34.8	81.5	5.1	211	150	1,450	32	32	782	700	I
Benzo[e]pyrene	31.4	27.9	57.1	4	157							
Indeno[1,2,3-cd]pyrene	38	32.5	68.1	3.8	189			17			330	M
Dibenz[a,h]anthracene	23.1	8.9	18.4	0.7	56.7	33		10			100	M
Total Selected PAHs	495.3	407.5	902.8	63.4	**2435.4**	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix V. Contaminant Levels in Sediments at the Kenyon Dam, Rhode Island.

Analyte *(1)*	Sediment Concentrations at Kenyon Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	USD1	USD2	USD3	USD4	USD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	0.6	3.0	1.0	1.0	BDL	9.79	33	10.8	5.9	17	17	M
Cadmium	**0.9**	**1.3**	**0.9**	**1.3**	**1.1**	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	3.0	12.0	11.0	5.4	6.3	43.4	111	36.3	37.3	90	95	H
Copper	4.0	22.0	5.4	4.0	2.0	31.6	149	28.0	35.7	197	86	I
Lead	10.0	**79.0**	17.0	9.0	BDL	35.8	128	37	35	91.3	127	H
Mercury	BDL	0.2	BDL	BDL	BDL	0.18	1.06		0.17	0.49	0.56	M
Nickel	BDL	5.0	BDL	BDL	BDL	22.7	48.6	19.5	18	35.9	43	H
Zinc	17.0	81.0	27.0	29.0	29.0	121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**2.5**	**7.3**	**4.3**	**8.9**	**5.1**
Grain Size Analysis (%)					
% Sand	**89.4**	**60.4**	**65.2**	**63.6**	**64.4**
% Silt	**5.7**	**25.8**	**26.1**	**26.0**	**25.7**
% Clay	**4.8**	**13.7**	**9.0**	**25.7**	**10.0**
Percent Moisture (%)	**44.2**	**61.7**	**66.1**	**70.5**	**53.8**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix V (continued). Contaminant Levels in Sediments at the Kenyon Dam, Rhode Island.

Analyte *(1)*	Sediment Concentrations at Kenyon Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	USD1	USD2	USD3	USD4	USD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	2.68	3.08	0.72	1	0.06				3.54	8.51	60	I
Sum-DDD	3.87	**5.93**	1.28	2.28	0.22	4.88	28					I
p,p-DDE	**3.32**	**3.13**	0.81	1.11	0.22				1.42	6.75	50	I
Sum-DDE	**3.49**	**3.45**	0.93	1.26	0.48	3.16	31.3					I
p,p-DDT	0.697	1.76	0.45	1.38	0.52						<50	I
Sum-DDT	0.83	2.09	0.52	1.54	0.52	4.16	62.9					I
Aldrin	1.07	7.65	BDL	1.36	BDL						40	I
alpha-BHC	0.05	0.212	0.154	0.132	0.158							
beta-BHC	BDL	0.07	0.12	0.13	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	0.06	0.15	0.15	0.17	0.13	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	0.231	0.149	0.154	0.362	0.296							
Dieldrin	0.06	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	BDL	BDL	BDL							
Endrin	BDL	BDL	0.127	0.146	0.13	2.22	207		2.67	62.4	500	I
HCB	BDL	0.08	BDL	BDL	BDL						100	
Heptachlor	0.08	0.32	0.08	0.13	BDL						10	I
Heptachlor epoxide	BDL	BDL	0.127	BDL	0.164	2.47	16		0.6	2.74	30	I
Mirex	0.201	0.499	BDL	BDL	BDL							
cis-Nonachlor	0.06	0.112	BDL	BDL	BDL							
trans-Nonachlor	BDL	BDL	BDL	BDL	BDL							
Oxychlordane	BDL	0.306	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	19.2	**80.8**	10	18	9.08	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix V (continued). Contaminant Levels in Sediments at the Kenyon Dam, Rhode Island.

Analyte *(1)*	Sediment Concentrations at Kenyon Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	USD1	USD2	USD3	USD4	USD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	33.1	173	9.73	71.5	BDL	176	561	15			600	I
2-Methylnaphthalene	64.2	298	12.7	126	BDL							
Acenaphthalene	35	81.9	BDL	23.6	BDL						160	M
Acenaphthene	5.61	59.2	6.99	9.86	BDL						290	M
Fluorene	26.1	115	6.96	37.8	BDL	77.4	536	10			300	M
Phenanthrene	**143**	**671**	24.8	**152**	6.67	204	1,170	19	42	515	800	I
Anthracene	27.8	**128**	5.52	24.5	BDL	57	845	10			260	M
Fluoranthene	**264**	**1020**	45.7	**207**	11.1	423	2,230	31	111	2,355	1,500	M
Pyrene	**106**	**344**	**323**	**753**	**754**	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	77	**382**	11.4	**53.4**	BDL	108	1,050	16	32	385	500	I
Chrysene	**118**	**481**	18.6	**89.1**	5.02	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	**169**	**720**	21.3	10.7	4.57	27	13,400					
Benzo[k]fluoranthene	43.8	160	6.76	36.6	BDL			27			13,400	B
Benzo[a]pyrene	**74.1**	**311**	8.61	**50.8**	BDL	150	1,450	32	32	782	700	I
Benzo[e]pyrene	72.2	320	10.6	58	BDL							
Indeno[1,2,3-cd]pyrene	71.8	306	11.5	63.4	BDL			17			330	M
Dibenz[a,h]anthracene	15	**71.9**	BDL	14.6	BDL	33		10			100	M
Total Selected PAHs	1345.7	**5642.0**	524.2	**1781.9**	781.4	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VI. Contaminant Levels in Sediments at the Lower Shannock Dam, Rhode Island.

Analyte *(1)*	Sediment Concentrations at Lower Shannock Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	LSD1	LSD2	LSD3	LSD4	LSD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	1.5	1.5	1.8	2.9	0.8	9.79	33	10.8	5.9	17	17	M
Cadmium	0.3	0.5	**0.7**	**0.6**	0.5	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	4.5	12.0	16.0	**40.0**	21.0	43.4	111	36.3	37.3	90	95	H
Copper	9.6	16.0	13.0	26.0	9.2	31.6	149	28.0	35.7	197	86	I
Lead	**49.0**	**76.0**	25.0	**80.0**	34.0	35.8	128	37	35	91.3	127	H
Mercury	0.1	**0.5**	**0.3**	**0.5**	0.1	0.18	1.06		0.17	0.49	0.56	M
Nickel	2.2	4.4	3.2	5.0	2.8	22.7	48.6	19.5	18	35.9	43	H
Zinc	78.0	68.0	55.0	78.0	41.0	121	459	98	123.1	315	520	M
Inorganics (%)												
Total Organic Carbon	**0.4**	**1.3**	**2.5**	**2.3**	**1.5**							
Grain Size Analysis (%)												
% Sand	**85.0**	**82.4**	**36.6**	**55.5**	**57.2**							
% Silt	**4.7**	**14.9**	**49.9**	**37.0**	**35.9**							
% Clay	**0.8**	**2.8**	**13.3**	**7.4**	**6.6**							
Percent Moisture (%)	**30.1**	**48.2**	**71.6**	**60.5**	**64.3**							

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VI (continued). Contaminant Levels in Sediments at the Lower Shannock Dam, Rhode Island.

Analyte (1)	Sediment Concentrations at Lower Shannock Dam					Freshwater Criteria (1)						
						McDonald et al. (2000)		1999 NOAA SQUIRTs, 1999				
	LSD1	LSD2	LSD3	LSD4	LSD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	**5.0**	**14.0**	2.0	**23.0**	3.0				3.54	8.51	60	I
Sum-DDD	5.0	**18.0**	2.0	**23.0**	3.00	4.88	28					I
p,p-DDE	2.0	7.0	5.0	6.0	4.00				1.42	6.75	50	I
Sum-DDE	2.0	**7.0**	**5.0**	**6.0**	**4.00**	3.16	31.3					I
p,p-DDT	BDL	BDL	BDL	BDL	2						<50	I
Sum-DDT	BDL	BDL	BDL	BDL	BDL	4.16	62.9					I
Aldrin	-	-	-	-	-						40	I
alpha-BHC	BDL	BDL	BDL	BDL	BDL							
beta-BHC	BDL	BDL	BDL	BDL	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	BDL	BDL	BDL	BDL	BDL	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	-	-	-	-	-							
Dieldrin	BDL	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	-	-	-	-	-							
Endrin	BDL	3.0	BDL	BDL	BDL	2.22	207		2.67	62.4	500	I
HCB	BDL	BDL	BDL	BDL	BDL						100	
Heptachlor	-	-	-	-	-						10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL	BDL	2.47	16		0.6	2.74	30	I
Mirex	BDL	BDL	BDL	BDL	BDL							
cis-Nonachlor	BDL	BDL	BDL	BDL	BDL							
trans-Nonachlor	BDL	BDL	BDL	BDL	BDL							
Oxychlordane	BDL	BDL	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) ug/kg dry weight)												
Total PCBs	BDL	**150.0**	**49.0**	**360**	19	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VI (continued). Contaminant Levels in Sediments at the Lower Shannock Dam, Rhode Island.

Analyte *(1)*	Sediment Concentrations at Lower Shannock Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	LSD1	LSD2	LSD3	LSD4	LSD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	36	110	22	1100	10	176	561	15			600	I
2-Methylnaphthalene	28	110	27	1400	10							
Acenaphthalene	100	34	28	150	42						160	M
Acenaphthene	68	180	10	1900	7						290	M
Fluorene	120	340	22	1500	21	77.4	536	10			300	M
Phenanthrene	920	2400	190	2800	160	204	1,170	19	42	515	800	I
Anthracene	190	560	47	640	42	57	845	10			260	M
Fluoranthene	1200	2800	260	1200	270	423	2,230	31	111	2,355	1,500	M
Pyrene	1100	2700	330	1700	270	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	940	1800	210	1100	220	108	1,050	16	32	385	500	I
Chrysene	890	2100	180	860	250	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	1100	2600	240	1700	770	27	13,400					
Benzo[k]fluoranthene	1100	2400	170	970	610			27			13,400	B
Benzo[a]pyrene	1200	2300	140	1100	540	150	1,450	32	32	782	700	I
Benzo[e]pyrene	830	1900	190	1600	610							
Indeno[1,2,3-cd]pyrene	670	2000	230	290	640			17			330	M
Dibenz[a,h]anthracene	200	1400	95	820	180	33		10			100	M
Total Selected PAHs	10692.0	25734.0	2391.0	20830.0	4652.0	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1	A detected concentration exceeded the TEC/TEL
11.1	A detected concentration exceeded the PEC/PEL/UET
BDL	Below Detection Limit

Appendix VII. Contaminant Levels in Sediments at the Dufresne Pond Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Dufresne Pond Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	DPD1	DPD2	DPD3	DPD4	DPD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	1.8	3.5	2.1	3.7	2.6	9.79	33	10.8	5.9	17	17	M
Cadmium	0.3	**1.3**	**1.0**	**1.1**	**0.6**	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	3.0	14.0	12.0	15.0	11.0	43.4	111	36.3	37.3	90	95	H
Copper	3.0	17.0	11.0	15.0	11.0	31.6	149	28.0	35.7	197	86	I
Lead	BDL	BDL	0.2	0.2	0.1	35.8	128	37	35	91.3	127	H
Mercury	**6.0**	**17.0**	**10.0**	**10.0**	**10.0**	0.18	1.06		0.17	0.49	0.56	M
Nickel	10.0	**30.0**	**31.0**	**25.0**	**22.0**	22.7	48.6	19.5	18	35.9	43	H
Zinc	44.0	**180.0**	120.0	**150.0**	**130.0**	121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**0.6**	**6.6**	**4.2**	**7.8**	**5.0**
Grain Size Analysis (%)					
% Sand	**95.0**	**30.0**	**28.0**	**23.0**	**43.0**
% Silt	**3.0**	**63.0**	**62.0**	**70.0**	**47.0**
% Clay	**2.0**	**7.0**	**10.0**	**7.0**	**10.0**
Percent Moisture (%)	**18.5**	**76.0**	**63.7**	**72.8**	**47.2**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VII (continued). Contaminant Levels in Sediments at the Dufresne Pond Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Dufresne Pond Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	DPD1	DPD2	DPD3	DPD4	DPD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	BDL	BDL	BDL	BDL	BDL				3.54	8.51	60	I
Sum-DDD	BDL	BDL	BDL	BDL	BDL	4.88	28					I
p,p-DDE	BDL	BDL	BDL	BDL	BDL				1.42	6.75	50	I
Sum-DDE	BDL	BDL	BDL	BDL	BDL	3.16	31.3					I
p,p-DDT	BDL	BDL	BDL	BDL	BDL						<50	I
Sum-DDT	BDL	BDL	BDL	BDL	BDL	4.16	62.9					I
Aldrin	BDL	BDL	BDL	BDL	BDL						40	I
alpha-BHC	BDL	BDL	BDL	BDL	BDL							
beta-BHC	BDL	BDL	BDL	BDL	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	BDL	BDL	BDL	BDL	BDL	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL							
Dieldrin	BDL	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	BDL	BDL	BDL							
Endrin	BDL	BDL	BDL	BDL	BDL	2.22	207		2.67	62.4	500	I
HCB	BDL	BDL	BDL	BDL	BDL						100	
Heptachlor	BDL	BDL	BDL	BDL	BDL						10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL	BDL	2.47	16		0.6	2.74	30	I
Mirex	BDL	BDL	BDL	BDL	BDL							
cis-Nonachlor	BDL	BDL	BDL	BDL	BDL							
trans-Nonachlor	BDL	BDL	BDL	BDL	BDL							
Oxychlordane	BDL	BDL	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	BDL	BDL	BDL	BDL	BDL	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VII (continued). Contaminant Levels in Sediments at the Dufresne Pond Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Dufresne Pond Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	DPD1	DPD2	DPD3	DPD4	DPD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	BDL	6	5	BDL	BDL	176	561	15			600	I
2-Methylnaphthalene	BDL	BDL	BDL	BDL	BDL							
Acenaphthalene	BDL	5	BDL	5	BDL						160	M
Acenaphthene	BDL	BDL	BDL	BDL	BDL						290	M
Fluorene	BDL	BDL	5	BDL	BDL	77.4	536	10			300	M
Phenanthrene	BDL	**50**	36	26	21	204	1,170	19	42	515	800	I
Anthracene	BDL	7	BDL	BDL	BDL	57	845	10			260	M
Fluoranthene	BDL	170	65	54	37	423	2,230	31	111	2,355	1,500	M
Pyrene	BDL	**130**	**53**	49	34	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	BDL	**53**	21	**34**	28	108	1,050	16	32	385	500	I
Chrysene	BDL	**81**	42	38	30	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	BDL	**84**	**35**	**49**	**34**	27	13,400					
Benzo[k]fluoranthene	BDL	49	29	23	21			27			13,400	B
Benzo[a]pyrene	BDL	**36**	16	27	20	150	1,450	32	32	782	700	I
Benzo[e]pyrene	7	54	28	40	25							
Indeno[1,2,3-cd]pyrene	BDL	29	23	21	18			17			330	M
Dibenz[a,h]anthracene	BDL	14	6	15	BDL	33		10			100	M
Total Selected PAHs	7.0	768.0	364.0	381.0	268.0	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VIII. Contaminant Levels in Sediments at the East Burke Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at East Burke Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	EBD1	EBD2	EBD3	EBD4	EBD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	BDL	0.6	0.5	0.6	0.7	9.79	33	10.8	5.9	17	17	M
Cadmium	BDL	BDL	BDL	BDL	BDL	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	11.0	13.0	13.0	18.0	14.0	43.4	111	36.3	37.3	90	95	H
Copper	3.6	3.5	3.8	4.1	4.7	31.6	149	28.0	35.7	197	86	I
Lead	BDL	BDL	BDL	5.0	BDL	35.8	128	37	35	91.3	127	H
Mercury	BDL	BDL	BDL	BDL	BDL	0.18	1.06		0.17	0.49	0.56	M
Nickel	8.0	8.0	8.0	10.0	9.0	22.7	48.6	19.5	18	35.9	43	H
Zinc	21.0	24.0	22.0	27.0	28.0	121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**0.2**	**0.2**	**0.2**	**0.4**	**0.4**
Grain Size Analysis (%)					
% Sand	**99.1**	**99.8**	**99.7**	**98.1**	**99.7**
% Silt	**0.6**	**0.2**	**0.3**	**1.4**	**0.3**
% Clay	**0.3**	**0.0**	**0.0**	**0.5**	**0.0**
Percent Moisture (%)	**27.9**	**17.0**	**25.4**	**34.8**	**24.9**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VIII (continued). Contaminant Levels in Sediments at the East Burke Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at East Burke Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	EBD1	EBD2	EBD3	EBD4	EBD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	BDL	BDL	BDL	BDL	0.758				3.54	8.51	60	I
Sum-DDD	BDL	BDL	BDL	BDL	1.27	4.88	28					I
p,p-DDE	BDL	BDL	BDL	BDL	0.32				1.42	6.75	50	I
Sum-DDE	BDL	BDL	BDL	BDL	0.32	3.16	31.3					I
p,p-DDT	BDL	BDL	BDL	0.264	0.969						<50	I
Sum-DDT	BDL	BDL	BDL	0.26	0.97	4.16	62.9					I
Aldrin	BDL	BDL	BDL	BDL	BDL						40	I
alpha-BHC	BDL	BDL	BDL	BDL	BDL							
beta-BHC	0.256	BDL	BDL	0.193	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	BDL	BDL	BDL	BDL	BDL	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL							
Dieldrin	BDL	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	BDL	BDL	BDL							
Endrin	BDL	BDL	BDL	BDL	BDL	2.22	207		2.67	62.4	500	I
HCB	BDL	BDL	BDL	BDL	BDL						100	
Heptachlor	BDL	BDL	BDL	BDL	BDL						10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL	BDL	2.47	16		0.6	2.74	30	I
Mirex	BDL	BDL	BDL	BDL	BDL							
cis-Nonachlor	BDL	BDL	BDL	BDL	BDL							
trans-Nonachlor	BDL	BDL	BDL	BDL	BDL							
Oxychlordane	BDL	BDL	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	4.71	BDL	2.95	4.91	2.8	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix VIII (continued). Contaminant Levels in Sediments at the East Burke Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at East Burke Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	EBD1	EBD2	EBD3	EBD4	EBD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	BDL	BDL	BDL	BDL	BDL	176	561	15			600	I
2-Methylnaphthalene	BDL	BDL	BDL	BDL	BDL							
Acenaphthalene	5.59	BDL	BDL	BDL	BDL						160	M
Acenaphthene	BDL	BDL	BDL	BDL	BDL						290	M
Fluorene	2.86	BDL	BDL	BDL	BDL	77.4	536	10			300	M
Phenanthrene	56.6	BDL	BDL	14.7	3.06	204	1,170	19	42	515	800	I
Anthracene	18.3	BDL	BDL	6.55	BDL	57	845	10			260	M
Fluoranthene	65.5	BDL	BDL	27	5.89	423	2,230	31	111	2,355	1,500	M
Pyrene	45.3	BDL	BDL	23.8	4.45	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	35.9	BDL	BDL	17.1	3.5	108	1,050	16	32	385	500	I
Chrysene	24.6	BDL	BDL	10.9	3.09	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	30.5	BDL	BDL	16.4	3.26	27	13,400					
Benzo[k]fluoranthene	9.81	BDL	BDL	BDL	BDL			27			13,400	B
Benzo[a]pyrene	25.7	BDL	3.11	BDL	BDL	150	1,450	32	32	782	700	I
Benzo[e]pyrene	12.9	BDL	BDL	7.18	BDL							
Indeno[1,2,3-cd]pyrene	10.5	BDL	BDL	6.24	BDL			17			330	M
Dibenz[a,h]anthracene	2.27	BDL	BDL	BDL	BDL	33		10			100	M
Total Selected PAHs	346.3	0.0	3.1	129.9	23.3	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix IX. Contaminant Levels in Sediments at the Island Corps Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Island Corp Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ICD1	ICD2	ICD3	ICD4	ICD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	1.1	0.8	0.9	1.9	1.0	9.79	33	10.8	5.9	17	17	M
Cadmium	0.5	0.5	**0.6**	**0.6**	0.5	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	6.6	5.7	10.7	7.4	8.2	43.4	111	36.3	37.3	90	95	H
Copper	7.1	6.3	13.1	9.6	9.6	31.6	149	28.0	35.7	197	86	I
Lead	2.3	2.3	3.7	2.5	3.3	35.8	128	37	35	91.3	127	H
Mercury	BDL	BDL	BDL	BDL	BDL	0.18	1.06		0.17	0.49	0.56	M
Nickel	7.3	8.5	9.2	11.2	9.0	22.7	48.6	19.5	18	35.9	43	H
Zinc	28.4	23.6	24.3	27.6	30.1	121	459	98	123.1	315	520	M
Inorganics (%)												
Total Organic Carbon	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**							
Grain Size Analysis (%)												
% Sand	**94.5**	**95.8**	**96.4**	**94.3**	**94.9**							
% Silt	**5.5**	**4.2**	**3.6**	**5.7**	**5.1**							
% Clay	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**							
Percent Moisture (%)	**24.8**	**23.4**	**17.4**	**23.0**	**23.5**							

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix IX (continued). Contaminant Levels in Sediments at the Island Corps Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Island Corps Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ICD1	ICD2	ICD3	ICD4	ICD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	BDL	BDL	BDL	BDL	BDL				3.54	8.51	60	I
Sum-DDD	BDL	BDL	BDL	BDL	BDL	4.88	28					I
p,p-DDE	BDL	BDL	BDL	BDL	BDL				1.42	6.75	50	I
Sum-DDE	BDL	BDL	BDL	BDL	BDL	3.16	31.3					I
p,p-DDT	BDL	BDL	BDL	BDL	BDL						<50	I
Sum-DDT	BDL	BDL	BDL	BDL	BDL	4.16	62.9					I
Aldrin	BDL	BDL	BDL	BDL	BDL						40	I
alpha-BHC	BDL	BDL	BDL	BDL	BDL							
beta-BHC	BDL	BDL	BDL	BDL	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	BDL	BDL	BDL	BDL	BDL	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL							
Dieldrin	BDL	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	BDL	BDL	BDL							
Endrin	BDL	BDL	BDL	BDL	BDL	2.22	207		2.67	62.4	500	I
HCB	BDL	BDL	BDL	BDL	BDL						100	
Heptachlor	BDL	BDL	BDL	BDL	BDL						10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL	BDL	2.47	16		0.6	2.74	30	I
Mirex	BDL	BDL	BDL	BDL	BDL							
cis-Nonachlor	BDL	BDL	BDL	BDL	BDL							
trans-Nonachlor	BDL	BDL	BDL	BDL	BDL							
Oxychlordane	BDL	BDL	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	BDL	BDL	BDL	BDL	BDL	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix IX (continued). Contaminant Levels in Sediments at the Island Corps Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Island Corps Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	ICD1	ICD2	ICD3	ICD4	ICD5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	BDL	BDL	BDL	BDL	BDL	176	561	15			600	I
2-Methylnaphthalene	BDL	BDL	BDL	BDL	BDL							
Acenaphthalene	BDL	34	BDL	BDL	7						160	M
Acenaphthene	BDL	BDL	BDL	BDL	BDL						290	M
Fluorene	BDL	13	BDL	BDL	BDL	77.4	536	10			300	M
Phenanthrene	12	**340**	21	31	43	204	1,170	19	42	515	800	I
Anthracene	BDL	**170**	BDL	5	8	57	845	10			260	M
Fluoranthene	22	**1170**	27	**47**	**70**	423	2,230	31	111	2,355	1,500	M
Pyrene	22	**970**	23	45	**63**	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	10	**550**	10	27	**38**	108	1,050	16	32	385	500	I
Chrysene	12	**470**	15	26	35	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	12	**430**	**51**	**70**	**86**	27	13,400					
Benzo[k]fluoranthene	BDL	410	22	30	47			27			13,400	B
Benzo[a]pyrene	11	**610**	11	35	42	150	1,450	32	32	782	700	I
Benzo[e]pyrene	11	320	12	20	24							
Indeno[1,2,3-cd]pyrene	10	520	8	20	BDL			17			330	M
Dibenz[a,h]anthracene	BDL	**89**	BDL	BDL	BDL	33		10			100	M
Total Selected PAHs	122.0	6096.0	200.0	356.0	463.0	**1,610**	**22,800**	**264**			**12,000**	**M**

Appendix X. Contaminant Levels in Sediments at the Lower Eaton Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Lower Eaton Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	LED1	LED2	LED3	LED4	LED5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Metals (mg/kg dry weight)												
Arsenic	0.9	2.0	2.6	0.5	0.8	9.79	33	10.8	5.9	17	17	M
Cadmium	0.5	**1.2**	**1.2**	0.3	0.5	0.99	4.98	0.58	0.60	3.53	3	I
Chromium	8.9	27.3	28.0	7.9	13.7	43.4	111	36.3	37.3	90	95	H
Copper	9.6	**52.4**	**38.6**	**338.0**	11.1	31.6	149	28.0	35.7	197	86	I
Lead	3.8	13.3	9.4	2.9	4.2	35.8	128	37	35	91.3	127	H
Mercury	BDL	BDL	BDL	BDL	BDL	0.18	1.06		0.17	0.49	0.56	M
Nickel	8.3	**30.6**	**28.8**	7.4	13.2	22.7	48.6	19.5	18	35.9	43	H
Zinc	25.6	73.4	75.6	19.6	29.6	121	459	98	123.1	315	520	M

Inorganics (%)					
Total Organic Carbon	**0.3**	**1.8**	**1.1**	**0.5**	**0.3**
Grain Size Analysis (%)					
% Sand	**97.1**	**81.3**	**96.7**	**96.5**	**94.1**
% Silt	**2.9**	**18.7**	**3.3**	**3.5**	**5.9**
% Clay	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Percent Moisture (%)	**25.3**	**39.0**	**36.1**	**26.2**	**29.1**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix X (continued). Contaminant Levels in Sediments at the Lower Eaton Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Lower Eaton Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	LED1	LED2	LED3	LED4	LED5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Pesticides (ug/kg dry weight)												
p,p-DDD	BDL	BDL	BDL	BDL	BDL				3.54	8.51	60	I
Sum-DDD	BDL	BDL	BDL	BDL	BDL	4.88	28					I
p,p-DDE	BDL	BDL	BDL	BDL	BDL				1.42	6.75	50	I
Sum-DDE	BDL	BDL	BDL	BDL	BDL	3.16	31.3					I
p,p-DDT	BDL	BDL	BDL	BDL	BDL						<50	I
Sum-DDT	BDL	BDL	BDL	BDL	BDL	4.16	62.9					I
Aldrin	BDL	BDL	BDL	BDL	BDL						40	I
alpha-BHC	BDL	BDL	BDL	BDL	BDL							
beta-BHC	BDL	BDL	BDL	BDL	BDL							
delta-BHC	BDL	BDL	BDL	BDL	BDL							
gamma-BHC (Lindane)	BDL	BDL	BDL	BDL	BDL	2.37	4.99		0.94	1.38	9	I
gamma Chlordane	BDL	BDL	BDL	BDL	BDL	3.24	17.6		4.5	8.9	30	I
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL							
Dieldrin	BDL	BDL	BDL	BDL	BDL	1.9	61.8		2.85	6.67	300	I
Endosulfan II	BDL	BDL	BDL	BDL	BDL							
Endrin	BDL	BDL	BDL	BDL	BDL	2.22	207		2.67	62.4	500	I
HCB	BDL	BDL	BDL	BDL	BDL						100	
Heptachlor	BDL	BDL	BDL	BDL	BDL						10	I
Heptachlor epoxide	BDL	BDL	BDL	BDL	BDL	2.47	16		0.6	2.74	30	I
Mirex	BDL	BDL	BDL	BDL	BDL							
cis-Nonachlor	BDL	BDL	BDL	BDL	BDL							
trans-Nonachlor	BDL	BDL	BDL	BDL	BDL							
Oxychlordane	BDL	BDL	BDL	BDL	BDL							
Toxaphene	BDL	BDL	BDL	BDL	BDL							
Polychlorinated Biphenyls (PCBs) (ug/kg dry weight)												
Total PCBs	BDL	BDL	BDL	BDL	BDL	59.8	676	31.6	34.1	277	26	M

(1) Based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit

Appendix X (continued). Contaminant Levels in Sediments at the Lower Eaton Dam, Vermont.

Analyte *(1)*	Sediment Concentrations at Lower Eaton Dam					Freshwater Criteria *(1)*						
						McDonald et al. *(2000)*		1999 NOAA SQUIRTs, 1999				
	LED1	LED2	LED3	LED4	LED5	TEC	PEC	TEL	TEL	PEL	UET	
						Threshold Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	
Selected Polycyclic Aromatic Hydrocarbons (PAHs) (ug/kg dry weight)												
Naphthalene	BDL	BDL	BDL	BDL	BDL	176	561	15			600	I
2-Methylnaphthalene	BDL	BDL	BDL	BDL	BDL							
Acenaphthalene	BDL	BDL	BDL	BDL	BDL						160	M
Acenaphthene	BDL	BDL	BDL	BDL	BDL						290	M
Fluorene	BDL	BDL	11	BDL	BDL	77.4	536	10			300	M
Phenanthrene	8	31	**70**	8	11	204	1,170	19	42	515	800	I
Anthracene	BDL	BDL	10	BDL	BDL	57	845	10			260	M
Fluoranthene	26	66	66	11	19	423	2,230	31	111	2,355	1,500	M
Pyrene	26	**58**	**56**	10	19	195	1,520	44	53	875	1,000	I
Benz[a]anthracene	10	26	**33**	BDL	8	108	1,050	16	32	385	500	I
Chrysene	19	39	41	8	13	166	1,290	27	57	862	800	I
Benzo[b]fluoranthene	**42**	**78**	**77**	7	9	27	13,400					
Benzo[k]fluoranthene	23	34	34	BDL	10			27			13,400	B
Benzo[a]pyrene	16	23	**33**	BDL	11	150	1,450	32	32	782	700	I
Benzo[e]pyrene	14	25	22	BDL	9							
Indeno[1,2,3-cd]pyrene	6	22	BDL	BDL	6			17			330	M
Dibenz[a,h]anthracene	BDL	BDL	BDL	BDL	BDL	33		10			100	M
Total Selected PAHs	190.0	402.0	453.0	44.0	115.0	**1,610**	**22,800**	**264**			**12,000**	**M**

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.

11.1 A detected concentration exceeded the TEC/TEL

11.1 A detected concentration exceeded the PEC/PEL

BDL Below Detection Limit