DATA SUMMARY REPORT

70018

Hudson River Project
Sampling and Analysis Program

1992 Food Chain Study

General Electric Company
Corporate Environmental Programs
Albany, New York

May 1993

O'BRIEN & GERE
ENGINEERS, INC.

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CORPORATE ENVIRONMENTAL PROGRAMS
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SECTION 1 - INTRODUCTION

1.01 Background

This data summary report presents results of the Food Chain Study performed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) in May of 1992. This work was prompted by the PCB Reassessment Remedial Investigation and Feasibility Study (RRI/FS) being performed on the upper Hudson River by the U.S. Environmental Protection Agency (USEPA). The work being performed by USEPA in conjunction with the Hudson River RRI/FS is described in their Phase 1 Report (USEPA, 1991) and the Final Phase 2 Work Plan and Sampling Plan (USEPA, 1992). The Food Chain Study involved sampling and analysis of sediment, water column particulates, and biota in three distinct habitat regions of the upper Hudson River. The details of the sampling and analysis procedures are presented in the Quality Assurance Project Plan (QAPP; O'Brien & Gere, 1993) as amended for this study (Appendix C). This study was conducted to support the evaluation of the food chain for the upper Hudson River. The establishment of a food chain is important since, 1) the top predator fish, Largemouth Bass, contain elevated levels of polychlorinated biphenyls (PCBs), 2) ingestion of Largemouth Bass is a potential route of human exposure to PCBs from the Hudson River, and 3) the relative importance of different Largemouth Bass PCB exposure pathways is relatively unknown.

PCBs have a tendency to accumulate in organisms to concentrations higher than those observed in the ambient environment due to partitioning of PCBs into lipid-rich tissues while resisting excretory mechanisms. Bioconcentration refers to contaminant accumulation in a single organism due to ambient exposures, while

bioaccumulation refers to accumulation in organisms due to dietary uptakes in the food chain. Bioaccumulation in Largemouth Bass is a function of PCB concentration in the lower trophic levels of the food chain. Largemouth Bass and other fish also bioconcentrate PCB directly from the water column. Bass are known to ingest smaller fish, such as Pumpkinseed, as well as aquatic macroinvertebrates; Pumpkinseed, in turn, feed on phytoplankton, water column particulates, and benthic organisms (Scott and Crossman, 1973). Depending on the source of food for benthic macroinvertebrates and the relative importance of PCB bioaccumulation and bioconcentration, the food chain may be more closely linked to one of two environmental compartments: the water column or the sediment.

In order to evaluate the extent to which these environmental compartments are linked to the food chain, sediment, water column particulate, and biota samples were collected and analyzed for PCB and stable isotopes of carbon, nitrogen, and sulfur. The congener specific PCB data presented herein can be used to compare PCB chromatographic patterns observed in fish tissue to patterns observed in selected food sources. Stable isotope measurements can also be used as chemical tracers to estimate trophic structure and evaluate the relative importance of various sources of food in the Hudson River ecosystem.

The remainder of this data summary report presents the objectives, methods of sample collection and analysis, and the raw analytical results of the Food Chain Study.

1.02 Program Objectives

The objective of the Food Chain Study was to provide environmental data to assist in the understanding of the food chain for the upper Hudson River. Data generated during this sampling program may be used to evaluate the food chain with regard to potential sources of PCBs to fish in the upper Hudson River ecosystem. Field sampling activities employed to accomplish this objective included:

- sampling and analysis of water column particulates for PCB and stable isotopes to identify potential sources of PCB to water column feeders,
- collection of sediment cores and analysis for PCB and stable isotopes to evaluate PCB distribution with sediment depth and to identify potential sources of PCB to benthic organisms which consume subsurface sediments,
- collection of surface sediment samples and analysis for PCB and stable isotopes to identify potential sources of PCB to organisms which consume surface sediments,
- sampling and analysis of benthic invertebrates for PCB and stable isotopes to identify potential sources of PCB to Pumpkinseed and other macroinvertebrate consumers, and
- sampling and analysis of several species of fish for PCB and stable isotopes to evaluate PCB distributions in the higher trophic levels of the food web.

SECTION 2 - FIELD SAMPLING AND ANALYSIS

2.01 Sampling Locations

Sampling locations were sited in areas of the river likely to support diverse biotic communities including depositional zones and stretches of slow moving water with abundant macrophyte beds. The three habitat stations shown in Figure 1 were selected based on a site reconnaissance conducted May 6, 1992. Physical markers were set to bound each sampling area once they were identified. These markers were later surveyed to provide coordinate-based sample location information. New York State planar coordinates, based on 1927 datum, for each of the markers are presented in the following table.

Habitat Station		Northing (feet)	Easting (feet)
HS-1	**Upstream**	1,183,075	696,438
	Downstream	1,183,005	696,389
HS-2	**Upstream**	1,159,890	699,691
	Downstream	1,159,805	699,709
HS-3	**Upstream**	1,093,308	694,455
	Downstream	1,093,237	694,435

Each habitat station was divided into an upstream and a downstream half; sediment samples were collected from the downstream half and biota samples were collected from the upstream half. Sediment sampling was conducted in the downstream portion prior to biota sampling to minimize disturbance of the sediment. The following sections describe the location of each habitat station.

2.01.1 Habitat Station 1

Habitat Station 1 (HS-1) is situated along the western shore of the river in the Town of Moreau approximately one-half mile downstream of the site of the Hudson River Research Station (General Electric, 1991). HS-1 is located at approximate river mile 192 in an area of aquatic vegetation dominated by eelgrass (*Vallisneria americana*).

2.01.2 Habitat Station 2

Habitat Station 2 (HS-2) is situated along the west side of Thompson Island below the dam in the Town of Northumberland at approximate river mile 188. The location of HS-2 was selected based on evidence of submerged aquatic vegetation and macroinvertebrates obtained during the site reconnaissance.

2.01.3 Habitat Station 3

Habitat Station 3 (HS-3) is situated on the east side of the Hudson River in the Town of Stillwater at approximate river mile 174. The location of HS-3 was selected because of its proximity to the site of fish surveys conducted by the New York State Department of Environmental Conservation (NYSDEC); (Sloan *et al.*, 1984). Therefore, a database exists pertaining to PCB fish concentrations in this locality.

2.02 Sample Collection

The following sections describe the procedures used to collect sediment and biota samples. A summary of the numbers and types of samples collected and analyzed is presented in Tables 1, 2 and 3. Appendix A contains field sampling documentation including copies of the Fish and Wildlife License obtained from NYSDEC, daily log sheets, and field notes.

2.02.1 Water Column Particulates

Samples of water column particulates were collected to characterize the water-borne media with respect to its importance as a possible source of PCB to biota which feed on suspended organisms and debris. One water column particulate sample was collected from each of the three habitat stations.

Water column particulate samples were collected using a stationary, submerged drift net positioned perpendicular to the direction of flow at each of the sampling stations. Based on reports of suspended particle size distributions in the Hudson River, most of the suspended particulate matter consists of silt and clay particles smaller than 50 μm in diameter. Therefore, a stream drift net with a mesh size of 5 μm and a square stainless steel frame measuring 31 cm on a side (1 ft^2) was used to collect silt and other particles larger than 5 μm.

The drift nets were deployed near the middle of each habitat station and upstream of the sediment collection area to avoid collecting resuspended sediment disturbed during coring activities. The bottom edge of the drift net

frame was held in position, approximately one foot above the sediment surface, using anchoring stakes. After an approximately twenty-four hour sample collection period, materials collected in the polycarbonate bottle at the end of the mesh were transferred to 500-ml glass sediment jars with Teflon-lined lids and placed in a sample cooler. A total of three water column particulate samples were collected.

2.02.2 Sediment Cores

The purpose of collecting sediment cores was to characterize the habitat of benthic organisms with respect to PCB concentrations and congener distributions in buried sediment. This information may then be used to evaluate the origin of sediment-bound PCB available to benthic macroinvertebrate populations.

Five cores were collected at each site. Sampling activities were conducted from a sixteen-foot flat-bottomed boat. Sediment cores were obtained by divers using a hand coring technique. Seaway Diving and Salvage, Inc. of Clifton Park, New York, was subcontracted to conduct the underwater sampling activities.

Lexan core tubes were inserted into the sediment to a depth of approximately two feet. The extent of compression and sediment disturbance was noted by the diver. Before removing the core, a surficial sediment sample was collected proximate to each coring location (surface sediment collection is described in the following section). The top and bottom of the plastic core tube were capped after removing the core from the sediment bed and the

sample were brought to the surface. The core samples were maintained in a vertical position following collection and transported to the analytical laboratory at the end of each day where they were placed in a lockable freezer and left overnight. A total of fifteen cores were collected.

2.02.3 Surface Sediment Particulates

Surface sediment particulates form the uppermost layer of sediment and serve as habitat for benthic organisms (for the purpose of this study, surface sediment was defined as the top 0.5 cm of sediment). The intent of surface sediment sampling was to collect materials from within the transition zone between the water and sediment at locations near coring stations. This was accomplished by, first, advancing a core tube into the sediment at a desired location, then collecting the top 0.5 cm layer of sediment near the base of the core tube with a vacuum hose and pump.

The sampling apparatus consisted of a PVC vacuum hose attached to a peristaltic pump through which sediment and river water were vacuumed from the river bottom and conveyed to the water surface and on board the boat. A diver directed the vacuum tube end through the surficial sediment.

River water and surface sediment were drawn through the vacuum sampling apparatus and filtered through a sieve and plankton net on board the boat to segregate sediment particulates from river water. Sediment material was passed through a 100 μm mesh sieve and a 20 μm mesh plankton net with a lined 500 ml PVC collecting bucket. The filtrate was returned to the river. After approximately five minutes, materials retained on the sieve

and the PVC collecting bucket were transferred to 500-ml glass sample containers with Teflon®-lined lids and placed in a sample cooler. A total of eleven surface sediment samples were collected at three habitat stations.

The surface sediment particulate sampling technique was successful in obtaining sediment particulates from the surficial sediments. Based on visual observations during sampling, the apparatus collected particulates for the approximate 0-0.5 cm sector of the sediments.

2.02.4 Macroinvertebrates

The purpose of macroinvertebrate sampling and analysis was to provide data for the evaluation of PCB concentrations and congener distribution as well as stable isotope ratios in the lower trophic levels of the Hudson River food web. These data may be used in combination with other data generated during this study to evaluate the relative magnitude of PCB sources to fish in the upper Hudson River. The following macroinvertebrate organism categories were targeted for collection:

- Oligochaeta (Orders: Lumbriculida, Tubificida, Haplotaxida [worms]),
- Chironomidae (midges),
- Caddisflies (Order: Trichoptera),
- Amphipoda (scuds, sideswimmers, shrimps),
- Snails (Class: Gastropoda),
- Clams (Class: Bivalvia), and
- Crayfish (Order: Decapoda).

Macroinvertebrate samples were obtained by collecting sediment with an Eckman dredge and sieving the material through a U.S. Standard No. 60 (0.25 mm) sieve. The purpose of sieving was to retain target macroinvertebrates while passing sediment materials smaller than 0.25 mm. Sieving was performed in the field immediately upon sediment sample collection. The sediment sample was placed into a 5-gallon bucket and made into a slurry by adding river water. The slurry was then poured through a sieve-bottomed bucket for separation of invertebrates from sediments. The final sieve contents were emptied into a white enamel pan. Sampling continued until approximately 100-grams of organisms from each category were obtained or until it was determined that a certain category was not present in sufficient quantities to meet the minimum analytical program requirements (USEPA, 1987). A total of thirty-one macroinvertebrate samples were collected.

During field sampling activities, sufficient quantities of many target organisms could not be obtained despite several attempts. This is likely attributed to the time of year during which sampling occurred. In late May, biotic activity in the sediment of a northern river was not expected to be robust, however, it was thought that adequate numbers of macroinvertebrates would be available for the purposes of this program. Except for an abundance of clams, populations of most macroinvertebrates were limited. Therefore, samples from different habitat stations were composited in order to meet the 5 gram minimum sample mass requirements for analysis (NEA, 1990). The following table presents a summary of the types and dry weights

of macroinvertebrate samples collected. Biota sample processing is discussed further in Section 2.03.2.

Macroinvertebrate Species	Quantity Collected (grams-dry weight)		
	HS-1	HS-2	HS-3
Gastropoda	0.371	0.116	0.148
Clams	1.58	1.06	1.32
Caddisflies	2.20	-	-
Anthropods	0.382	0.049	0.048
Chironomids	0.016	0.019	-
Oligiochaetes	0.104	0.328	0.281

2.02.5 Fish

Sampling and analysis of several species of fish from different trophic levels was conducted at each habitat station. These data were collected to allow an evaluation of the relationship between PCB content in fish and PCB found in various compartments of their immediate environment. Seven categories of fish species were targeted for collection as follows:

Common Name	(? Species)	Age
Pumpkinseed	*(Lepomis gibbosus)*	yearling
Pumpkinseed		mature
Bluegill	*(Lepomis macrochirus)*	mature (3-6 yr)
Largemouth Bass	*(Micropterus salmoides)*	mature
Largemouth Bass		yearling
Carp	*(Cyprinus carpio)*	mature
Brown Bullhead	*(Ictalurus nebulosus)*	mature

Fish sampling was conducted in accordance with the conditions outlined in the license to collect or possess issued by NYSDEC for this effort (Appendix A). Fish sample collection was initially attempted by electro-shocking. Considerable difficulty was encountered, however, in attempting to collect adequate numbers of target fish. As previously mentioned, evidence of biological activity was sparse because of the time of year. Electroshocking was largely unsuccessful; only one fish was collected using the electroshocking technique.

Most samples of fish were obtained by setting gill nets and collecting the trapped fish the following day. Graded mesh size gill nets were anchored on the bottom, perpendicular to the anticipated direction of fish movement in these areas, and operated for up to two 24-hour periods. A total of thirty fish were collected in this manner. The following table shows the types and quantities of fish collected at each site.

Fish Species	Quantity Collected (grams-dry weight)		
	HS-1	HS-2	HS-3
White Sucker	7.86	5.49	-
Small Mouth Bass	4.36	3.37	-
Rock Bass	4.92	5.50	3.68
Pumpkinseed	4.61	2.56	-
Yellow Perch	5.16	4.14	-
Chain Pickerel	4.30	4.29	-
Brown Bullhead	5.29	-	4.20

2.03 Sample Processing

Following sample collection, sediment cores and biota samples were brought to Northeast Analytical Laboratories, Inc. (NEA) in Schenectady, N.Y. for processing prior to submittal for analysis. The procedures used for sample processing are described in the following sections.

2.03.1 Sediment Core Processing

Sediment core processing involved segmenting frozen cores with a hacksaw. One core collected from each site was removed from the freezer and segmented at 1, 3, 5, and 10 cm depths below the sediment/water interface. The remaining cores from each habitat station were archived frozen at NEA.

The core sections were placed into 500 ml glass sample containers with Teflon lined lids and submitted to NEA for analysis along with samples of water column particulates and surface sediment, which did not require processing. A total of twelve sediment core samples were submitted to the analytical laboratory in addition to three water column particulate and three surface sediment samples.

2.03.2 Macroinvertebrate Sample Processing

Macroinvertebrate sample processing involved identification and compositing. Preliminary identification of macroinvertebrate organisms by order was conducted in the field. Organisms belonging to the same category and collected from the same habitat station were composited into a single

sample for subsequent analyses. A total of thirty-one macroinvertebrate samples were submitted to the laboratory.

Upon drying and calculating the dry weights of each sample, however, it was apparent that insufficient sample amounts of some samples were available for the requested analyses. Subsequently, certain macroinvertebrate samples collected from different habitat stations were composited to meet the 5 gram minimum sample mass requirements for analysis (NEA, 1990; see Table 2).

2.03.3 Fish Sample Processing

Following collection, whole fish samples were measured, wrapped in aluminum foil, placed in a cooler, then transported to the analytical laboratory for further processing. Processing involved removing the stomachs and scales prior to mincing. Scales were retained for subsequent determination of fish age. Scales were collected by scraping a dull knife against the free tips of the scales. The scales were placed into labeled envelopes after being removed. The remainder of each fish sample was submitted to NEA for analysis. Appendix B contains length and weight measurements as well as estimated ages of each fish collected.

2.04 Analytical Testing

NEA and Coastal Science Laboratories, Inc. (CSL) of Austin, Texas, provided analytical services for the Food Chain Study. NEA was responsible for conducting congener specific PCB analysis of sediment and biota samples. In addition, NEA

coordinated sample preparation and shipment of samples for stable isotope analysis to CSL. CSL was responsible for analyzing environmental samples for stable isotopes of carbon, nitrogen, and sulfur using an isotope ratio mass spectrometer.

2.04.1 Particulates

Sediment core and surface sediment samples obtained during the Food Chain Study were analyzed for congener specific PCB and stable isotopes of carbon, nitrogen, and sulfur. The amount of suspended particulate matter collected during water column particulate sampling was insufficient for congener specific PCB analysis, therefore, these samples were not analyzed for PCB.

Congener specific PCB analytical methods and protocols for sediment are described in detail in the QAPP (O'Brien & Gere, 1993). Samples were analyzed for congener-specific PCBs utilizing capillary columns according to method NEA-608CAP, Rev. 3.0 (NEA, 1990). Stable isotope sample preparation and analytical methods are contained in an addendum to the QAPP (Appendix C). Stable isotype analysis of biota and sediment samples were performed in accordance with procedures outlined in *A Brief Overview of Coastal Science Labs and C, N,S Stable Isotope Analyses* (Coastal Science, 1992).

2.04.2 Biota

Deviations from the macroinvertebrate sample preparation and analytical methods specified in the QAPP addendum (Appendix C) were necessary due to the small quantities of some target species collected. The addendum called for the analysis of several types of macroinvertebrate samples collected from each habitat station for congener specific PCB, lipid content, dry tissue weight, and stable isotopes of carbon, nitrogen, and sulfur. Modifications to the plan involved compositing samples of gastropoda, oligiochaetes, anthropods, and chironomids across habitat stations in order to meet the minimum sample size requirements for the analyses. As a result, one sample of each species was submitted for analysis instead of three. Although this deviation from the QAPP resulted in the inability to evaluate trends with respect to river mile, it did not jeopardize project objectives, as discussed in Section 1.

Whole-fish samples were analyzed for congener specific PCBs, lipid content, moisture content, and stable isotopes of carbon, nitrogen, and sulfur. Fish sample analytical methods are specified in an addendum to the QAPP (Appendix C). Samples were analyzed for congener-specific PCBs utilizing capillary columns according to method NEA-608CAP, Rev. 3.0 (NEA, 1990). Stable isotope analysis was performed in accordance with procedures outlined in *A Brief Overview of Coastal Science Labs and C, N,S Stable Isotope Analyses.* (Coastal Science, 1992).

2.05 Quality Assurance/Quality Control

Equipment blank samples were collected and analyzed during the study for quality assurance/quality control (QA/QC) purposes. Equipment blank samples were prepared in the field by decontaminating the sampling equipment with organic free water. The rinse water was collected and submitted to the laboratory for analyses. The results of the QA/QC analyses are included in Appendix D, as described in Section 4. PCBs were not detected in the two equipment blank samples.

SECTION 3 - DATA PRODUCTION AND REPORTING

3.01 Northeast Analytical Laboratories, Inc.

Analytical data packages were provided for each sample analyzed by NEA which documented sample preparation, extraction, and analytical procedures. The data reports include the following:

- a case narrative,
- a physical description of samples,
- summaries of calibration and QA/QC data,
- copies of completed chain of custody forms,
- analytical results of environmental, trip blank, field blank, and method blank samples, and
- appropriate raw instrument outputs.

Total PCB concentrations in sediment are presented on a dry weight basis in mg/kg. Fish and invertebrate concentrations were provided on a wet tissue weight basis (mg/kg) along with lipid content and dry weights. PCB data packages include a summary report containing total PCB and homolog distribution results, and a PCB congener report with details on peak identification, retention time, integrated peak area, amount of solution, and sample amount.

3.02 Coastal Science Laboratories, Inc.

CSL provided stable isotope analysis for sediment and biota samples using mass spectroscopy. Analysis was performed relative to CSL working standards to derive stable isotope ratios. Stable isotope ratios of carbon, nitrogen, and sulfur are

reported on a dry weight basis relative to international standards PDB and CDT for carbon and sulfur, respectively, and to air for nitrogen. Stable isotope ratios referred to as del, or delta, are calculated from measurements of the molar ratios of two isotopes present in a particular sample and the molar ratios in the international standards (PDB or CDT) or air using the following equation:

$$\text{del}^{13}\text{C (or del}^{15}\text{N or del}^{34}\text{S)} = \frac{R_{sample} - R_{standard}}{R_{standard}} \times 100 \quad \text{(Eqn 1)}$$

where $R = {}^{13}C/{}^{12}C$ (or ${}^{15}N/{}^{14}N$ or ${}^{34}S/{}^{32}S$).

SECTION 4 - SAMPLING AND ANALYSIS RESULTS

The Food Chain Study involved the collection and analysis of eighteen sediment, fifteen fish, and fifteen macroinvertebrate samples from three habitat stations located along the upper Hudson River. Samples were analyzed for congener specific PCB and stable isotopes of carbon, nitrogen, and sulfur.

4.01 Congener Specific PCB Testing Results

Results of PCB testing are summarized in Tables 1, 2, and 3. PCB concentrations quantified in sediment core samples ranged from 4.0 mg/kg-dry weight in a sample collected from HS-3 (3-5 cm depth) to 27.4 mg/kg-dry weight in a sample collected from HS-2 (5-10 cm depth). Surface sediment PCB concentrations ranged from 5.3 mg/kg-dry weight quantified in a sample collected from HS-3 to 34.8 mg/kg-dry weight in a sample collected from HS-2.

Whole-fish PCB concentrations, reported on a wet weight basis, ranged from 1.8 mg/kg quantified in a Rock Bass sample collected from HS-3 to 130.8 mg/kg quantified in a White Sucker sample from HS-1. Two Pumpkinseed fish were netted, one from HS-1 and one from HS-2, having total PCB concentrations of 11.5 and 24.3 mg/kg wet weight, respectively. No samples of Largemouth Bass were obtained during the study. Other predatory species, Chain Pickerel and Smallmouth Bass, were collected, however, allowing evaluation of the food chain.

PCB analyses of macroinvertebrate samples were limited because of the small number of specimens collected. The results of the three analyses performed showed

concentrations ranging from 0.8 mg/kg in a sample of clams collected from HS-1 to 35.0 mg/kg in a sample of caddisflies collected from HS-1.

4.02 Stable Isotope Testing Results

Stable isotope ratios for sediment and biota samples are presented in Table 1, 2, and 3. Raw data is contained in Appendix E. Results for carbon (del^{13}C), nitrogen (del^{15}N), and sulfur (del^{34}S) are reported relative to the CSL working standard in dimensionless units (see Eqn 1). Values for del^{13}C in particulates (sediment cores, surface sediment, and water column particulates) ranged from -26.1 to -27.0. Values for del^{15}N in particulates ranged from -0.7 to 3.1, while del^{34}S ranged from -14.2 to 1.8.

In fish, stable isotope ratios for carbon (del^{13}C) were reported ranging from -34.4 to -21.0. Values for del^{15}N ranged from 5.55 to 11.9 and del^{34}S values ranged from -2.4 to 1.8. Stable isotope ratios measured in macroinvertebrate samples ranged from -27.1 to -21.9 for del13C, -0.35 to 4.9 for del^{15}N, and -2.15 to 1.65 for del^{34}S.

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Tables

TABLE 1
GENERAL ELECTRIC COMPANY
HUDSON RIVER PROJECT
FOOD CHAIN STUDY

SEDIMENT ANALYTICAL TESTING RESULTS

Sample ID	NEA ID	Date Collected	Total PCB * (mg/kg)	Homolog Distribution (% by weight)										Stable Isotope Ratios **		
				Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Carbon	Nitrogen	Sulfur
Habitat Station 1																
FC-C1(0-1)	921570	5/13/92	15.6	8.5	13.0	31.5	33.6	8.6	3.7	0.8	0.2	0.0	0.0	-26.5	-0.7	-4.9
FC-C1(1-3)	921571	5/13/92	8.1	18.5	19.8	26.1	24.2	7.1	3.3	0.8	0.2	0.0	0.0	-26.5	0.9	-1.2
FC-C1(3-5)	921572	5/13/92	17.3	8.0	10.6	32.2	35.7	8.9	3.6	0.7	0.2	0.0	0.0	-26.3	0.2	-0.9
FC-C1(5-10)	921573	5/13/92	8.8	19.3	24.6	25.0	21.1	6.3	2.9	0.7	0.1	0.0	0.0	-26.4	-0.3	-0.9
FC-SS-1	921574	5/13/92	11.0	8.2	16.4	33.3	30.6	7.6	3.1	0.6	0.1	0.0	0.0	-26.2	1.5	-3.2
FC-WCP-1	921575	5/13/92	INS											-26.9	0.2	1.8
Habitat Station 2																
FC-C2D(0-1)	921576	5/13/92	INS											-26.6	1.1	INS
FC-C2D(1-3)	921577	5/13/92	20.3	9.6	19.4	31.4	26.2	8.2	3.5	1.1	0.4	0.1	0.0	-26.9	1.0	-1.0
FC-C2D(3-5)	921578	5/13/92	25.9	11.8	23.3	31.4	21.7	7.3	3.1	1.1	0.4	0.1	0.0	-26.8	0.4	-1.2
FC-C2D(5-10)	921579	5/13/92	27.4	8.0	24.7	34.0	21.6	7.3	3.0	1.0	0.3	0.1	0.0	-26.7	-0.5	-0.9
FC-SS-2D	921580	5/13/92	34.8	9.3	21.7	32.4	25.7	7.1	2.8	0.8	0.2	0.1	0.0	-26.5	-0.5	1.2
FC-WCP-2	921581	5/13/92	INS											-26.8	-0.5	-0.5
Habitat Station 3																
FC-C3C(0-1)	921582	5/14/92	INS											-26.8	1.1	-2.2
FC-C3C(1-3)	921583	5/14/92	4.5	9.4	18.3	29.8	27.5	8.9	4.2	1.0	0.5	0.4	0.1	-26.9	2.5	INS
FC-C3C(3-5)	921584	5/14/92	4.0	11.5	22.7	27.3	24.4	8.3	4.1	1.0	0.4	0.2	0.1	-27.0	3.1	-0.2
FC-C3C(5-10)	921585	5/14/92	4.8	14.6	28.3	26.6	19.2	6.5	3.3	0.9	0.4	0.2	0.1	-26.7	2.7	-0.4
FC-SS-3C	921586	5/14/92	5.3	8.8	12.2	30.4	32.2	10.1	4.7	1.1	0.3	0.1	0.1	-26.1	2.2	1.1
FC-WCP-3	921587	5/14/92	INS											-26.4	1.9	-14.2
EQPT BLANK1	921588	5/14/92	0.0											-24.0	INS	INS

Notes:
INS = Insufficient sample amount for analysis
* = Total PCB concentrations expressed on a dry weight basis
** = Stable isotope values calculated based on ratios of two isotopes present in a sample relative to same ratio present in isotope standard

TABLE 2
GENERAL ELECTRIC COMPANY
HUDSON RIVER PROJECT
FOOD CHAIN STUDY

MACROINVERTEBRATE ANALYTICAL TESTING RESULTS

Species	NEA ID	Habitat Station	Date Collected	Percent Lipids	Total PCB ** (mg/kg)	Homolog Distribution (% by weight)										Stable Isotope Ratios ***		
						Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Carbon	Nitrogen	Sulfur
Gastropoda *	921675	HS-1	5/20/92	INS	INS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-21.9	4.3	0.3
	921699	HS-2	5/21/92															
	921715	HS-3	5/22/92															
Clams	921676	HS-1	5/20/92	INS	0.8	0.1	2.2	21.9	46.1	16.0	9.1	3.4	0.8	0.3	0.1	-26.5	2.7	0.3
	921707	HS-2	5/21/92	INS	INS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-26.7	4.2	1.6
	921718	HS-3	5/22/92	INS	2.8	0.4	2.4	21.1	47.7	17.9	7.7	2.1	0.5	0.2	0.1	-27.1	4.9	1.7
Oligiochaetes *	921677	HS-1	5/20/92	INS	INS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-23.6	2.9	-2.2
	921709	HS-2	5/21/92															
	921719	HS-3	5/22/92															
Caddisflies	921678	HS-1	5/20/92	INS	35.0	0.0	0.3	25.0	54.3	13.9	5.5	0.8	0.1	0.0	0.0	-24.4	0.5	0.1
Anthropods *	921680	HS-1	5/20/92	INS	INS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-22.6	-0.4	0.3
	921708	HS-2	5/21/92															
	921717	HS-3	5/22/92															
Chironomids *	921681	HS-1	5/20/92	INS	INS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-25.0	-0.1	INS
	921705	HS-2	5/21/92															
EQUIP BLK	921722	HS-3	5/22/92	N/A	0.0											N/A	N/A	N/A

Notes:
INS = Insufficient sample amount for analysis
N/A = Not applicable
* = samples were composited across three habitat stations to meet minimum weight requirements except for chironomids which were composited across two habitat stations (HS-1 and HS-2)
** = total PCB concentrations are expressed on a wet weight basis.
*** = stable isotope values calculated based on ratios of two isotopes present in a sample relative to same ratio present in isotope standard

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TABLE 3
GENERAL ELECTRIC COMPANY
HUDSON RIVER PROJECT
FOOD CHAIN STUDY

FISH ANALYTICAL TESTING RESULTS

Sample ID	NEA ID	Date Collected	Fish Species	Percent Lipid	Total PCB * (mg/kg)	Homolog Distribution (% by weight)										Stable Isotope Ratios **		
						Mono	Di	Tri	Tetra	Penta	Hexa	Hepta	Octa	Nona	Deca	Carbon	Nitrogen	Sulfur
Habitat Station 1																		
WS-2	921662	5/20/92	White Sucker	11.6	130.8	0.2	3.7	27.6	45.4	15.0	6.3	1.5	0.3	0.1	0.0	-23.8	5.55	-0.9
SMB-1	921665	5/20/92	Small Mouth Bass	1.37	65.7	0.0	1.0	16.0	45.1	22.4	11.8	2.9	0.7	0.2	0.0	-22.1	8.3	0.5
RB-2	921668	5/20/92	Rock Bass	3.38	18.5	0.5	4.6	23.6	45.5	16.1	7.3	1.9	0.4	0.1	0.0	-34.4	8.6	-1.5
PKSD-1	921669	5/20/92	Pumpkinseed	3.05	11.5	0.1	2.2	22.5	49.9	15.8	7.0	2.0	0.4	0.1	0.0	-31.7	11.4	-1.9
YP-2	921671	5/20/92	Yellow Perch	4.96	89.7	0.0	2.7	27.0	50.7	13.2	5.0	1.1	0.2	0.1	0.0	-23.0	8.4	-2.2
CP-1	921672	5/20/92	Chain Pickerel	2.64	99.6	0.0	1.0	22.3	51.4	16.6	6.8	1.5	0.3	0.1	0.0	-21.1	9.4	-2.4
BB-2	921674	5/20/92	Bullhead	4.55	55.9	0.0	2.6	30.2	46.8	13.6	5.3	1.3	0.3	0.1	0.0	-23.4	9.0	-1.1
Habitat Station 2																		
WS-2	921685	5/21/92	White Sucker	7.86	60.2	0.3	3.1	25.7	46.4	15.8	6.7	1.7	0.4	0.1	0.0	-25.2	8.3	-2.1
SMB-1	921688	5/21/92	Small Mouth Bass	1.97	71.1	0.1	1.4	21.5	46.8	19.2	8.4	2.1	0.5	0.1	0.0	-21.0	11.9	-0.3
PKSD-1	921689	5/21/92	Pumpkinseed	3.68	24.3	0.2	4.4	35.6	44.1	10.9	3.8	0.8	0.1	0.0	0.0	-21.4	9.5	0.5
CP-2	921691	5/21/92	Chain Pickerel	1.80	21.7	0.2	2.0	26.9	45.5	14.2	7.9	2.5	0.7	0.1	0.0	-23.0	10.7	-1.8
RB-1	921692	5/21/92	Rock Bass	2.78	50.0	0.2	2.0	21.7	47.6	18.1	7.9	2.1	0.4	0.1	0.0	-26.2	10.4	1.5
YP-1	921695	5/21/92	Yellow Perch	2.39	32.7	0.1	1.6	24.0	50.2	15.9	6.3	1.6	0.3	0.1	0.0	-23.2	8.8	1.8
Habitat Station 3																		
BB-1	921711	5/22/92	Bullhead	1.31	4.4	0.1	0.7	12.9	36.6	18.6	18.0	8.5	3.5	1.1	0.1	-24.7	11.4	0.5
RB-1	921713	5/22/92	Rock Bass	INS	1.8	1.2	5.0	28.0	42.0	14.1	7.0	2.2	0.4	0.1	0.0	-21.0	8.0	1.4

Notes:

INS = Insufficient sample amount for analysis

* = Total PCB concentrations expressed on a wet weight basis

** = Stable isotope values calculated based on ratios of two isotopes present in a sample relative to same ratio present in isotope standard

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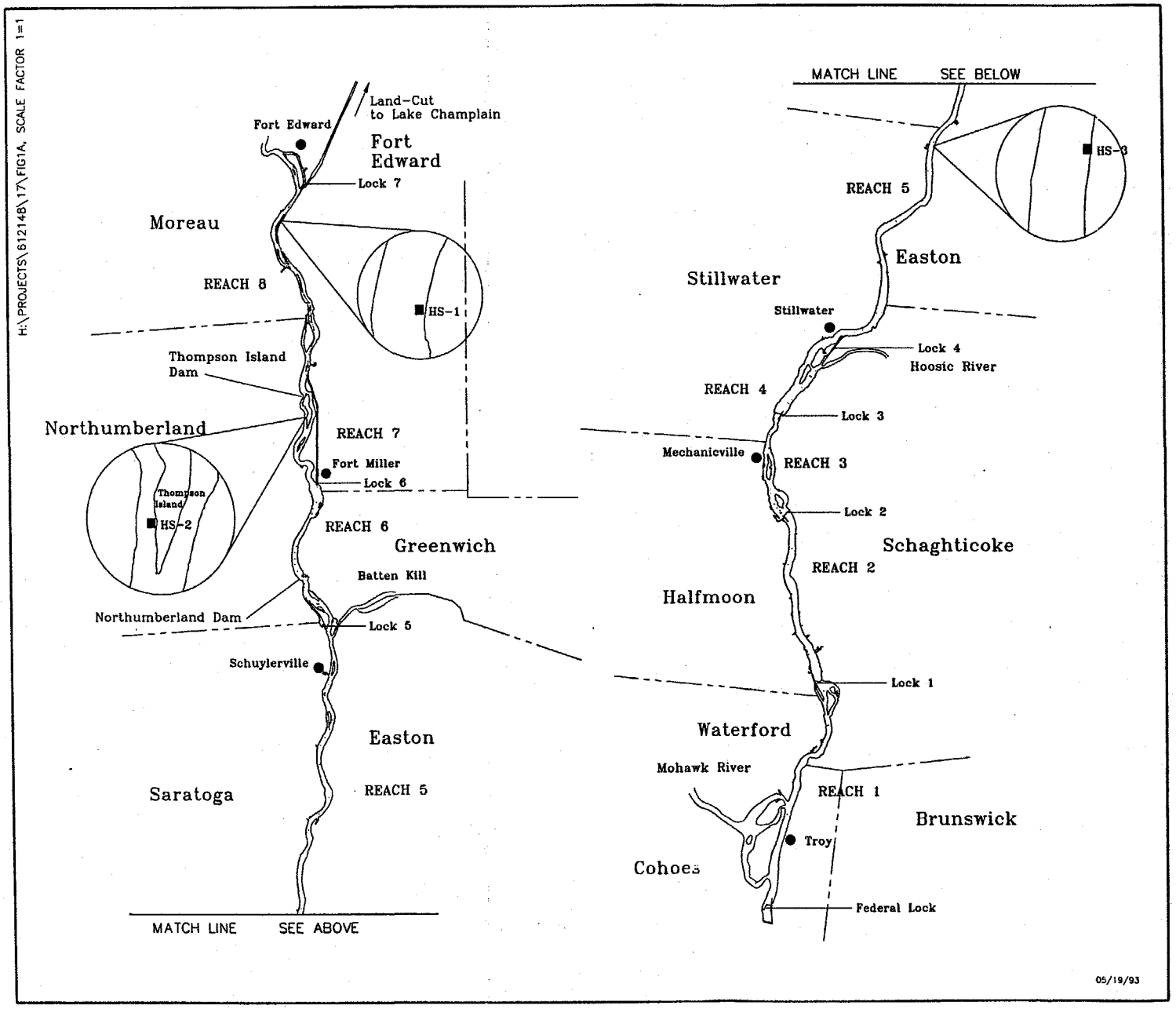
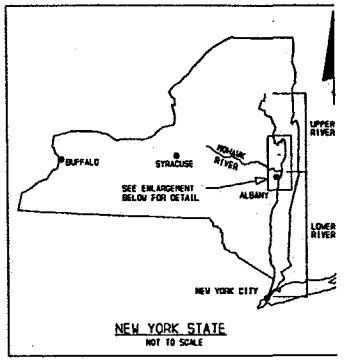
Figures

FIGURE 1





GENERAL ELECTRIC COMPANY

HUDSON RIVER PROJECT FOOD CHAIN STUDY

HABITAT STATION LOCATIONS

SOURCE:
NEW YORK STATE BARGE CANAL SYSTEM MAPS (NOAA, 1973)

NOT TO SCALE

O'BRIEN & GERE ENGINEERS INC.
Syracuse, New York

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