



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Mr. Greco:

Enclosed you will find copies of the following documents, a) Contaminants in Fish and Sediments from Sixmile Creek and Threemile Creek in the Vicinity of Griffiss Air Force Base, Oneida County, New York, and b) scoring package for the NPL listing of Griffiss Air Force Base.

If you have any comments or need to discuss any issues feel free to contact me at (212) 264-6695.

Welcome aboard.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "L. Richman".

Lance R. Richman, PG  
Regional Project Manager

Enclosure

**Contaminants in Fish and Sediment from Sixmile Creek  
and Threemile Creek in the Vicinity of Griffiss Air Force Base,  
Oneida County, New York**

Prepared for:  
United States Air Force  
Griffiss Air Force Base  
Rome, New York

Prepared by:  
United States Fish and Wildlife Service  
Cortland Field Office  
Cortland, New York

February, 1989



Contaminants in Fish and Sediment from Sixmile Creek  
and Threemile Creek in the Vicinity of Griffiss Air Force Base,  
Oneida County, New York

Prepared for:  
United States Air Force  
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Cortland, New York

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## Executive Summary

The U.S. Fish and Wildlife Service conducted a study to determine the extent of contamination in fish and sediments in Threemile Creek and Sixmile Creek in the vicinity of Griffiss Air Force Base in Oneida County, New York. Griffiss has been listed as a hazardous waste site by the Environmental Protection Agency under the Superfund legislation.

Samples were collected at two sites on Sixmile Creek, one upstream from and one downstream from the Base. Threemile Creek, which originates on the Base, was sampled downstream of the Base boundary. These samples were then submitted for laboratory analysis. The results showed polychlorinated biphenyl (PCB) contamination in Threemile Creek and, to a lesser extent, in Sixmile Creek, downstream from the Base. White suckers from Threemile Creek contained 4.7 parts per million (ppm) PCBs (whole body), well above the Food and Drug Administration action level for fish of 2.0 ppm. Samples from the upstream site were free from PCBs. A known PCB source exists on the Base. Strontium concentrations in Threemile Creek sediments were found to be high; however, strontium would only be hazardous as a radioisotope.

Threemile Creek has received inputs of a number of contaminants, especially polynuclear aromatic hydrocarbons, lead, chromium, selenium, and nickel, which approach, but do not exceed, concentrations considered toxicologically significant or indicative of heavy pollution.

Recommendations are made for continued monitoring of contamination and consideration of a health advisory. Threemile Creek restoration should be considered in any remediation plan.

This study was completed by the Cortland Field Office, U.S. Fish and Wildlife Service, with funding from Griffiss Air Force Base.

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Contaminants in Fish and Sediments from Sixmile Creek  
and Threemile Creek in the Vicinity of Griffiss Air Force Base,  
Oneida County, New York

INTRODUCTION

Griffiss Air Force Base is located in the City of Rome, Oneida County, New York (Figure 1), and covers about 3,900 acres (1579 ha). The western portion of the Base drains into the Mohawk River which also forms part of the western boundary of the installation. Sixmile Creek originates north and east of the base, flows south through its eastern portion and continues on to the New York State Barge Canal. Threemile Creek originates on the Base and flows south for about two miles to the Canal.

The Base has been listed as a hazardous waste site by the Environmental Protection Agency (EPA) under the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund). Hazardous wastes were generated from Base operations and research and development activities. The sources include industrial shops and laboratories. Wastes were disposed of primarily in landfills and dry wells covering about 110 acres (45 ha) (Figure 1). Information regarding these waste sites is provided in Table 1. The list is not intended to be all inclusive, but rather features those sites which have been investigated for the Air Force Installation Restoration Program (IRP), and have the greatest potential for off-site contamination. Contamination has been documented in Sixmile Creek, where heavy metals and organic compounds were found in ground water, surface water, and sediments (Fred C. Hart Associates, 1981, 1982; Roy G. Weston, Inc., 1982). Polychlorinated biphenyls (PCB's) were found in Threemile Creek sediments (USGS, 1987).

Sixmile Creek is classified by the New York State Department of Environmental Conservation (State) as "C(t)" above and below Griffiss Air Force Base, indicating trout waters. It is classified as "D" on the base, the best use of which is secondary contact recreation (State's lowest category). Sixmile Creek supports a wild population of brook trout (Salvelinus fontinalis), and receives some fishing pressure from local anglers (J. Hasse, State, personal communication). White sucker (Catostomus commersoni), blacknose dace (Rhinichthys atratulus), creek chub (Semotilus atromaculatus), and other nongame fish are also found there. The fishery of Threemile Creek includes white sucker and perhaps other species.

STUDY OBJECTIVE

The objective of this study is to determine the extent of contamination of fish and sediment in Sixmile Creek and Threemile Creek downstream of Griffiss Air Force Base. Recommendations for remediation and further study are also made.

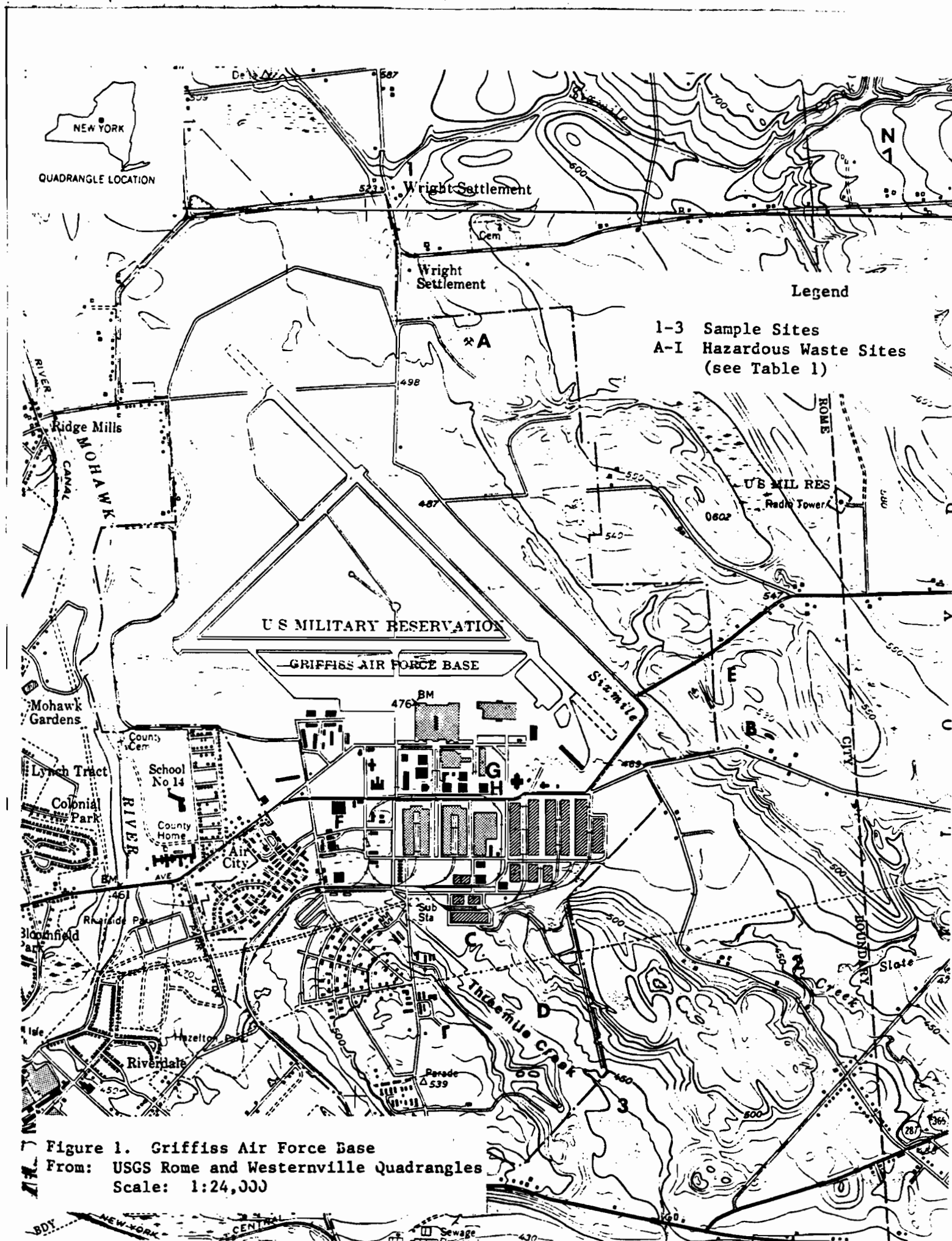


Figure 1. Griffiss Air Force Base  
From: USGS Rome and Westernville Quadrangles  
Scale: 1:24,000



Table 1. Hazardous waste sites at Griffiss Air Force Base, Oneida County, New York, investigated in Phase II, Installation Restoration Program.

Map Reference*	Site	Watershed	Wastes	Contamination	Remediation
A	Landfill No. 1	Sixmile Creek	General Refuse, Boiler Ash, Hardfill	Several metals, phenols, volatile organics, calcium in ground, surface waters, sediment	cleaned up & capped, 1984
B	Landfill No. 2	Sixmile Creek	Hardfill, General Refuse	No significant contamination detected	closed 1980, capped 1984
C	Landfill No. 5	Threemile Creek	General Refuse	"	deemed unnecessary
D	Landfill No. 6	Threemile Creek	Hardfill, General Refuse	"	deemed unnecessary
E	Landfill No. 7	Sixmile Creek	General Refuse, Liquid Waste	Phenols, oil & grease, lead, copper, volatile organics in ground, surface water, sediment	capped 1985
F	Dry Well, Bldg. 301	Threemile Creek or Mohawk RI. (?)	Pesticides	No significant contamination detected	removed 1985/1987
G	PCB Handling Area (Bldg. 112)	Threemile Creek or Sixmile Creek (?)	PCB's	PCB in soils in the vicinity of Bldg. 112	removal & disposal of structures, soils, 1984
H	Fuel Spillage Areas	?	Petroleum-based fuel products	Fuel products, oil & grease, lead found in soil, groundwater near site	removal of buried tank, soils, 1984/1985
I	Battery Acid Pits (Bldg. 101,222)	?	Battery Acid	Lead, copper, zinc, antimony, and chromium in pits, some off site	removal of soils, pits sealed, 1985

\*See Figure 1.

## METHODS AND MATERIALS

### Sample Sites

Three sample sites were selected to collect fish and sediment (Figure 1). Site 1 is located on Sixmile Creek upstream of the Base boundary, and is intended as a reference site to indicate background conditions. Sixmile Creek, at Site 1, is a small creek with alternating pools and riffles and overhanging trees. It is up to eight feet (2.4 m) wide and three feet (0.9 m) deep and has a gravel and cobble bottom. Sediment was sampled at a point about 200 feet (61 m) upstream from the Base boundary, and fish were collected in a zone extending from the Base boundary upstream about 300 feet (91 m).

Site 2 is located on Sixmile Creek downstream from the Base boundary. At this point, the creek is wider (to 20 feet or 6 m) and deeper (to four feet or 1.2 m), has overhanging trees, pools and riffles, and a sand and silt bottom. Sediment was sampled at a point about 100 feet (30 m) downstream from the Base boundary and just upstream from a tributary. Fish were collected in a zone from the Base boundary downstream about 2,000 feet (600 m) to the first highway bridge.

Site 3 is located on Threemile Creek downstream from the Base boundary. This is a small creek up to four feet (1.2 m) wide and three feet (.9 m) deep, flowing through abandoned agricultural fields. The bottom is silt with some sand.

### Sampling Methods

One sediment sample was collected at each sample site on July 20, 1988. Duplicate samples (1A and 1B) were taken at Site 1 as a quality control measure. Each sample consisted of a composite of five cores taken in an area of likely sediment deposition. Cores were collected using a soil auger with a 3 1/4 inch (8.25 cm) diameter, stainless steel auger bucket. Sediment was shaken out of the auger and placed into a stainless steel tray. The five cores were mixed in the tray with a stainless steel spatula and placed into 16 oz. (473 ml) I-CHEM glass containers. One container was delivered immediately to a laboratory for total organic carbon and grain size analysis. The other was refrigerated (not frozen) from time of collection to arrival at the laboratory on August 1, 1988. The auger, mixing tray, and spatula were cleaned initially and after each sample by rinsing with stream water, nitric acid, acetone, and distilled water.

Fish sampling efforts were directed at bottom dweller and predator species. In addition to the water, bottom feeders are exposed to contaminants in sediment through physical contact and through feeding on benthic organisms. Predators are exposed via water and the food chain where they are known to bioaccumulate a number of contaminants. White sucker, a bottom feeder, was collected at all three sites, and brook trout, a predator, was collected from Sites 1 and 2 (Sixmile Creek).

Fish were collected at all sites with a battery-operated backpack electroshocker. Sites 1 and 2 were sampled on June 20, and Site 3 on June 21, 1988. Fish were kept on ice from the time of collection until

processing later the same day at the Cortland Field Office. At the office, the five largest fish of each species (white sucker and brook trout) were measured for length and weight. Each fish was then wrapped in aluminum foil that had been rinsed with hexane. Fish were subsequently frozen until received by the laboratory on August 1, 1988. The five whole fish for each sample site were composited for analysis at the laboratory. Thus, one fish sample was analyzed from each site.

The following stream data were collected at each sample site: temperature, pH, and conductivity.

#### Laboratory Analyses

Analysis of fish and sediment for organochlorines and polynuclear aromatic hydrocarbons (PAHs) was performed by the Mississippi State Chemical Laboratory at Mississippi State (Appendix A). Analysis of fish and sediment for inorganic elements was performed by the Environmental Trace Substances Research Center of the University of Missouri at Columbia (Appendix B). Total organic carbon and grain size were analyzed at OBG Laboratories in Syracuse, New York (Appendix C).

### RESULTS

#### Sediment

PCB's (total) were the only organochlorine compounds detected in sediment of 22 tested for and only at Site 3 (Threemile Creek) in a concentration of 0.3 ppm. PAH data are shown in Table 2. All 14 PAH compounds tested for were found at or above detection limits (.01 ppm) in at least two sites. Most PAH compounds show slight increases from Site 1 to Site 2, with Site 2 values ranging up to 0.20 ppm for fluoranthrene. Almost all PAH compounds increased from Site 1 to Site 3, some greatly, with values ranging up to 0.57 ppm for benzo(g,h,i)perylene at Site 3. Differences between the duplicates (1A and 1B) were small, but were not quantified because most are near the detection limit.

Among the inorganic elements, 18 of 21 elements tested for were found in at least one site (Table 3). A few of these (barium, cadmium, lead, and strontium) showed increases from Site 1 to Site 2. Several (arsenic, cadmium, mercury, lead, selenium, and strontium) also increased from Site 1 to Site 3. The duplicate samples (1A and 1B) showed consistent values, with most elements varying less than 10%. The most significant difference was in vanadium at 22%.

The samples showed considerable variation in total organic carbon content (Table 4), even between Sites 1A and 1B which were duplicates from the same location. Sediment from Sites 1A and 1B were not homogeneous in nature, and included gravel and clumped material. Grain sizes (Table 5) were relatively similar between Sites 1A and 1B and between Sites 2 and 3. Sites 2 and 3, however, showed smaller grain sizes than Sites 1A and 1B.

Table 2. Polynuclear aromatic hydrocarbons (PAH) detected in sediment from Sixmile Creek and Threemile Creek, Oneida County, NY, 1988.<sup>A</sup>

Compound	Sample Site		
	1A* (Sixmile Creek-upstream)	1B* (Sixmile Creek-downstream)	3 (Threemile Creek)
naphthalene	ND <sup>B</sup>	ND	0.02
fluorene	0.01	0.01	0.04
phenanthrene	0.04	0.12	0.28
anthracene	0.02	0.05	0.10
fluoranthrene	0.04	0.08	0.30
pyrene	0.04	0.09	0.21
1,2-benzanthracene	0.07	0.06	0.14
chrysene	0.02	0.07	0.16
benzo(b)fluoranthrene	0.02	0.03	0.14
benzo(k)fluoranthrene	ND	0.01	0.03
benzo(e)pyrene	0.01	0.05	0.15
benzo(a)pyrene	0.02	0.03	0.27
1,2,5,6-dibenzanthracene	ND	0.02	ND
benzo(g,h,i)perylene	0.02	0.08	0.57

<sup>A</sup> Concentration in parts per million (ppm), detection limit 0.01 ppm.

<sup>B</sup> ND = None Detected

\*Sites 1A and 1B are duplicates

Table 3. Metals detected in sediment from Sixmile Creek and Threemile Creek, Oneida County, NY, 1988.A

Element (detection limit)	Sample Site		
	1A* (Sixmile Creek-upstream)	2 (Sixmile Creek-downstream)	3 (Threemile Creek)
aluminum (0.6-2)	13,700	6,670	3,580
arsenic	3.4	2.1	3.9
barium (0.02-0.07)	39.2	45.9	20.3
beryllium (0.02-0.07)	0.82	0.35	0.35
boron (0.4-1)	<1	1	<0.9
cadmium (0.05-0.2)	<0.2	0.31	1.0
chromium (0.2-0.7)	20	8.0	14
copper (0.08-0.2)	29.2	9.71	14.2
iron (0.5-5)	30,400	13,800	9,600
lead (1-3)	9	17	40
magnesium (0.05-2)	5,920	2,570	3,200
manganese (0.1-0.3)	356	260	190
mercury	0.03	0.02	0.034
nickel (0.2-0.9)	29	8.4	10
selenium	<0.07	<0.05	0.1
strontium (0.02-0.07)	7.08	11.1	24.7
vanadium (0.08-0.2)	18	9.80	15.8
zinc (0.06-0.2)	66.4	63.7	56.2

A Concentration in parts per million (ppm)

\*Sites 1A and 1B are duplicates

The following elements were not detected in any sample:

- molybdenum
- silver
- thallium

Table 4. Total organic carbon content of sediments from Sixmile Creek and Threemile Creek, Oneida County, New York.<sup>A</sup>

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<u>Sample</u>	<u>Total Organic Carbon</u>
1A* (Sixmile Creek)	450
1B (Sixmile Creek)	210
2 (Sixmile Creek)	520
3 (Threemile Creek)	110

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<sup>A</sup> Concentration in mg/kg wet weight.

\* Sites 1A and 1B are duplicates.

Table 5. Grain size of sediments from Stimile Creek and Thremille Creek, Oneida County, New York.

Site 1A* (Stimile Cr.)		Site 1B (Stimile Cr.)		Site 2 (Stimile Cr.)		Site 3 (Thremille Cr.)	
Slave Opening (mm)	& Retained	Slave Opening (mm)	& Retained	Slave Opening (mm)	& Retained	Slave Opening (mm)	& Retained
12.7	15.3	12.7	20.1	...	...	...	...
6.35	27.4	6.35	18.5	...	...	...	...
4.75	7.2	4.75	4.7	4.75	1.5	4.75	1.8
2.00	13.4	2.00	7.8	2.00	3.1	2.00	2.5
1.19	3.9	1.19	2.4	1.19	4.1	1.19	4.1
0.30	14.4	0.30	27.7	0.595	17.2	0.595	17.7
PAN	18.4	PAN	18.8	0.30	51.1	0.30	25.8
...	...	...	...	0.149	17.7	0.149	31.9
...	...	...	...	PAN	5.3	PAN	16.2

\* Sites 1A and 1B are duplicates.

Table 6. Organochlorines detected in fish tissue (whole body) from Sixmile Creek and Threemile Creek, Oneida County, NY, 1988. A

Compound	Sample Site					
	1		2		3	
	(Sixmile Creek-upstream)		(Sixmile Creek-downstream)		(Threemile Creek)	
	Brook Trout	White Sucker	Brook Trout	White Sucker	White Sucker	
t-Nonachlor	ND <sup>B</sup>	ND	0.01	ND	0.01	0.01
PCB's (total)	ND	ND	1.7	0.74	4.7	
p,p'-DDE	0.04	0.08	0.01	ND	0.01	
Dieldrin	ND	0.01	0.08	0.01	0.02	
p,p'-DDD	0.01	0.02	0.03	0.01	0.06	
p,p'-DDT	ND	0.01	ND	ND	0.02	
DDT (total)	0.05	0.11	0.04	0.01	0.09	

A Concentrations in parts per million (ppm), detection limit 0.01 ppm.

B ND = None Detected

The following compounds not detected in any sample:

- HCB
- α-BHC
- γ-BHC
- β-BHC
- δ-BHC
- Oxychlorane
- Hept. Epox.
- γ-Chlordane
- Toxaphene
- o,p'-DDE
- α-Chlordane
- o,p'-DDD
- Endrin
- cis-Nonachlor
- o,p'-DDT
- Mirex



### Fish

Organochlorine data are shown in Table 6. Seven of 22 compounds tested for were detected. Several compounds show slight increases at Sites 2 and 3 over Site 1. PCB's (total) show large increases at Sites 2 and 3 (Sixmile Creek downstream and Threemile Creek) over Site 1 (Sixmile Creek upstream), for both fish species. PAH data are shown in Table 7. Ten PAH compounds were detected in fish, but all at levels close to the detection limit (.01 ppm). A few showed slight increases at the downstream sites (2 and 3) over the control site (1).

Inorganic data are shown in Table 8. Twelve of 14 elements tested for were found in fish. Nine of these showed increases at Site 2 over Site 1 in at least one species (arsenic, cadmium, chromium, copper, iron, manganese, mercury, nickel, and selenium). Six (arsenic, cadmium, chromium, copper, nickel, and selenium) increased at Site 3 over Site 1 for at least one species.

### DISCUSSION

In order to assign some level of significance to data which show increased concentrations of a given chemical in sediment or fish downstream from Griffiss Air Force Base compared to upstream (control) concentrations, the data must be examined using two sets of criteria. First, any such increases must be larger than estimated experimental error. Some components of this error can be observed in quality control reports from the laboratories. Field variability undoubtedly exists, but cannot be estimated in this limited study because only one composite was taken at each site. Second, the levels of contamination, even though elevated over the controls, must be shown to be problematic to the organisms involved. This involves examining the data in light of the toxicological literature, where such information exists.

### Sediment

While the Site 3 PCB sediment concentration, 0.3 ppm, is not indicative of heavily polluted conditions, it is well above the control site samples where PCB's were not detected, and well above other reported background (unpolluted) levels (Eisler, 1986). This is so despite relatively lower organic carbon content found in the Site 3 sample. Although the smaller grain size in that sample would favor higher contaminant concentrations, PCB's were not detected at Site 2 which had similar grain size. This result is also consistent with Threemile Creek sediment data taken upstream, on the Base, which showed total PCB levels in a range of 0.4 to 20 ppm (USGS, 1987). A known PCB source exists within the Threemile Creek Watershed on the Base.

Although the PAH compounds were consistently higher at the downstream sites, indicating some Base impact, even the highest levels (in the 0.1-0.5 ppm range) are consistent with results from control (unpolluted) sites from other studies. Heit (1985) found an average fluoranthrene concentration of 0.285 +/- 0.067 ppm in deepwater sediments from Cayuga Lake, New York. The average fluoranthrene concentration in Cayuga Lake littoral sediments was 0.32 +/- 0.20 ppm. Heit found these levels, both from areas away from known PAH sources (marinas, power plants), to be similar to those reported elsewhere for rural eastern U.S. lakes. Fluoranthrene is usually found in association



Table 8. Metals detected in fish tissue (whole body) from Sixmile Creek and Threemile Creek, Oneida County, NY, 1988.<sup>A</sup>

Element (detection limit)	Sample Site					
	1		2		3	
	(Sixmile Creek-upstream)		(Sixmile Creek-downstream)		(Threemile Creek)	
	Brook Trout	White Sucker	Brook Trout	White Sucker	White Sucker	
aluminum (0.3-0.4)	24	463	8.5	422	193	
arsenic	<0.1	<0.1	<0.1	0.2	0.37	
beryllium (0.01)	<0.01	0.02	<0.01	0.02	<0.01	
cadmium (0.02-0.03)	0.16	0.16	0.10	0.29	0.38	
chromium (0.1)	0.83	1.7	1.2	2.1	3.2	
copper (0.02)	5.17	4.11	3.93	4.35	6.53	
iron (0.1)	95.3	467	115	946	445	
manganese (0.2-0.32)	5.3	38.5	14.6	153	33.2	
mercury	0.26	0.42	0.661	0.48	0.19	
nickel (0.2)	0.56	1.1	0.90	1.3	2.0	
selenium	1.1	0.96	1.5	1.4	2.3	
zinc (0.02)	106	84.8	65.6	76.6	81.6	

<sup>A</sup> Concentrations in parts per million (ppm)

The following elements were not detected in any sample:

lead  
thallium

with other PAH compounds. Sediments from industrial or urban waterways typically show individual PAH compound concentrations in the one to ten ppm range (Eisler, 1987).

Most of the increases in inorganic element concentrations in the downstream site are too small to be considered meaningful or too close to detection limits. Only lead and strontium concentrations warrant further assessment. Both downstream sites (Sites 2 and 3) showed increases in strontium over reference; the Site 3 increase was sizeable (232% to 24.7 ppm). Strontium, however, is known to be benign to organisms except at extremely high concentrations (USEPA, 1978). Strontium ions behave much like calcium and concentrate in bone tissue. The only exception would be the radioisotopes of strontium, which would be considered hazardous and are linked to bone cancer. The present study did not test for radioactivity, but the EPA did investigate the only known potentially radioactive site near Threemile Creek, on the Base, in 1980 (USEPA, 1980a). No levels of radioactivity above background levels were detected. Potential sources of non-radioactive strontium include flares and tracer bullets.

Lead is known to have a number of deleterious effects upon aquatic biota (Eisler, 1988a). Clearly, there are large increases in lead concentrations at the downstream sites (100% to 17 ppm at Site 2, 371% to 40 ppm at Site 3), perhaps originating from fuel and battery acid sources. The highest concentration (40 ppm) reaches the threshold level for "moderately polluted" sediments under the EPA's Great Lakes Criteria for sediment. Just upstream on Threemile Creek, a 1982 study found 10.5 ppm lead in sediment (Fred C. Hart Assoc., 1982). Both the strontium and lead data must be interpreted in light of the smaller grain size found in sediments at Sites 2 and 3. Smaller sizes tend to accumulate higher contaminant concentrations.

#### Fish

Although several organochlorine compounds, except PCB's, showed slight increases at the downstream sites, all are close to the detection limit (0.01 ppm) and none represent threats to the aquatic ecosystem. The largest increase among the non-PCB compounds was in dieldrin at Site 2 in brook trout. The 0.08 ppm concentration recorded there is below the U.S. Food and Drug Administration (FDA) action level of 0.3 ppm for dieldrin in fish and shellfish for human consumption.

Both species of fish at both downstream sites (Sites 2 and 3) showed evidence of PCB contamination (0.74-4.7 ppm). PCB's elicit a variety of toxic effects in organisms, and are known to bioaccumulate and biomagnify within the food chain (Eisler, 1986). The FDA action level for PCB's in fish and shellfish is 2.0 ppm for edible portions (fillets). Sloan (1987) found PCB concentrations in lake trout (*Salvelinus namaycush*) fillets to be about 80% of whole body levels. Gessner and Corline (1980) found fillet concentrations consistently less than whole body in five Lake Erie fishes. PCB concentrations exceeding the FDA limit have been recorded from fish in many U.S. waters, however, there is a definite trend toward lower concentrations in the last decade, presumably as a result of prohibition of most PCB uses in 1979. Whole body residues of 0.4 ppm PCB's are associated with reproductive toxicity in rainbow trout (EPA, 1980b). Mink, a fish-eating mammal, were found sensitive to certain PCB concentrations as low as 0.11 ppm in fish (R. Sloan, personal communication).

Large increases in PCB levels at the downstream sites over reference sites (where none was detected) are consistent with sediment data from this and the U.S. Geological Survey (USGS) study, and with the existence of a known PCB source on Base.

Concentrations of PAH compounds in fish were all close to the detection limit - the highest was 0.04 ppm anthracene at Site 2 in brook trout. PAH levels are usually low in fish because they are rapidly metabolized. PAH's are normally undetectable in fish tissue from unpolluted sources, however, the levels found in this study are well below the 0.3 ppm level, above which increases in detoxifying enzymes were found in fish (Eisler, 1987).

Among the inorganic elements, arsenic showed increases at both downstream sites for white sucker. Even the highest concentration (0.37 ppm), however, is within the range of recorded values in fish tissue from sites not known to be polluted with arsenic (Eisler, 1988b). Diminished growth and survival has been reported in bluegills when muscle residues exceed 1.5 ppm in immature fish or 5 ppm in adults (NRCC, 1978).

Similar increases in cadmium were found in the downstream sites in white sucker. Again, however, the highest level, 0.38 ppm, seems within recorded background levels (Eisler, 1985a). Levels above 2.0 ppm in whole body are considered as evidence of probable cadmium contamination.

Iron and manganese, although showing large increases at Site 2, are considered non-toxic except at levels much higher than found in this study (USEPA, 1978).

Mercury levels increased greatly at Site 2 in brook trout, to 0.661 ppm. The FDA action level for mercury in fish and shellfish is 1.0 ppm. Mercury levels in the five to seven ppm range in brook trout tissue were found to cause death (McKim, et al., 1976).

Copper levels increased somewhat in white suckers at Site 3 (to 6.53 ppm), however, this increase may not be experimentally significant. Data on copper residues in tissue are very limited.

Chromium levels increased greatly at Site 3 in white suckers (88% to 3.2 ppm). Available evidence suggests that tissues containing greater than 4.0 ppm chromium residue are contaminated. Thus the Site 3 samples approach that criteria.

Selenium levels also increased greatly at Site 3 in white suckers (140% to 2.3 ppm). This level is higher than background (unpolluted) levels reported from other studies, but lower than those levels reported for sites of known selenium contamination (Eisler, 1985b). Although the selenium residue literature is inconclusive at this time, one source suggests a limit of 2.0 ppm in seafood for human consumption (Bebbington, et al., 1977).

Nickel concentrations increased at Site 2 in brook trout (61% to 0.9 ppm) and at Site 3 in white sucker (82% to 2.0 ppm). Nickel is known to have toxic effects to aquatic biota, but little residue data are available to interpret these results.

#### CONCLUSIONS AND RECOMMENDATIONS

There is clear evidence of PCB contamination of Threemile Creek and Sixmile Creek, although the situation is less serious at Sixmile Creek. PCB contamination is corroborated by data from other studies of Threemile Creek. Strontium concentrations in Threemile Creek sediments are high, but this would not be significant unless radioactivity is detected.

The Threemile Creek ecosystem has received inputs of a number of other contaminants, especially PAHs, lead, chromium, selenium, and nickel. Individually, these chemicals approach but do not exceed quantities considered biologically significant or indicative of heavy pollution. Synergistic effects may exist but are difficult to predict.

PCB contamination should be monitored in Threemile and Sixmile Creeks until concentrations are reduced, presumably through restoration efforts. A health advisory should be considered for Threemile Creek along its entire length by the appropriate authorities, warning against consumption of fish. Threemile Creek should be surveyed immediately for radioactivity resulting from strontium isotopes. The Air Force Installation Restoration Plan and the Superfund Remediation Plan should address Threemile Creek restoration both on and off Base.

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APPENDIX A

Laboratory Analysis of Organic Compounds

U. S. FISH AND WILDLIFE SERVICE  
PATUXENT ANALYTICAL CONTROL FACILITY

QUALITY ASSURANCE REPORT

RE:# 5574      REGION : 5      REGIONAL ID 020-88-R5

THE ANALYSES ON THE ABOVE MENTIONED SAMPLES WERE PERFORMED AT:

THE MISSISSIPPI STATE CHEMICAL LABORATORY  
BOX CR  
MISSISSIPPI STATE, MISSISSIPPI 39762

THIS LABORATORY WAS SUBJECTED TO A RIGOROUS EVALUATION PROCESS PRIOR TO THE AWARDING OF IT'S CONTRACT. A PANEL OF FISH AND WILDLIFE SERVICE SCIENTISTS CERTIFIED IT TO BE TECHNICALLY QUALIFIED TO PERFORM THE ANALYSES REPORTED HERE. IN ADDITION WE HAVE CONTINUED TO CLOSELY MONITOR THIS LABORATORY'S PERFORMANCE AND HAVE FOUND THE PRECISION AND ACCURACY OF THEIR WORK REMAINS ACCEPTABLE. WE HAVE GREAT CONFIDENCE IN THE ACCURACY OF THESE DATA.

*John F. Moore 8-26-88*  
\_\_\_\_\_  
JOHN F. MOORE

MISSISSIPPI STATE UNIVERSITY



MISSISSIPPI  
STATE CHEMICAL LABORATORY

BOX CR - MISSISSIPPI STATE, MISSISSIPPI 39762



August 24, 1988

Mr. Danny Day  
Stickel Building/Chemistry  
Patuxent Wildlife Research Center  
U.S. Fish and Wildlife Service  
Route 197  
Laurel, MD 20708

Dear Danny:

Enclosed are analytical results for one batch of samples submitted by the U.S. Fish and Wildlife Service (Catalog #5574, Study #020-88-R5, Order No. 85800-88-30021). The samples were analyzed by Methods 1, 2, 3 & 4; descriptions are enclosed.

Please call if you have any questions.

Sincerely,

Larry G. Lane  
Principal Investigator

MISSISSIPPI STATE UNIVERSITY  
 MISSISSIPPI STATE CHEMICAL LABORATORY  
 BOX CR  
 MISSISSIPPI STATE, MS 39762  
 REPORT FORM  
 USDI/FWS

SAMPLE TYPE: Fish and  
 Sediment  
 CAT NO. 5574  
 BATCH NO. 020-98-R5  
 ORDER NO. 85800-98-  
 30021

**ORGANOCHLORINES**

DATE RECEIVED 08/01/98

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	CFO-GAB-X K2	88-1	88-2	88-3	88-4	88-5	88-6	88-7
LAE #		752895	752896	752897	752898	752899	752900	752901
MATRIX		Brook Trout	Brook Trout	White Sucker	White Sucker	White Sucker	Sediment	Sediment
COMPOUND								
HCB		ND*	ND	ND	ND	ND	ND	ND
p-BHC		ND	ND	ND	ND	ND	ND	ND
r-BHC		ND	ND	ND	ND	ND	ND	ND
s-BHC		ND	ND	ND	ND	ND	ND	ND
o-BHC		ND	ND	ND	ND	ND	ND	ND
Oxychlorodane		ND	ND	ND	ND	ND	ND	ND
Hept. Epox.		ND	ND	ND	ND	ND	ND	ND
p-Chlorodane		ND	ND	ND	ND	ND	ND	ND
t-Nonachlor		ND	0.01	ND	ND	0.01	ND	ND
Toxaphene		ND	ND	ND	ND	ND	ND	ND
PCB's (total)		ND	1.7	ND	0.74	4.7#	ND	ND
o, p'-DDE		ND	ND	ND	ND	ND	ND	ND
p-Chlorodane		ND	ND	ND	ND	ND	ND	ND
o, p'-DDE		0.04	0.01	0.05	ND	0.01	ND	ND
Dieldrin		ND	0.08	0.01	0.01	0.02	ND	ND
o, p'-DDD		ND	ND	ND	ND	ND	ND	ND
Endrin		ND	ND	ND	ND	ND	ND	ND
cis-nonachlor		ND	ND	ND	ND	ND	ND	ND
o, p'-DDT		ND	ND	ND	ND	ND	ND	ND
p, p'-DDD		0.01	0.03	0.02	0.01	0.06	ND	ND
p, p'-DDT		ND	ND	0.01	ND	0.02	ND	ND
Mirex		ND	ND	ND	ND	ND	ND	ND
OTHER:								
WEIGHT (g)		670	350	250	655	538	844	833
MOISTURE (%)		72.6	73.8	76.0	78.4	78.0	32.4	32.8
LIPID (%)		7.35	6.00	2.89	1.64	3.68	-	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. LLD = 0.005 for Water  
 \*\*Spike = ppm for  
 # = Confirmed by GC/Mass Spectrometry  
 \*ND = None Detected  
 \*\*NS = Not Spiked

*Larry Lane*

SAMPLE TYPE: Fish and  
 Sediment  
 CAT NO. 5574  
 BATCH NO. 020-88-RE  
 ORDER NO. 85800-89-  
 30021

**ORGANOCHLORINES**

DATE RECEIVED 08/01/88

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	CFO-GAB-X X=	88-8	88-9	Blank	Blank	Matrix: Blank	Spike**	% Recovery
LAB #		752902	752903	752904	752906	for	752907	
MATRIX		Sediment	Sediment	Reagent	Reagent	Fish	Fish	
COMPOUND								
HCB		ND*	ND	ND	ND	ND	0.065	65
$\alpha$ -BHC		NS	ND	ND	ND	ND	NS***	
$\gamma$ -BHC		ND	ND	ND	ND	ND	0.090	90
$\beta$ -BHC		ND	ND	ND	ND	ND	0.10	100
$\delta$ -BHC		ND	ND	ND	ND	ND	NS	
Oxychlorane		ND	ND	ND	ND	ND	0.082	82
hept. Etox.		ND	ND	ND	ND	ND	0.085	85
$\gamma$ -Chlordane		ND	ND	ND	ND	ND	NS	
$\beta$ -Nonachlor		ND	ND	ND	ND	ND	0.090	90
Toxaphene		ND	ND	ND	ND	ND	NS	
PCB's (total)		ND	0.80	ND	ND	ND	NS	
$o, p'$ -DDE		ND	ND	ND	ND	ND	0.099	99
$\gamma$ -Chlordane		ND	ND	ND	ND	ND	0.093	93
$p, p'$ -DDE		ND	ND	ND	ND	0.01	0.10	100
Dieldrin		ND	ND	ND	ND	ND	0.088	88
$o, p'$ -DDD		ND	ND	ND	ND	ND	NS	
Endrin		ND	ND	ND	ND	ND	0.090	90
cis-nonachlor		ND	ND	ND	ND	ND	0.096	96
$o, p'$ -DDT		ND	ND	ND	ND	ND	0.098	98
$p, p'$ -DDD		ND	ND	ND	ND	ND	0.095	95
$p, p'$ -DDT		ND	ND	ND	ND	ND	0.10	100
Mirex		ND	ND	ND	ND	ND	0.093	93
OTHER:								
WEIGHT (g)		889	778	-	-	-	-	-
MOISTURE (%)		18.0	18.2	-	-	78.6	77.8	-
LIPID (%)		-	-	-	-	1.45	1.64	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. LLD = 0.005 for Water  
 \*\*Spike = 0.10 ppm for Fish  
 # = Confirmed by GC/Mass Spectrometry  
 \*ND = None Detected  
 \*\*\*NS = Not Spiked

A-4

*Larry Lane*

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 MISSISSIPPI STATE CHEMICAL LABORATORY  
 BOX CR  
 MISSISSIPPI STATE, MS 39762  
 REPORT FORM  
 USDI/FWS

Page 1

SAMPLE TYPE: Fish and  
 Sediment  
 CAT NO. 5574  
 BATCH NO. 020-88-R5  
 ORDER NO. 85800-88-  
 30021

POLYNUCLEAR AROMATIC HYDROCARBONS

DATE RECEIVED 06/01/88

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	CFO-GAE-X X=	88-1	88-2	88-3	88-4	88-5	88-6	88-7
LAB #		752895	752896	752897	752898	752899	752900	752901
MATRIX		Brook Trout	Brook Trout	White Sucker	White Sucker	White Sucker	Sediment	Sediment
COMPOUND								
naphthalene		0.01	ND	ND	ND	ND	ND	ND
fluorene		ND*	ND	0.01	0.01	0.01	0.01	0.02
phenanthrene		0.02	0.02	ND	0.01	0.01	0.04	0.02
anthracene		0.02	0.01	0.04	ND	ND	0.02	0.05
fluoranthrene		ND	0.03	0.01	0.01	0.01	0.04	0.06
pyrene		0.01	0.02	0.03	0.02	0.02	0.04	0.09
1,2-benzanthracene		ND	0.01	0.01	ND	0.01	0.07	0.06
chrysene		0.01	0.01	ND	ND	0.01	0.02	0.07
benzo(b)fluoranthrene		ND	ND	ND	ND	ND	0.02	0.03
benzo(k)fluoranthrene		ND	ND	ND	ND	ND	ND	ND
benzo(e)pyrene		ND	0.01	ND	0.01	0.01	0.01	0.03
benzo(a)pyrene		ND	ND	ND	ND	ND	0.02	0.03
1,2,5,6-dibenzanthracene		ND	ND	ND	ND	ND	ND	0.02
benzo(g,h,i)perylene		ND	ND	0.01	ND	ND	0.02	0.03
WEIGHT (g)		-	-	-	-	-	-	-
MOISTURE (%)		72.6	73.8	76.0	78.4	78.0	32.4	32.5
LIPID (%)		7.35	6.00	2.89	1.64	3.68	-	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Sediment, etc.  
 LLD = 0.005 ppm for Water  
 \*ND = None Detected  
 \*\*Spike = \_\_\_\_\_ ppm for \_\_\_\_\_  
 \*\*\*NS = Not Spiked  
 # = Confirmed by GC/Mass Spectrometry

*Larry Lane*

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Page 2

SAMPLE TYPE: Fish and  
 Sediment  
 CAT NO. 5574  
 BATCH NO. 020-89-95  
 ORDER NO. 88800-33-  
 3002

**POLYNUCLEAR AROMATIC HYDROCARBONS**

DATE RECEIVED 08/01/95

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	CFO-GAB-X X=	88-8	88-9	Blank	Blank	Matrix Blank	Spike	% Recovery
LAB #		752902	752903	752904	752908	for	752905	
MATRIX		Sediment	Sediment	Reagent	Reagent	Fish	Fish	
COMPOUND								
naphthalene		0.31	0.02	ND*	ND	ND	0.085	85
fluorene		0.04	0.04	ND	ND	ND	0.085	85
bienanthrene		0.35	0.25#	ND	ND	ND	0.079	79
anthracene		0.95	0.10#	ND	ND	ND	0.10	100
fluoranthrene		0.20	0.30#	ND	ND	ND	0.085	85
pyrene		0.17	0.21#	ND	ND	ND	0.070	70
1,2-benzanthracene		0.05	0.14#	ND	ND	ND	0.072	72
chrysene		0.10	0.16#	ND	ND	ND	0.085	85
benzo(b)fluoranthrene		0.35	0.14#	ND	ND	ND	0.085	85
benzo(k)fluoranthrene		0.31	0.03	ND	ND	ND	0.30	100
benzo(a)pyrene		0.05	0.15#	ND	ND	ND	0.075	75
benzo(a)pyrene		0.05	0.27#	ND	ND	ND	0.077	77
1,2,5,6-dibenzanthracene		0.04	ND	ND	ND	ND	0.085	85
benzo(g,h,i)perylene		0.02	0.57#	ND	ND	ND	0.077	77
WEIGHT (g)		-	-	-	-	-	-	-
MOISTURE (%)		18.0	18.2	-	-	80.4	78.4	-
LIPID (%)		-	-	-	-	-	-	-

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Sediment, etc.  
 LLD = 0.005 ppm for Water  
 \*ND = None Detected  
 \*\*Spike = 0.10 ppm for Fish  
 \*\*\*NS = Not Spiked  
 # = Confirmed by GC/Mass Spectrometry

*Larry Lane*

UNKNOWN COMPONENTS - PAH FRACTION

(RRT) - RETENTION TIME RELATIVE TO PHENANTHRENE

(PPM) - PARTS PER MILLION BASED ON PHENANTHRENE RESPONSE FACTOR

STUDY 020-88-R5  
CATALOG 5574

RECALC  
TITLE:

CFO-GAB-88-1

18:22 5 AUG 88

CHANNEL NO: 2

SAMPLE: 35734 PAH

METHOD: PAH

PEAK NO	PEAK NAME	RESULT PPM	TIME (MIN)	AREA COUNTS	RRT	SEP CODE
1		0.1071	19.316	27847	0.93	VV
2		0.7875	21.997	204676	1.06	VB
3		0.1174	23.778	30514	1.14	VV
4		0.1014	24.596	26354	1.18	VV
5		0.5812	26.160	151040	1.26	VV
6		0.5945	26.257	154506	1.26	VV
7		0.2070	26.765	53794	1.29	VB
8		0.3360	27.371	87315	1.32	VV
9		0.3984	27.497	103549	1.32	VV
10		0.1019	39.197	26475	1.89	VV
11		0.1369	43.532	35568	2.10	VV
12		0.1528	43.786	39701	2.11	VV
13		1.9109	45.588	496622	2.19	VB
14		0.4390	46.408	114101	2.23	BV
TOTALS:		5.9720		1552060		

DIVISOR: 25.0000 MULTIPLIER: 1.00000

ERRORS:  
REL RETEN PEAK NOT FOUND



Elution Profiles for Florisil, Silica Gel and  
Silicic Acid Column Separations

A. Florisil Column:

1. Fraction I (6% ethyl ether with 2% ethanol, 94% petroleum ether)  
HCB, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, oxychlordane,  
heptachlor epoxide, gamma-chlordane, trans-nonachlor, toxaphene,  
PCB's, o,p'-DDE, alpha-Chlordane, p,p'-DDE, o,p'-DDT,  
cis-nonachlor, o,p'-DDT, p,p'-DDD, p,p'-DDT, mirex, dicofol,  
endosulfan I (Split with FII).
2. Fraction II - (15% ethyl ether with 2% ethanol, 85% petroleum  
ether)  
dieldrin, endrin, dacthal, endosulfan I (split with FI),  
endosulfan II (split with FIII), endosulfan sulfate (split with  
FIII).
3. Fraction III - (50% ethyl ether with 2% ethanol, 50% petroleum  
ether)  
endosulfan II (split with FII), endosulfan sulfate (split  
with FII), malathion.

7-31-87

B. Florisil Mini-Column:

1. Fraction I - (12 ml hexane followed by 12 ml 1% methanol in hexane)

HCB, gamma-BHC (25%), alpha-BHC (splits with FII),  
trans-nonachlor, o,p'-DDE, p,p'-DDE, o,p'-DDD, p,p'-DDD (splits  
with FII), o,p'-DDT, p,p'-DDT, mirex, cis-nonachlor,  
cis-chlordane, trans-chlordane, PCB's

2. Fraction II - (24 ml 1% methanol in hexane)

gamma BHC (75%), beta-BHC, alpha-BHC (splits with FI), delta-BHC,  
oxychlordane, heptachlor epoxide, toxaphene, dicofol, dacthal.

C. Silica Gel:

1. SG Fraction I - (100 ml petroleum ether)

n-dodecane, n-tridecane, n-tetradecane, octylcyclohexane,  
n-pentadecane, nonylcyclohexane, n-hexadecane, n-heptadecane,  
pristane, n-octadecane, phytane, n-nonadecane, n-eicosane.

2. SG Fraction II (100 ml 40% methylene chloride in petroleum ether followed by 50 ml methylene chloride)

naphthalene, fluorene, phenanthrene, anthracene, fluoranthrene,  
pyrene, 1,2-benzanthracene, chrysene, benzo [b] fluoranthrene,  
benzo [k] fluoranthrene, benzo [e] pyrene, benzo [a] pyrene,  
1,2:5,6-dibenzanthracene, benzo [g,h,i] perylene.

D. Silicic Acid:

1. SA Fraction I (20 ml petroleum ether)  
HCB, mirex

2. SA Fraction II (100 ml petroleum ether)

PCB's, p,p'-DDE (splits with SA III)

3. SA Fraction III (20 mls-mixed solvent: 1% acetonitrile, 80 % methylene chloride, 19 % hexane)
- alpha-BHC, beta BHC, gamma-BHC, delta-BHC, oxychlordane, hextachlor epoxide, gamma-chlordane, trans-nonachlor, toxaphene, o,p'-DDE, alpha-chlordane, p,p'-DDE (splits with SA II), o,p'-DDT, cis-nonachlor, o,p'-DDT, p,p'-DDD, p,p'-DDT, dicofol.

**Method 1. Analysis For Organochlorine Pesticides and PCBs In Animal and Plant Tissue.**

Ten gram tissue samples are thoroughly mixed with anhydrous sodium sulfate and soxhlet extracted with hexane for seven hours. The extract is concentrated by rotary evaporation; transferred to a tared test tube, and further concentrated to dryness for lipid determination. The weighed lipid sample is dissolved in petroleum ether and extracted four times with acetonitrile saturated with petroleum ether. Residues are partitioned into petroleum ether which is washed, concentrated, and transferred to a glass chromatographic column containing 20 grams of Florisil. The column is eluted with 200 ml 6% diethyl ether/94% petroleum ether (Fraction I) followed by 200 ml 15% diethyl ether/85% petroleum ether (Fraction II). Fraction II is concentrated to appropriate volume for quantification of residues by packed column electron capture gas chromatography. Fraction I is concentrated and transferred to a Silicic acid chromatographic column for additional cleanup required for separation of PCBs from other organochlorines. Three fractions are eluted from the Silicic acid column. Each is concentrated to appropriate volume for quantification of residues by packed or megabore column, electron capture gas chromatography. PCBs are found in Fraction II.

**Method 2. Analysis For Organochlorine Pesticides and PCBs In Soil and Sediment.**

Twenty five gram soil or sediment samples are extracted with acetone followed by hexane, by allowing to soak one hour in each with intermittent shaking. The combined extracts are centrifuged and decanted into a separatory funnel containing sufficient water to facilitate partitioning of residues into hexane portion. The hexane is washed twice with water and concentrated to appropriate volume for transfer to a 1.6 gram Florisil mini-column topped with 1.6 grams sodium sulfate. Residues are eluted from the column in two elution fractions. Fraction I consists of 12 milliliters hexane followed by 12 milliliters of 1% methanol in hexane, and Fraction II consists of an additional 24 milliliters of 1% methanol in hexane. If additional cleanup is required to separate PCBs from other organochlorines in Fraction I, further chromatography on a Silicic acid column is performed. Quantification of residues in the two Florisil fractions and three Silicic acid fractions is by packed or megabore column, electron capture gas chromatography.

**Method 3. Analysis For Aliphatic and Polynuclear Aromatic Hydrocarbons In Animal and Plant Tissue.**

A sample of appropriate size (i.e. 15 grams animal or plant tissue, 2 grams adipose, 5 grams eggs) is digested in 6N aqueous potassium hydroxide for 24 hours at 35°C. Cool digestate thoroughly in an ice bath and carefully neutralize with glacial acetic acid. Extract the neutralized reaction mixture three times with methylene chloride; concentrate the combined extracts to near dryness and reconstitute in petroleum ether for transfer to a 20 gram 1% deactivated silica gel column, topped with 5 grams neutral alumina. Aliphatic and polynuclear aromatic hydrocarbon residues are separated by eluting aliphatics from the column with 100 ml petroleum ether (Fraction I) followed by elution of aromatics using first, 100 ml 40% methylene chloride/60% petroleum ether, then 50 ml methylene chloride (Combined eluates, Fraction II). If needed, Fraction I containing aliphatics is subjected to additional cleanup by concentration and transfer to a deactivated (2% water) Florisil column. Aliphatic residues are eluted from the Florisil column using 200 ml 6% diethyl ether/94% petroleum ether. The eluate is concentrated to appropriate volume for quantification by capillary column, flame ionization gas chromatography. The silica gel Fraction II containing aromatic hydrocarbons is concentrated, reconstituted in methylene chloride, and subjected to gel permeation chromatographic (GPC) cleanup prior to quantification by capillary, flame ionization gas chromatography and fluorescence HPLC.

**Method 4. Analysis For Aliphatic and Aromatic Hydrocarbons In Soil and Sediment.**

Twenty gram soil or sediment samples are extracted with acetone, followed by petroleum ether, by allowing to soak one hour in each with intermittent shaking. A final acetone/petroleum ether extraction is done, and the extracts are combined, centrifuged, and transferred to a separatory funnel containing sufficient water to facilitate partitioning of residues into petroleum ether portion. The petroleum ether is washed twice with water and concentrated by Kuderna-Danish to appropriate volume for transfer to a 20 gram 1% deactivated silica gel column, topped with five grams neutral alumina. Aliphatic and polynuclear aromatic hydrocarbon residues are fractionated by eluting aliphatics from the column with 100 ml petroleum ether (Fraction I) followed by elution of aromatics using first, 100 ml 40% methylene chloride/60% petroleum ether, then 50 ml methylene chloride (Combined eluates, Fraction II). If needed, Fraction I containing aliphatics is subjected to additional cleanup by concentration and transfer to a deactivated (2% water) Florisil column. Aliphatic residues are eluted from the Florisil column using 200 ml 6% diethyl ether/94% petroleum ether. The eluate is concentrated to appropriate volume for quantification by capillary column, flame ionization gas chromatography. The silica gel Fraction II containing aromatic hydrocarbons is concentrated, reconstituted in methylene chloride, and subjected to gel permeation chromatographic (GPC) cleanup prior to quantification by capillary, flame ionization gas chromatography and fluorescence HPLC.

APPENDIX B

Laboratory Analysis of Inorganic Compounds



U. S. FISH AND WILDLIFE SERVICE  
PATUXENT ANALYTICAL CONTROL FACILITY

QUALITY ASSURANCE REPORT

RE:# 5574      REGION : 5      REGIONAL ID 020-88-R5

THE ANALYSES ON THE ABOVE MENTIONED SAMPLES WERE PERFORMED AT:

THE ENVIRONMENTAL TRACE SUBSTANCES RESEARCH CENTER  
ROUTE 3  
COLUMBIA, MISSOURI 65201

THIS LABORATORY WAS SUBJECTED TO A RIGOROUS EVALUATION PROCESS PRIOR TO THE AWARDING OF IT'S CONTRACT. A PANEL OF FISH AND WILDLIFE SERVICE SCIENTISTS CERTIFIED IT TO BE TECHNICALLY QUALIFIED TO PERFORM THE ANALYSES REPORTED HERE. IN ADDITION WE HAVE CONTINUED TO CLOSELY MONITOR THIS LABORATORY'S PERFORMANCE AND HAVE FOUND THE PRECISION AND ACCURACY OF THEIR WORK REMAINS ACCEPTABLE. WE HAVE GREAT CONFIDENCE IN THE ACCURACY OF THESE DATA.

*John F. Moore 9-17-83*  
\_\_\_\_\_  
JOHN F. MOORE



UNIVERSITY OF MISSOURI

Environmental Trace Substances Research Center

Route 3  
Columbia, Missouri 65203  
Telephone (314) 882-2151

September 12, 1988

Gregory Smith  
U.S. Department of the Interior  
Patuxent Wildlife Research Center  
Laurel, Maryland 20708

Dear Dr. Smith:

Enclosed are data, quality control reports and invoice for  
Cat. #5574.

Let me know if you have any questions.

Sincerely,

*Edward J. Hinderberger, Jr.*

Edward J. Hinderberger, Jr.  
Group Leader

EJH:ds

Enclosures

COLEMAN KANSAS CITY ROLLA ST. LOUIS

MISSOURI STATE UNIVERSITY

A 16

ETSRC Sample Report

USDI - Cat. 5574  
B-38080815

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817	MOIST	69.8	%	BROOK TROUT
CFO-GAB-88-2	8080818	MOIST	73.0	%	BROOK TROUT
CFO-GAB-88-3	8080819	MOIST	81.0	%	WHITE SUCKER
CFO-GAB-88-4	8080820	MOIST	78.4	%	WHITE SUCKER
CFO-GAB-88-5	8080821	MOIST	76.6	%	WHITE SUCKER

ETSRC Sample Report

USDI - Cat. 5574

B-88080815

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817	SE	1.1	MCG/G DW	BROOK TROUT
CFO-GAB-88-2	8080818	SE	1.5	MCG/G DW	BROOK TROUT
CFO-GAB-88-3	8080819	SE	0.96	MCG/G DW	WHITE SUCKER
CFO-GAB-88-4	8080820	SE	1.4	MCG/G DW	WHITE SUCKER
CFO-GAB-88-5	8080821	SE	2.3	MCG/G DW	WHITE SUCKER

ETSRC Quality Control Report -- Duplicates

USDI - Cat. 5574  
B-88080815

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-38-4	8080820	SE	1.4	MCG/G DW	WHITE SUCKER
CFO-GAB-38-4	8080820D	SE	1.4	MCG/G DW	WHITE SUCKER
Percent Deviation			0.0		

ETSRC Quality Control Report -- Spikes

USDI - Cat. 5574  
B-88080815

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817	SE	1.1	MCG/G DW	BROOK TROUT
CFO-GAB-88-1	8080817S	SE	98.	MCG/G DW	BROOK TROUT
MCG of Spike Added		50.00	Percent Spike Recovery		98.

ETSRC Quality Control Report -- Reference Standards

USDI - Cat. 5574  
B-88080815

Reference ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Expected Value	Standard Deviation	Description
NBS 1577A	8080816	SE	0.71	MCG/G DW	0.71	0.07	BOVINE LIVER
NRCC TORT1	8080822	SE	6.3	MCG/G DW	6.88	0.24	LOBSTER - CA

ETSRC Sample Report

USDI - Cat. 5574  
B-88080815

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817	HG	0.26	MCG/G DW	BROOK TROUT
CFO-GAB-88-2	8080818	HG	0.661	MCG/G DW	BROOK TROUT
CFO-GAB-88-3	8080819	HG	0.42	MCG/G DW	WHITE SUCKER
CFO-GAB-88-4	8080820	HG	0.48	MCG/G DW	WHITE SUCKER
CFO-GAB-88-5	8080821	HG	0.19	MCG/G DW	WHITE SUCKER



ETSRC Quality Control Report -- Duplicates

USDI - Cat. 5574  
B-88080815

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-4	8080820	HG	0.47	MCG/G DW	WHITE SUCKER
CFO-GAB-88-4	8080820D	HG	0.48	MCG/G DW	WHITE SUCKER
Percent Deviation		2.1			

ETSRC Quality Control Report -- Spikes

USDI - Cat. 5574  
B-88080815

Submitter's ID Number	ETSRC ID Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817 HG	0.26	MCG/G DW	BROOK TROUT
CFO-GAB-88-1	8080817S HG	2.21	MCG/G DW	BROOK TROUT
MCG of Spike Added		1.00	Percent Spike Recovery 98.	

ETSRC Quality Control Report -- Reference Standards

USDI - Cat. 5574  
B-38080815

Reference ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Expected Value	Standard Deviation	Description
NRCC TORT1	8080822	HG	0.32	MCG/G DW	0.33	0.05	LOBSTER - CA

ETSRC Sample Report

USDI - Cat. 5574  
B-88080815

submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817	AS	<0.1	MCG/G DW	BROOK TROUT
CFO-GAB-88-2	8080818	AS	<0.1	MCG/G DW	BROOK TROUT
CFO-GAB-88-3	8080819	AS	<0.1	MCG/G DW	WHITE SUCKER
CFO-GAB-88-4	8080820	AS	0.2	MCG/G DW	WHITE SUCKER
CFO-GAB-88-5	8080821	AS	0.37	MCG/G DW	WHITE SUCKER

ETSRC Quality Control Report -- Duplicates

USDI - Cat. 5574  
B-86080815

submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-4	8080820	AS	0.2	MCG/G DW	WHITE SUCKER
CFO-GAB-88-4	8080820D	AS	0.2	MCG/G DW	WHITE SUCKER
Percent Deviation			0.0		

ETSRC Quality Control Report -- Spikes

USDI - Cat. 5574  
B-88080815

Submitter's ID Number	ETSRC ID Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-1	8080817 AS	<0.1	MCG/G DW	BROOK TROUT
CFO-GAB-88-1	8080817S AS	94.	MCG/G DW	BROOK TROUT
MCG of Spike Added	50.00	Percent Spike Recovery	95.	

ETSRC Quality Control Report -- Reference Standards

USDI - Cat. 5574  
B-88080815

Reference ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Expected Value	Standard Deviation	Description
NBS 1577A	8080816	AS	<0.1	MCG/G DW	0.047	0.006	BOVINE LIVER
NRCC TORT1	8080822	AS	25.	MCG/G DW	24.6	1.1	LOBSTER - CA

Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88080815

Customer ID: CFC-GAB-88-1  
Description: BROOK TROUT  
ETSRC ID: 8080817

Elm : Result	Estimated Sample Detection Limit
AL : 24.	0.4
BE : <0.01	0.01
CD : 0.16	0.03
CR : 0.83	0.1
CU : 5.17	0.02
FE : 95.3	0.1
MN : 5.3	0.32
NI : 0.56	0.2
PB : <0.4	0.4
TL : <0.7	0.7
ZN : 106.	0.02

Customer ID: CFC-GAB-88-2  
Description: BROOK TROUT  
ETSRC ID: 8080818

Elm : Result	Estimated Sample Detection Limit
AL : 8.5	0.3
BE : <0.01	0.01
CD : 0.10	0.02
CR : 1.2	0.1
CU : 3.93	0.02
FE : 115.	0.1
MN : 14.6	0.2
NI : 0.90	0.2
PB : <0.4	0.4
TL : <0.7	0.7
ZN : 63.6	0.02



Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88080815

Customer ID: CFO-GAB-88-3  
Description: WHITE SUCKER  
ETSRC ID: 8080619

Elm	Result	Estimated Sample Detection Limit
AL	463.	0.3
BE	0.02	0.01
CD	0.16	0.03
CR	1.7	0.1
CU	4.11	0.02
FE	467.	0.1
MN	38.5	0.3
NI	1.1	0.2
PB	<0.5	0.5
TL	<0.7	0.7
ZN	84.8	0.02

Customer ID: CFO-GAB-88-4  
Description: WHITE SUCKER  
ETSRC ID: 8080620

Elm	Result	Estimated Sample Detection Limit
AL	422.	0.3
BE	0.02	0.01
CD	0.29	0.03
CR	2.1	0.1
CU	4.35	0.02
FE	946.	0.1
MN	153.	0.3
NI	1.3	0.2
PB	<0.5	0.5
TL	<0.7	0.7
ZN	76.6	0.02

Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88080815

Customer ID: CFO-GAB-88-5  
Description: WHITE SUCKER  
ETSRC ID: 8080821

Elm : Result	Estimated Sample Detection Limit
AL : 193.	0.3
BE : <0.01	0.01
CD : 0.38	0.03
CR : 3.2	0.1
CU : 6.53	0.02
FE : 445.	0.1
MN : 33.2	0.3
NI : 2.0	0.2
PB : <0.5	0.5
TL : <0.7	0.7
ZN : 81.6	0.02

Quality Control Report  
Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88080815

Customer ID: CFO-GAB-38-4  
Description: WHITE SUCKER  
ETSRC ID: 8080820

Elm	Result	Duplicate	% Deviation	Estimated Sample Detection Limit
AL	437.	391.	11.1	0.3
BE	0.02	0.01	66.7	0.01
CD	0.31	0.24	25.5	0.03
CR	2.7	1.5	57.1	0.1
CU	4.55	4.33	5.0	0.02
FE	943.	911.	3.5	0.1
MN	51.9	62.6	18.7	0.03
NI	1.6	0.82	64.5	0.2
PB	<0.5	<0.4	0.0	0.5
TL	<0.7	<0.6	0.0	0.6
ZN	73.8	73.4	0.5	0.02
Average % Deviation			23.0	

This sample was apparently not homogenous for Cr, Ni and possibly Cd, but was very acceptable for the other elements. We also checked the Ca and P concentrations to see if the problem was more bone in one of the samples, but these agreed within 3-5 %.

Quality Control Report  
 Environmental Trace Substances Research Center  
 ICP Scan - Sample Analysis Report  
 Project: USDI - Cat. 5574                      Units: MCG/G DRY WEIGHT  
   Batch #: B-88080815

Customer ID: CFC-GAB-88-1  
 Description: BROOK TROUT  
 ETSRC ID: 8080817

Elm	Result	MCG Added	Spiked Sample	% Recovery	Estimated Sample Detection Limit
AL	: 24.	100.0	222.	100.	0.4
BE	: <0.01	5.0	10.0	101.	0.01
CD	: 0.16	10.0	20.7	104.	0.04
CR	: 0.83	50.0	101.	101.	0.1
CU	: 5.17	100.0	208.	103.	0.02
FE	: 95.3	1000.0	2130.	103.	0.1
MN	: 5.3	50.0	105.	101.	0.3
NI	: 0.56	50.0	104.	105.	0.2
PB	: <0.4	50.0	95.6	97.	0.5
TL	: <0.7	50.0	98.3	99.	0.8
ZN	: 106.	200.0	513.	103.	0.06

Average % Recovery      102.

- Not Spiked
- \* Possibly Not Spiked - Not in Average
- \*\*\* Spike Too Low

Quality Control Report  
 Environmental Trace Substances Research Center  
 ICP Scan - Sample Analysis Report  
 Project: USDI - Cat. 5574 Units: MCG/G  
 Batch #: B-38080815

Customer ID: NBS 1577A  
 Description: BOVINE LIVER  
 ETSRC ID: 8080815

Elm	Result	Expected Value	+/- STD.DEV.	Estimated Sample Detection Limit
AL	1.4	2.	NO CERT	0.3
BE	<0.01			0.01
CD	0.42	0.44	0.06	0.03
CR	0.40			0.1
CU	154.	158.	7.	0.02
FE	192.	194.	20.	0.1
MN	10.	9.9	0.8	0.3
NI	0.4			0.2
PB	<0.4	0.135	0.015	0.4
TL	<0.7	0.003	NO CERT	0.7
ZN	123.	123.	8.	0.06

Customer ID: NRCC TORT1  
 Description: LOBSTER - CANADA  
 ETSRC ID: 8080822

Elm	Result	Expected Value	+/- STD.DEV.	Estimated Sample Detection Limit
AL	26.			0.3
BE	0.02			0.01
CD	26.1	26.3	1.1	0.05
CR	2.3	2.4	0.3	0.1
CU	404.	439.	11.	0.02
FE	198.	186.	5.5	0.1
MN	23.	23.4	0.5	0.3
NI	2.5	2.3	0.2	0.2
PB	9.9	10.4	1.0	0.5
TL	<0.7			0.7
ZN	163.	177.	5.	0.1

ETSRC Sample Report -

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-6	8070847	MOIST	35.4	%	SEDIMENT
CFO-GAB-88-7	8070848	MOIST	32.2	%	SEDIMENT
CFO-GAB-88-8	8070849	MOIST	30.9	%	SEDIMENT
CFO-GAB-88-9	8070850	MOIST	26.5	%	SEDIMENT

ETSRC Sample Report

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-6	8070847	AS	3.4	MCG/G DW	SEDIMENT
CFO-GAB-88-7	8070848	AS	3.6	MCG/G DW	SEDIMENT
CFO-GAB-88-8	8070849	AS	2.1	MCG/G DW	SEDIMENT
CFO-GAB-88-9	8070850	AS	3.9	MCG/G DW	SEDIMENT

ETSRC Quality Control Report -- Duplicates

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin. Conc.	Description
CFO-GAB-88-8	3070849	AS	2.2	MCG/G DW	SEDIMENT
CFO-GAB-88-8	8070849D	AS	2.0	MCG/G DW	SEDIMENT
Percent Deviation		9.5			



ETSRC Quality Control Report -- Spikes

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-7	8070848	AS	3.6	MCG/G DW	SEDIMENT
CFO-GAB-88-7	8070848S	AS	74.	MCG/G DW	SEDIMENT
MCG of Spike Added		50.00	Percent Spike Recovery 100.		

ETSRC Quality Control Report -- Reference Standards

USDI - Cat. 5574  
B-88070845

Reference ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Expected Value	Standard Deviation	Description
NBS 1645	8070846	AS	54.	MCG/G DW	66.	NO CERT	RIVER SEDIME
NBS 1571	8070851	AS	10.	MCG/G DW	10.	2.	ORCHARD LEAV

ETSRC Sample Report

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-6	8070847	SE	<0.07	MCG/G DW	SEDIMENT
CFO-GAB-88-7	8070848	SE	<0.06	MCG/G DW	SEDIMENT
CFO-GAB-88-8	8070849	SE	<0.05	MCG/G DW	SEDIMENT
CFO-GAB-88-9	8070850	SE	0.1	MCG/G DW	SEDIMENT

ETSRC Quality Control Report -- Duplicates

USDI - Cat. 5574  
B-38070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-38-3	8070849	SE	<0.05	MCG/G DW	SEDIMENT
CFO-GAB-38-3	8070849D	SE	<0.05	MCG/G DW	SEDIMENT
Percent Deviation		0.0			

ETSRC Quality Control Report -- Spikes

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-7	8070848	SE	<0.06	MCG/G DW	SEDIMENT
CFO-GAB-88-7	8070848S	SE	55.	MCG/G DW	SEDIMENT
MCG of Spike Added		50.00	Percent Spike Recovery		90.

ETSRC Quality Control Report -- Reference Standards

USDI - Cat. 5574  
B-88070845

Reference ID Number	ETSRC ID	Test	Final Concen.	Units of Fin. Conc.	Expected Value	Standard Deviation	Description
NBS 1645	8070846	SE	1.1	MCG/G DW	1.5	NO CERT	RIVER SEDIME
NBS 1571	8070851	SE	<0.1	MCG/G DW	0.08	0.01	ORCHARD LEAV

ETSRC Sample Report

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-6	6070847	HG	0.03	MCG/G DW	SEDIMENT
CFO-GAB-88-7	6070848	HG	0.02	MCG/G DW	SEDIMENT
CFO-GAB-88-8	6070849	HG	0.02	MCG/G DW	SEDIMENT
CFO-GAB-88-9	6070850	HG	0.034	MCG/G DW	SEDIMENT

ETSRC Quality Control Report -- Duplicates

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-8	8070849	HG	0.02	MCG/G DW	SEDIMENT
CFO-GAB-88-8	8070849D	HG	0.01	MCG/G DW	SEDIMENT
Percent Deviation			66.7		



ETSRC Quality Control Report -- Spikes

USDI - Cat. 5574  
B-88070845

Submitter's ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Description
CFO-GAB-88-7	8070848	HG	0.02	MCG/G DW	SEDIMENT
CFO-GAB-88-7	8070848S	HG	1.31	MCG/G DW	SEDIMENT
MCG of Spike Added		1.00	Percent Spike Recovery 98.		

ETSRC Quality Control Report -- Reference Standards

USDI - Cat. 5574  
B-38070845

Reference ID Number	ETSRC ID	Test	Final Concen.	Units of Fin.Conc.	Expected Value	Standard Deviation	Description
NBS 1645	8070846	HG	1.1	MCG/G DW	1.1	0.5	RIVER SEDIME
NBS 1571	8070851	HG	0.14	MCG/G DW	0.155	0.015	ORCHARD LEAV

Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-38070845

Customer ID: CFO-GAB-88-6  
Description: SEDIMENT  
ETSRC ID: 8070847

Elm	Result	Estimated Sample Detection Limit
AG	<1.	1.
AL	13700.	2.
AS	<10.	10.
B	<1.	1.
BA	39.2	0.07
BE	0.82	0.07
CD	<0.2	0.2
CR	20.	0.7
CU	29.2	0.2
FE	30400.	0.8
MG	5920.	2.
MN	356.	0.3
MO	<3.	3.
NI	29.	0.9
PB	9.	3.
SE	<10.	10.
SR	7.08	0.07
TL	<3.	3.
V	18.	0.2
ZN	66.4	0.2

Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88070845

Customer ID: CFO-GAB-88-7  
Description: SEDIMENT  
ETSRC ID: 8070848

Elm	Result	Estimated Sample Detection Limit
AG	<1.	1.
AL	15200.	2.
AS	<10.	10.
B	2.	1.
BA	44.8	0.06
BE	0.96	0.06
CD	<0.2	0.2
CR	20.	0.7
CU	27.8	0.2
FE	29200.	0.8
MG	5860.	2.
MN	331.	0.3
MO	<3.	3.
NI	28.	0.9
PB	8.	3.
SE	<10.	10.
SR	7.78	0.06
TL	<3.	3.
V	22.	0.2
ZN	62.8	0.2

Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88050845

Customer ID: CFO-GAB-38-3  
Description: SEDIMENT  
EISRC ID: 8070849

Elm : Result	Estimated Sample Detection Limit
AG : <0.5	0.5
AL : 6670.	0.6
AS : <4.	4.
B : 1.	0.4
BA : 45.9	0.02
BE : 0.35	0.02
CD : 0.31	0.05
CR : 8.0	0.2
CU : 9.71	0.08
FE : 13800.	5.
MG : 2570.	0.8
MN : 260.	0.1
MO : <1.	1.
NI : 8.4	0.2
PB : 17.	1.
SE : <6.	6.
SR : 11.1	0.02
TL : <1.	1.
V : 9.80	0.08
ZN : 63.7	0.06

Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-88070845

Customer ID: CFC-GAB-88-9  
Description: SEDIMENT  
EISRC ID: 8070850

Elm	Result	Estimated Sample Detection Limit
AG	<1.	1.
AL	3580.	1.
AS	<4.	4.
B	<0.9	0.9
BA	20.3	0.05
BE	0.35	0.05
CD	1.0	0.1
CR	14.	0.5
CU	14.2	0.1
FE	9600.	0.5
MG	3200.	0.05
MN	190.	0.2
MO	<1.	1.
NI	10.	0.6
PB	40.	2.
SE	<6.	6.
SR	24.7	0.05
TL	<2.	2.
V	15.8	0.2
ZN	56.2	0.2

Quality Control Report  
 Environmental Trace Substances Research Center  
 ICP Scan - Sample Analysis Report

Project: USDI - Cat. 5574                               Units: MCG/G DRY WEIGHT  
 Batch #: B-38050845

Customer ID: CFO-GAB-38-3  
 Description: SEDIMENT  
 ETSRC ID: 8070849

Elm	Result	Duplicate	% Deviation	Estimated Sample Detection Limit
AG	<0.5	<0.5	0.0	0.5
AL	6600.	6740.	2.1	0.6
AS	<4.	<4.	0.0	4.
B	1.	1.	0.0	0.4
BA	33.1	56.6	55.6	0.02
BE	0.35	0.35	0.0	0.02
CD	0.30	0.32	6.5	0.05
CR	8.4	7.6	10.0	0.2
CU	10.0	9.40	6.2	0.08
FE	13800.	13700.	0.7	5.
MG	2550.	2590.	1.6	0.8
MN	242.	277.	13.5	0.1
MO	<1.	<1.	0.0	1.
NI	8.6	8.2	4.8	0.2
PB	18.	17.	5.7	1.
SE	<6.	6.	***	6.
SR	10.3	11.8	13.6	0.02
TI	<1.	<1.	0.0	1.
V	9.64	9.96	3.3	0.08
ZN	62.9	64.4	2.4	0.06
Average % Deviation			6.6	

Quality Control Report  
Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574                      Units: MCG/G DRY WEIGHT  
    Batch #: B-88070845

Customer ID: CFC-GAB-38-7  
Description: SEDIMENT  
ETSRC ID: 8070848

Elm	Result	MCG Added	Spiked Sample	% Recovery	Estimated Sample Detection Limit
AG	<1.	20.0	26.	107.	1.
AL	15200.	5000.0	20600.	***	2.
AS	<10.	50.0	66.	108.	10.
B	2.	100.0	88.	71.	1.
BA	44.8	10.0	55.7	***	0.07
BE	0.96	10.0	13.4	102.	0.06
CD	<0.2	20.0	24.5	101.	0.2
CR	20.	100.0	140.	99.	0.7
CU	27.8	200.0	268.	99.	0.2
FE	29200.	5000.0	36100.	***	0.9
MG	5860.	1000.0	7060.	***	2.
MN	331.	1000.0	1540.	99.	0.4
MO	<3.	100.0	110.	90.	3.
NI	28.	50.0	90.2	102.	0.9
PB	8.	50.0	70.	102.	3.
SE	<10.	50.0	79.	130.	20.
SR	7.78	20.0	32.2	100.	0.06
TL	<3.	100.0	120.	99.	3.
V	22.	50.0	75.5	88.	0.3
ZN	62.8	1000.0	1220.	95.	0.3

Average % Recovery                      99.

- Not Spiked
- \* Possibly Not Spiked - Not in Average
- \*\*\* Spike Too Low



Quality Control Report  
 Environmental Trace Substances Research Center  
 ICP Scan - Sample Analysis Report

Project: USDI - Cat. 5574                      Units: MCG/G DRY WEIGHT  
 Batch #: B-38070845

Customer ID: NBS 1645  
 Description: RIVER SEDIMENT  
 ETSRC ID: 8070846

Elm	Result	Expected Value	+/- STD.DEV.	Estimated Sample Detection Limit
AG	<3.			3.
AL	4930.	22600.	400.	4.
AS	90.	66.	NO CERT	30.
B	16.			2.
BA	52.2			0.1
BE	0.86			0.1
CD	8.4	10.2	1.5	0.3
CR	27300.	29600.	2800.	1.
CU	104.	109.	19.	0.4
FE	97900.	113000.	12000.	20.
MG	6310.	7400.	200.	0.1
MN	663.	785.	97.	0.9
MO	20.			8.
NI	37.	45.8	2.9	1.
PB	649.	714.	28.	6.
SE	<40.	1.5	NO CERT	40.
SR	762.			0.1
TL	<5.	1.44	0.07	5.
V	24.	23.5	6.9	3.
ZN	1550.	1720.	170.	3.

Quality Control Report  
Environmental Trace Substances Research Center  
ICP Scan - Sample Analysis Report  
Project: USDI - Cat. 5574 Units: MCG/G DRY WEIGHT  
Batch #: B-38070845

Customer ID: NBS 1571  
Description: ORCHARD LEAVES  
ETSRC ID: 8070851

Elm	Result	Expected Value	+/- STD.DEV.	Estimated Sample Detection Limit
AG	<2.			2.
AL	93.			3.
AS	10.	10.	2.	4.
B	29.	33.	3.	2.
BA	41.9	44.	NO CERT	0.1
BE	0.1	0.027	0.010	0.1
CD	<0.2	0.11	0.01	0.2
CR	1.	2.6	0.3	1.
CJ	11.	12.	1.	0.2
FE	239.	270.	20.	1.
MG	5590.	6200.	200.	0.1
MN	83.7	91.	4.	0.2
MO	<1.	0.3	0.1	1.
NI	2.	1.3	0.2	1.
PB	39.	45.	3.	4.
SE	<5.	0.08	0.01	5.
SR	35.0	37.	1.	0.1
TL	<4.			4.
V	0.3			0.3
ZN	23.	25.	3.	0.3

APPENDIX C

Laboratory Analysis of Sediment Grain Size and Total Organic Carbon



# Laboratory Report

CLIENT U.S. FISH & WILDLIFE SERVICE JOB NO. 4298.001.517

DESCRIPTION Soils

DATE COLLECTED 7-20-88 DATE REC'D. 7-22-88 DATE ANALYZED \_\_\_\_\_

Description	Sample #	TOTAL ORGANIC CARBON mg/kg Wet Weight			
1A 6 Mile Creek	H2451	450.			
1B 6 Mile Creek	H2452	210.			
#2 6 Mile Creek	H2453	520.			
#3 3 Mile Creek	H2454	110.			

Methodology: Federal Register — 40 CFR, Part 136, October 26, 1984 Units: mg/l (ppm) unless otherwise noted

Comments: \_\_\_\_\_

OBG Laboratories, Inc.  
Box 4942 / 1304 Buckley Rd. / Syracuse, NY / 13221 / (315) 457-1494

Authorized: *D. R. Bindon*  
Date: August 16, 1988

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SIEVE ANALYSIS

SOIL SAMPLE H2451 TEST # ONE  
 FROM: U.S. FISH & WILDLIFE and DRY SOIL 1814.8 DATE: 8-16-88  
1-A - 6 Mile Creek TARE WEIGHT 352.9 TESTED BY: GORDON TALBOT  
 WT. OF DRY SOIL 1461.9 JOB # 4298-001-517

SIEVE NO.	SIEVE OPENING IN M.M.	WT. SIEVE IN G.	WT. SIEVE and SOIL IN G.	WT. SOIL RETAINED IN G.	% RETAINED	CUMULATIVE % RETAINED	% FINER
1/4	12.7	825.0	1048.7	223.7	15.3	15.3	
1/2	6.35	523.2	924.2	401.0	27.4	42.7	
4	4.75	532.0	636.9	104.9	7.2	49.9	
10	2.00	518.1	714.0	195.9	13.4	63.3	
16	1.19	418.9	475.4	56.5	3.9	67.2	
50	0.30	365.3	576.1	210.8	14.4	81.6	
PAN	-	377.1	646.2	269.1	18.4	100.	

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### SIEVE ANALYSIS

SOIL SAMPLE H2452 TEST # TWO  
 FROM: U.S. FISH & WILDLIFE DATE: 8-16-88  
1-B - 6 Mile Creek TARE WEIGHT 312.5 TESTED BY: GORDON TALBOT  
 WT. OF CONTAINER 1830.9 WT. OF DRY SOIL 1518.4 JOB # 4298-001-517

SIEVE NO.	SIEVE OPENING IN M.M.	WT. SIEVE IN G.	WT. SIEVE and SOIL IN G.	WT. SOIL RETAINED IN G.	% RETAINED	CUMULATIVE % RETAINED	% FINER
$\frac{1}{2}$	12.7	825.0	1130.5	305.5	20.1	20.1	
$\frac{1}{4}$	6.35	523.2	804.7	281.5	18.5	38.6	
4	4.75	532.0	603.7	71.7	4.7	43.3	
10	2.00	518.1	636.1	118.0	7.8	51.1	
16	1.19	418.9	455.6	36.7	2.4	53.5	
50	0.30	365.3	785.2	419.9	27.7	81.2	
PAN	-	377.1	662.2	285.1	18.8	100.	

APPENDIX D  
Field Data Sheets

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**SIEVE ANALYSIS**

SOIL SAMPLE H2453 WT. OF CONTAINER THREE  
 FROM: U.S. FISH & WILDLIFE and DRY SOIL 1500.9 DATE: 8-16-88  
#2 - 6 Mile Creek TARE WEIGHT 361.4 TESTED BY: GORDON TALBOT  
 WT. OF DRY SOIL 1139.5 JOB # 4298-001-517

SIEVE NO:	SIEVE OPENING IN M.M.	WT. SIEVE IN G.	WT. SIEVE and SOIL IN G.	WT. SOIL RETAINED IN G.	% RETAINED	CUMULATIVE % RETAINED	% FINER
4	4.75	532.	549.6	17.6	1.5	1.5	
10	2.00	518.1	553.5	35.4	3.1	4.6	
16	1.19	418.9	465.6	46.7	4.1	8.7	
30	0.595	420.4	616.2	195.8	17.2	25.9	
50	0.30	365.3	947.4	582.1	51.1	77.0	
100	0.149	421.6	623.2	201.6	17.7	94.7	
PAN	-	377.1	437.4	60.3	5.3	100.	



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### SIEVE ANALYSIS

SOIL SAMPLE	H2454	WT. OF CONTAINER	FOUR	TEST #	
FROM:	U.S. FISH & WILDLIFE	and DRY SOIL	1489.4	DATE:	8-16-88
	#3 - 3 Mile Creek	TARE WEIGHT	360.8	TESTED BY:	GORDON TALBOT
		WT. OF DRY SOIL	1128.6	JOB #	4298-001-517

SIEVE NO.	SIEVE OPENING IN M.M.	WT. SIEVE IN G.	WT. SIEVE and SOIL IN G.	WT. SOIL RETAINED IN G.	% RETAINED	CUMULATIVE % RETAINED	% FINER
4	4.75	532.	552.2	20.2	1.8	1.8	
10	2.00	518.1	545.9	27.8	2.5	4.3	
16	1.19	418.9	465.2	46.3	4.1	8.4	
30	0.595	420.4	565.6	200.3	17.7	26.1	
50	0.30	365.3	656.7	291.4	25.8	51.9	
100	0.149	421.6	781.6	360.0	31.9	83.8	
PAN	-	377.1	559.7	182.6	16.2	100.0	

Griffiss Air Force Base - Data Sheet

Date: June 20, 1988 Time: 2:30 p.m.  
Site #: 1 Location: from Griffiss property line, 75 yds.  
Temperature: 19°C pH: 5.8 :  
DO: \_\_\_\_\_ Conductivity: 140 umhos/cm  
Stream Width: 8 ft. Stream Depth: to 3 ft. (pool)  
Description: Beautiful trout stream. Gravel/cobble bottom. Tree roots,  
overhang cover.

Sediment Sample (describe): Gravel, a little sand/silt. Taken 200 ft.  
upstream from bridge.

Fish Sample: \_\_\_\_\_

Gear: \_\_\_\_\_

Species	Weight	Length	Age
GAB-1-SF-1 Brook trout	252g	11.6 in.	
GAB-2-SF-1 Brook trout	164g	9.8 in.	
GAB-3-SF-1 Brook trout	149g	9.2 in.	
GAB-4-SF-1 Brook trout	90g	7.8 in.	
GAB-5-SF-1 Brook trout	21g	5.1 in.	
GAB-1-CC-1 White sucker	69g	7.5 in.	

Notes: Brook trout #5 - lower half of tail fin missing.

Griffiss Air Force Base - Data Sheet

Date: June 20, 1988 Time: \_\_\_\_\_  
 Site #: 1 (Page 2) Location: \_\_\_\_\_  
 Temperature: \_\_\_\_\_ pH: \_\_\_\_\_  
 DO: \_\_\_\_\_ Conductivity: \_\_\_\_\_  
 Stream Width: \_\_\_\_\_ Stream Depth: \_\_\_\_\_

Description: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Sediment Sample (describe): \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Fish Sample: \_\_\_\_\_  
 \_\_\_\_\_

Gear: \_\_\_\_\_  
 \_\_\_\_\_

<u>Species</u>	<u>Weight</u>	<u>Length</u>	<u>Age</u>
GAB-1-CC-2 White sucker	65g	7.3 in.	
GAB-1-CC-3 White sucker	39g	6.4 in.	
GAB-1-CC-4 White sucker	46g	6.6 in.	
GAB-1-CC-5 White sucker	35g	5.9 in.	

Notes: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Griffiss Air Force Base - Data Sheet

Date: June 20, 1988 Time: 11:00 a.m.  
 Site #: 2 Location: between Griffiss property line and road downstream  
 Temperature: 20°C pH: 6.1-6.2  
 DO: \_\_\_\_\_ Conductivity: 425 M mhos/cm  
 Stream Width: 20 ft. Stream Depth: to 4 ft. (pool)

Description: Braided channel - riffles, pools. Significant silt accumulation in pool. Gravel in some riffles.

Sediment Sample (describe): Silt/sand. Taken just above 1st confluence.

Fish Sample: \_\_\_\_\_

Gear: \_\_\_\_\_

Species	Weight(g)	Length (in.)	Age
GAB-2-SF-1 Brook trout	237	11.0	
GAB-2-SF-2 Brook trout	85	7.8	
GAB-2-SF-3 Brook trout	15	4.5	
GAB-2-SF-4 Brook trout	20	4.9	
GAB-2-CC-1 White sucker	216	11.1	
GAB-2-CC-2 White sucker	152	10.0	
GAB-2-CC-3 White sucker	116	8.9	
<del>NO DATA</del>			
GAB-2-CC-4 White sucker	102	8.5	
GAB-2-CC-5 White sucker	80	7.6	

Griffiss Air Force Base - Data Sheet

Date: June 21, 1988

Time: 11:00 a.m.

Site #: 3

Location: downstream of Griffiss property line 100 yds.

Temperature: 15°C

pH: 7.6

DO: \_\_\_\_\_

Conductivity: \_\_\_\_\_

Stream Width: 4 ft.

Stream Depth: to 3 ft.

Description: Silty bottom, narrow, some pools/riffle. Abandoned field.

Sediment Sample (describe): Silt, some sand. Taken 100 yds. below road.

Fish Sample: \_\_\_\_\_

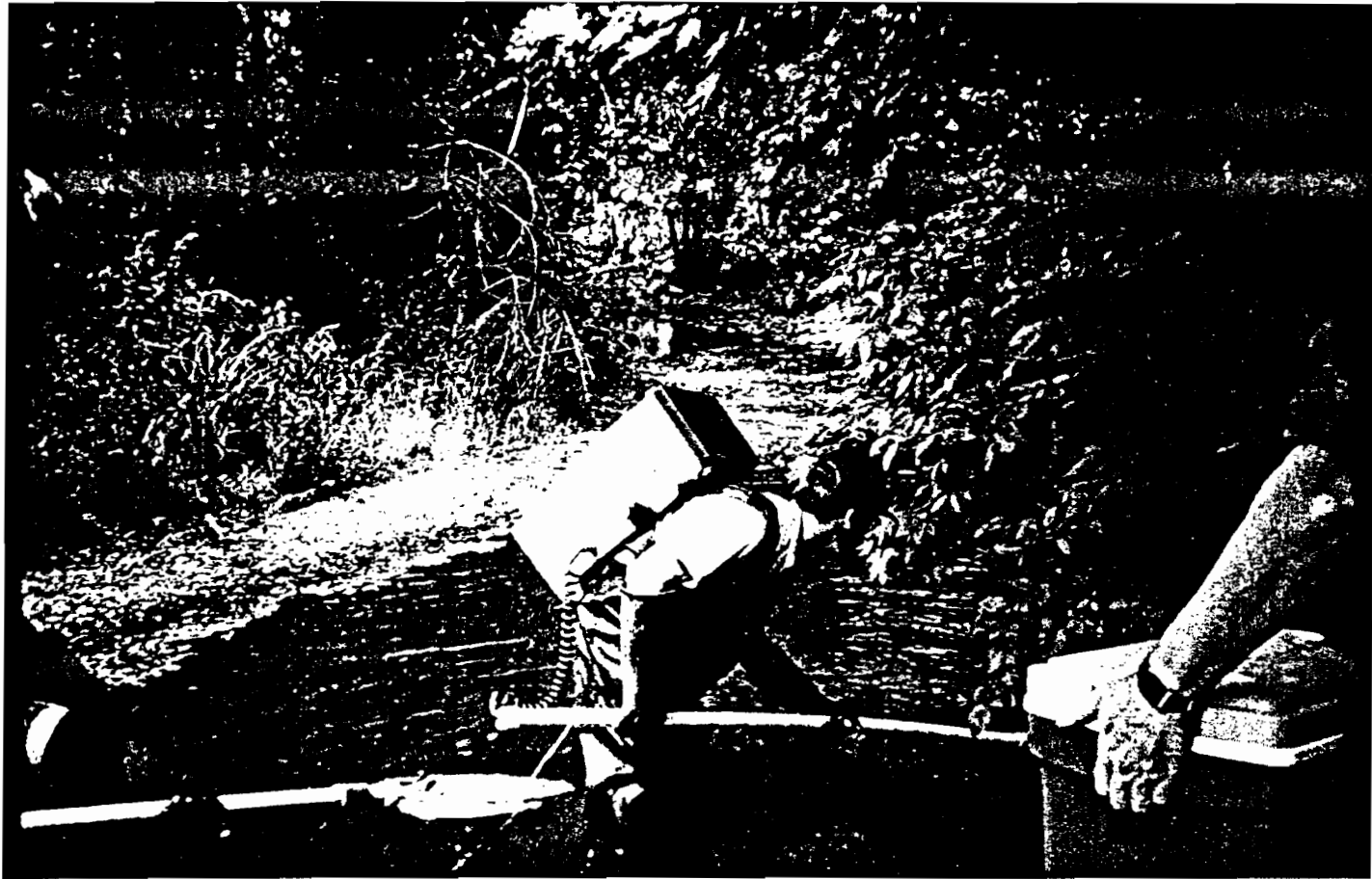
Gear: \_\_\_\_\_

Species	Weight (g)	Length(in.)	Age
GAB-3-CC-1 White sucker	167	9.7	
GAB-3-CC-2 White sucker	148	9.4	
GAB-3-CC-3 White sucker	81	7.6	
GAB-3-CC-4 White sucker	76	7.3	
GAB-3-CC-5 White sucker	73	7.3	

Notes: \_\_\_\_\_

APPENDIX E  
Photographs

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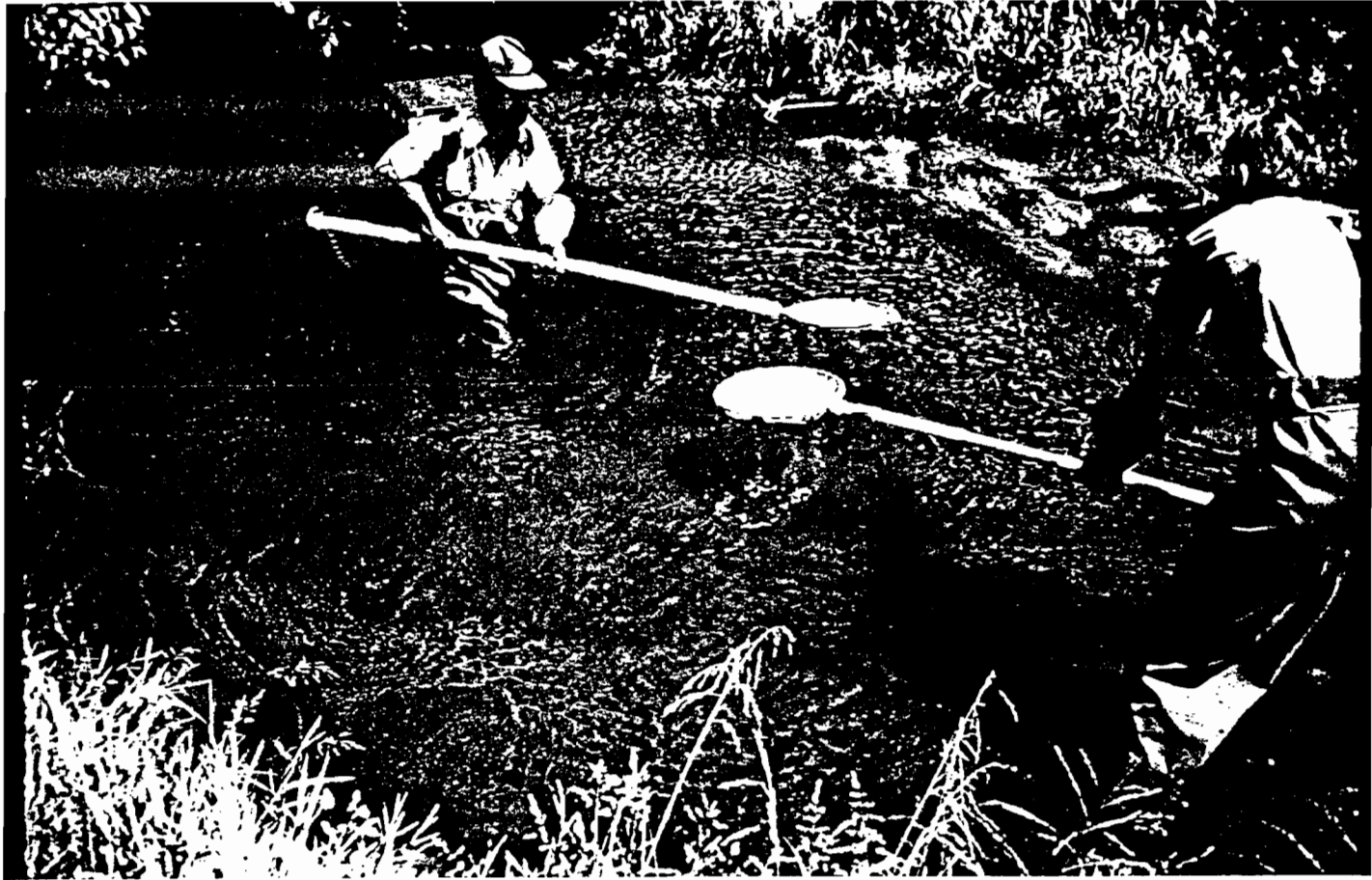


1. Electroshocking fish at site 1, Sixmile Creek, upstream from Base.

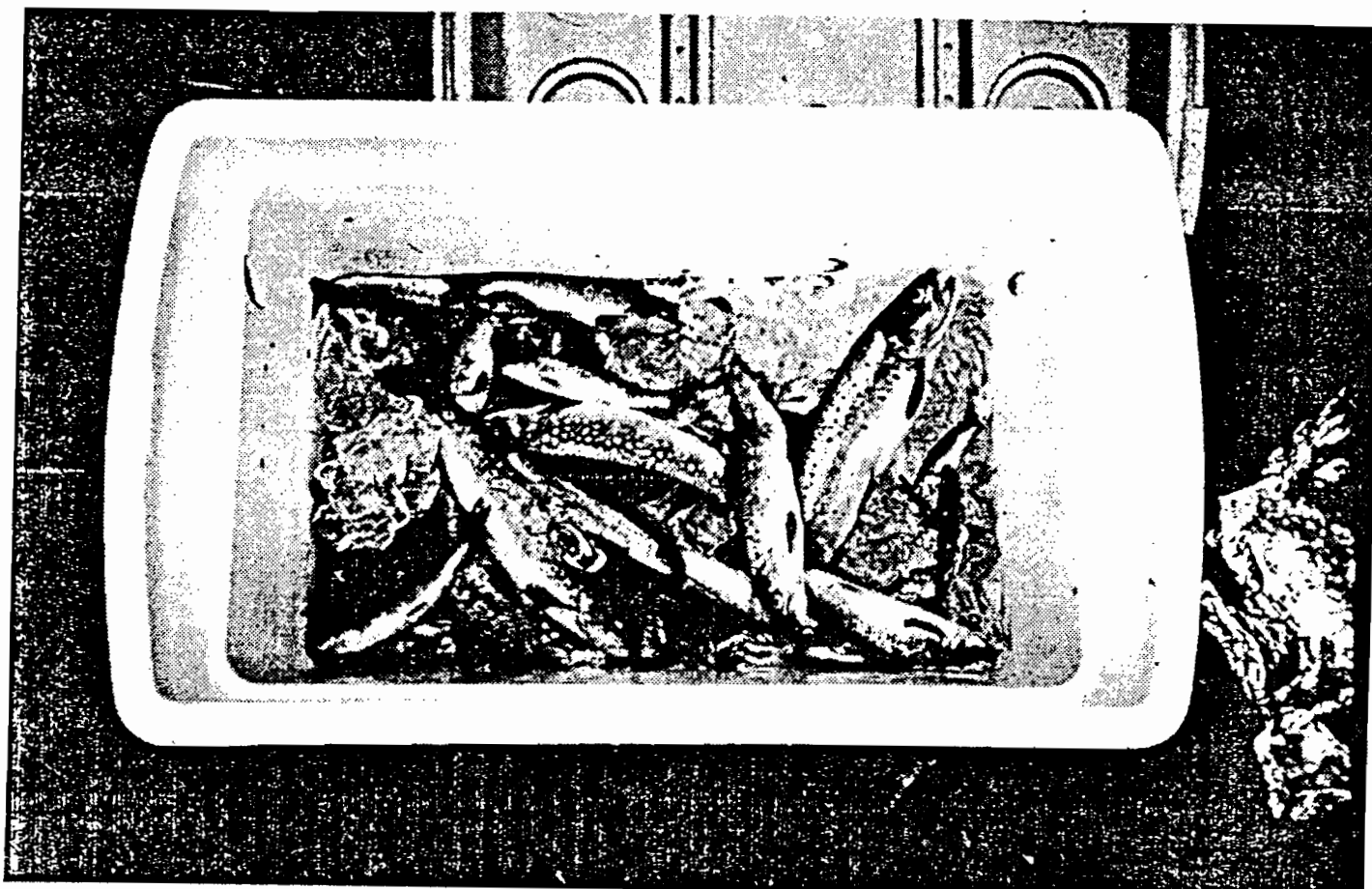


2. Site 2, Sixmile Creek, downstream from Base.

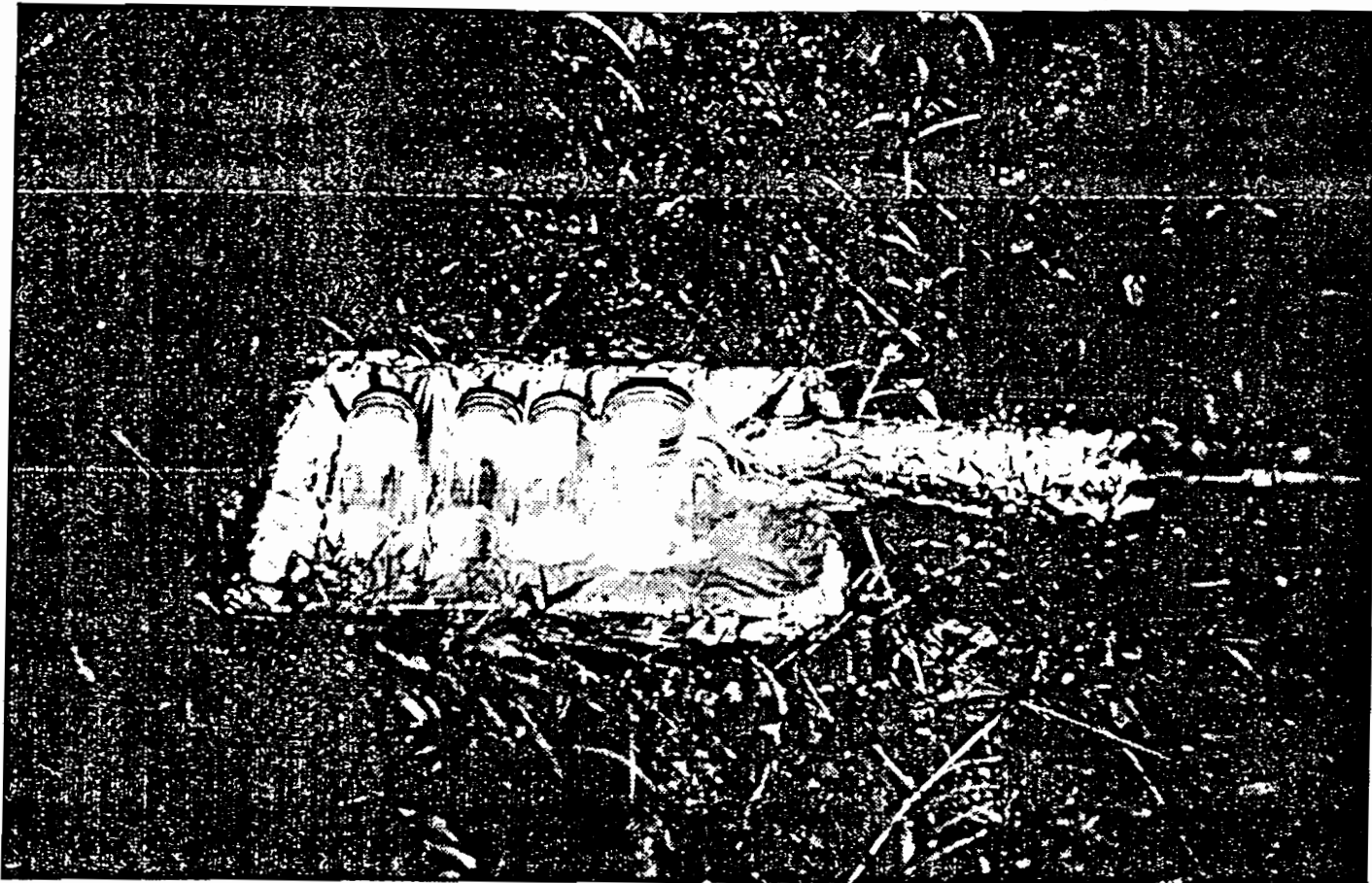




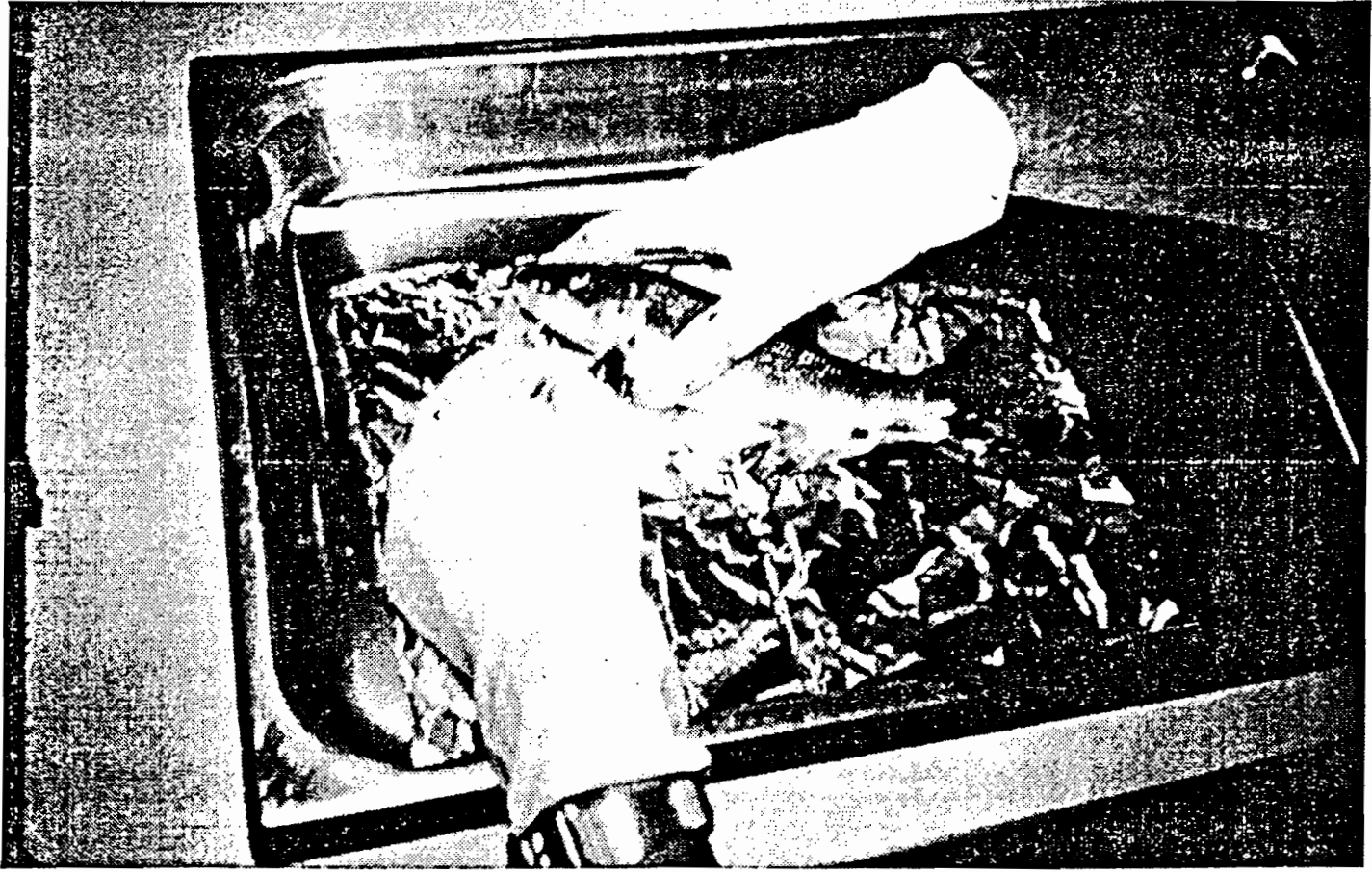
3. Electroshocking fish at Site 3, Threemile Creek, downstream from Base.



4. Brook trout and white sucker collected at Site 1, Sixmile Creek, upstream from Base.



5. Sediment sampling gear, cleaned and ready for field use.



6. Preparation of white sucker for shipment to laboratory.