

## HEALTH CONSULTATION

Lake Hartwell Fish Consumption PCB Contamination

SANGAMO WESTON, INCORPORATED/TWELVE-MILE CREEK/LAKE HARTWELL

PICKENS, PICKENS COUNTY, SOUTH CAROLINA

EPA FACILITY ID: SCD003354412

Prepared by:

South Carolina Department of Health and Environmental Control  
Division of Health Hazard Evaluation  
Under a Cooperative Agreement with the  
Agency for Toxic Substances and Disease Registry

## **Background and Statement of Issues**

Lake Hartwell is a 56,000-acre reservoir with 962 miles of shoreline located in the northwest corner of South Carolina on the Georgia border (Figure 1). According to the U. S. Army Corps of Engineers (COE), it is one of the Southeast's largest and most popular public recreation lakes. The COE built the dam between 1955 and 1963 as part of a flood control and hydropower project on the Savannah River. Lake Hartwell is one of the top three most visited COE lakes in the nation, serving about 10 million visitors annually (<http://www.sas.usace.army.mil/hartwell.htm>).

In 1976, it was discovered that the sediment and fish in the lake were contaminated with polychlorinated biphenyls (PCBs). From 1955-1977, over 400,000 pounds of PCBs were discharged with untreated effluent directly into Town Creek from the Sangamo Weston, Inc. plant in Pickens, South Carolina. PCBs moved down Town Creek to Twelve Mile Creek and into Lake Hartwell and are found throughout the lake (Bechtel Environmental, 1993). Twenty-eight years since the discovery of the contamination, high levels of PCBs are found in fish from the lake. Fish with the highest levels of PCBs are found in Twelve Mile Creek and the Seneca River.

Fish samples are taken from six areas of the lake each year, and the lean tissue is analyzed for PCBs. The fish consumption advisory for Lake Hartwell was first issued in 1976. Sampling was expanded in the early 1980s, and the advisory was extended to include some advice for the entire lake.

In 1998, the South Carolina Department of Health and Environmental Control (SCDHEC) changed from using United States Federal Drug and Food Administration (FDA) tolerance levels to a risk-based approach. SCDHEC recommends that no fish be eaten that are caught in Twelve Mile Creek or in the Seneca River Arm of Lake Hartwell. The consumption advisory for the main body of the lake recommends that people limit consumption of channel catfish and largemouth bass to one meal (eight ounces) per month. Hybrid bass should not be eaten from any part of the lake.

In 2003, samples of lean fish tissue from Twelve Mile Creek and the Seneca River had PCB concentrations ranging from 0.08 parts per million (ppm) to 14.70 ppm. PCB levels in fish collected from the remaining waters of the Lake ranged from below the detection limit to 5.48 ppm. Previous PCB levels were much higher, with a maximum concentration of 48 ppm in a largemouth bass sample collected in 1990. The SCDHEC advisory level for PCBs is 0.05 ppm.

In 1993, the South Carolina Department of Natural Resources (SCDNR) conducted a creel survey. The results indicated there

was a significant population that consumed those types of fish included in the advisory. The survey indicated that all anglers interviewed from the "Do not eat" parts of the lake were aware of the fish consumption advisory, yet 70% continued to eat the fish they caught. Evidence also pointed to subsistence fishing in areas of Twelve Mile Creek, the area of the lake with the highest PCB levels (SCDNR, 1993).

The purpose of this SCDHEC exposure investigation was to determine whether people consuming fish from Lake Hartwell are being exposed to elevated levels of PCBs. As an exposure investigation rather than a research study, the results are applicable only to the participants and cannot be inferred to any other population.

## **Methods**

### *Target Population*

Areas around Twelve Mile Creek and the Seneca River Arm of Lake Hartwell are rural. This area includes Pickens, Oconee, and Anderson Counties. These areas have a combined population of 336,000 (1999 US Bureau of Census estimate) over 1,840 square miles or 183 people per square mile. The majority of the population is not mobile. However, over the past ten years there has been an influx of people moving into the area with a population increase of over 10 percent. In 1990, between 16% and 17% of persons 25 years or older had less than a 9<sup>th</sup> grade education. About 64% had high school diplomas, and the percentage of persons with at least four years of college ranged from 13-17% for these counties (US Bureau of the Census, 1990 Census Tape Files).

Identifying the target population was challenging. It was necessary to find people who had regularly eaten the fish in the past year from Twelve Mile Creek and the Seneca River areas of Lake Hartwell. An environmental science graduate student from Clemson University was hired to go to the banks of Lake Hartwell to find anglers and interview them. The interviewer encountered people fishing from the bank that would say they did not eat the fish, but knew someone else that did or they used to eat the fish. It was difficult to find individuals that would admit they actually ate the fish.

It was decided to survey the families who had students enrolled in the twenty-two public schools (K-12) nearest the Twelve Mile Creek and the Seneca River Arm of Lake Hartwell. These schools were in three school districts. Each superintendent was contacted in order to obtain permission to distribute the surveys throughout the schools. SCDHEC staff took the surveys to each

school in March 1999. After 2-3 weeks the completed surveys were picked up from each school.

The exposure investigation protocols were reviewed and approved by SCDHEC's Institutional Review Board for Human Research (IRB). Project staff informed health and environmental staff in the Appalachia I and Appalachia II Health Districts that included Anderson, Oconee, Pickens, and Greenville Counties. The United States Environmental Protection Agency, (U.S.EPA) the Army COE, the SCDNR, and the Georgia Department of Natural Resources (GA DNR) were informed of the investigation on March 1, 1999. In February and March 1999, project staff presented information at each county medical society for Anderson, Pickens, and Oconee counties. A brief history of the lake and the source of contamination, the exposure investigation process, and the ramifications to the medical community if people were identified with elevated levels of PCBs.

#### *Phase I - Screening Survey*

A simple, one page survey was created to screen for people who had eaten fish from the Seneca River area of Lake Hartwell in the previous year. There was no consent form with this survey. Completing the survey was voluntary. When an individual completed the form, consent was implied. On the back of the survey was a letter of explanation and names of whom to call for further information. Basic demographic data collected on the survey included name, age, address, phone number, number of people in the home, and length of time residing in the upstate area. Another section asked about awareness of the fish consumption advisory in effect for Lake Hartwell, and if fish from the Twelve Mile Creek or the Seneca River areas of Lake Hartwell were eaten in the past year. This part of the survey asked how often fish was eaten from these areas, how much fish was eaten at a meal, the specific species of fish eaten from these areas of the Lake, and the location on the lake where fish were caught.

Approximately 11,000 surveys were distributed throughout the three county areas. Surveys were distributed through several methods: (1) local public schools, (2) local Department of Natural Resources and SCDHEC offices, (3) along the lake (in person), (4) on-line through SCDHEC's web site from May-July, 1999, (5) Pendleton Town Hall, and (6) individual requests. Surveys were distributed throughout the Anderson, Pickens, and Oconee County School Districts close to Lake Hartwell (22 schools). Surveys were color coded for each school district. Teachers distributed surveys to the students, who took them home for their parents. Once completed, the surveys were returned to the teachers. Surveys were picked up, and the results were compiled at SCDHEC. School faculty and staff, including

teachers, bus drivers, cafeteria, and janitorial staff were also asked to complete the survey. Surveys through the schools were completed in the spring (March - April) of 1999. At the same time, a six to eight week effort was made to survey fishermen along the lake. Surveys were distributed in person along the lake in the Twelve Mile Creek and the Seneca River areas of the lake. Self-addressed stamped envelopes were provided for their return.

Surveys were returned to SCDHEC in Columbia, South Carolina. Data from surveys were entered and compiled as they were returned. Microsoft Access and Epi-Info 6 were used for analysis. All surveys indicating fish consumption were closely examined, species consumed, frequency and quantity of consumption, and locations of capture were recorded.

#### *Phase II - Biologic Specimen Collection and Analysis*

Respondents who had consumed fish in the past year were contacted by mail regarding participation in the second part of the survey (Appendix A). A total of 310 surveys reported consumption within the past year. One hundred four surveys reported eating the fish at least monthly. Anyone who reported they had eaten fish in the past year was eligible for participation. However those who listed they consumed fish at least weekly or at least monthly were sought out for inclusion in this portion of the EI.

An attempt was made to contact each of these respondents by phone in order to set up appointments. These individuals were requested to participate in a more detailed interview and provide a blood sample for PCB analysis. Each person completing an interview first signed a consent form (Appendix B).

SCDHEC contracted with Clemson University's School of Nursing for the use of their mobile clinic for conducting the detailed interview and blood collection at familiar and convenient locations in the counties (high schools and Clemson University). Non-fasting venous blood samples were collected from participants by a trained phlebotomist. A sample of approximately 10 milliliters (ml) was collected for PCB analysis. The serum was extracted and sent to Pacific Toxicology Laboratories in Los Angeles, California. Total PCBs were analyzed on the serum samples. The serum PCB results were not adjusted for serum lipid levels. PCB congener analysis was to be performed on all individuals with detectable total PCB levels (>3 parts per billion (ppb)), but due to confusion at the laboratory, this analysis was not done. Laboratory results were sent directly to ATSDR.

All participants (or their parents/guardians) received written notification and interpretation of their results from SCDHEC.

## Results

### *Phase I Survey Findings*

Approximately 10,000 surveys were distributed through twenty-two public schools (K-12) and another 1,000 were distributed to the local SCDHEC and SCDNR offices, Clemson University, bank fishermen, the Town Hall in Pendleton, and upon request. There were 3,864 surveys returned for a response rate of 35%. Of the one-thousand surveys not distributed through the schools, less than a dozen were returned, and none reported eating fish. Of the surveys that were returned, 74 were not included in the study due to incomplete, missing data, or duplicate surveys turned in by more than one child in the same family.

Of all the survey respondents, 57% were aware of the fish consumption advisory in effect for Lake Hartwell and 92% did not eat any fish in the past year from the "Do not eat any fish" portion of the lake. Only three hundred and ten (8%) stated they ate the fish in the past year. Of those who ate the fish, 39% said they were not aware of the fish consumption advisory. Awareness did not vary much for the fish consumers by number of years residing in the area.

Awareness did seem to vary by county. Pickens County had the longest average years residing in the area of 19 years and the lowest percentage (29%) of fish consumers who were unaware of the advisory. Residence in Anderson County averaged 16 years and 38% of responders were unaware of the advisory. Oconee County averaged 14 years, and 48 % were unaware of the advisory.

Catfish was the most frequently consumed fish with 69% of survey responders reporting to eat catfish. Next, 49% said they ate crappie, 41% ate largemouth bass, 37% ate striped or hybrid bass, 29% ate bream, and 10% ate spotted bass.

All participants in the blood draw ate fish from the Twelve Mile Creek and Seneca River areas of Lake Hartwell in the past year. Three percent had eaten fish from these areas for less than one year, 14% for one to five years, and 24% for six to ten years. Fifty-nine percent of participants have been eating fish from the lake for more than ten years. Fish meal frequency varied from two meals per year to one meal per day. The median value was two meals per month. The mean daily consumption, based on self-estimated consumption frequency and meal size for fish was 97grams/day. The median was 15 grams/day. Reported daily consumption ranged from 0.6 to 895.0 grams. This high value skewed the mean. The next three highest values were 701, 185, and 145 grams. Therefore, the median may be a better indication of the average consumption. Portion size of cooked fish was

estimated using multiple decks of cards with each deck representing a three-ounce portion. Reported portion size ranged from three ounces to 180 ounces. The mean was 19 ounces, and the median was 11 ounces.

Fish preparation and cooking methods were examined in the interview. Most of the participants never trim the fat (66%), while 17% usually trim the fat. Forty-five percent usually remove the skin, 24% sometimes remove the skin, and 28% never remove the skin. Forty-six percent never eat the whole fish, 21% usually eat the whole fish and 25% sometimes eat the whole fish. Forty-eight percent usually filet the fish, while 31% sometimes filet the fish. Cooking techniques vary, but the majority (72%) usually deep-fry their fish, 21% sometimes fry the fish, and 3% never fry the fish. Fifty-nine percent never bake or broil the fish, 31% sometimes bake or broil the fish, and 7% usually bake or broil the fish.

It was noted that 31% of participants "sometimes" or "usually" reuse their cooking oil, while 60% never reuse the oil or fat used in cooking the fish. Seventy-two percent never make sauces or gravy, but 10% usually do, and 3% sometimes make sauces or gravy.

Of the participants who had their blood drawn, 55% were aware of the fish advisory and 45% were unaware. Participants were asked if a nearby place to catch uncontaminated fish were available, would they fish there instead. Eighty-three percent responded yes they would, 55% definitely would, and 27% probably would. Ten percent said maybe, and seven percent did not respond.

### *Phase II Biologic Findings*

Thirty individuals were interviewed and participated in the blood sampling. One sample was destroyed due to laboratory error. The twenty-nine individuals who participated in the blood sampling lived in Anderson, Pickens, and Oconee Counties. Participants were 59% male and 41% female. The age range was from seven years to 57 years, with a mean age of 35 years. The racial/ethnic composition of the participants was 66% white, 31% black, and 3% Latino. The majority of the adult participants (79%) completed high school, and 17% completed four or more years of college. Length of residence in the area varied, but most are long-term residents. Three percent have lived in the area for one to five years, 14% have lived in the area for six to ten years, and 83% have lived in the area for eleven or more years.

Serum PCBs levels in the participants ranged from less than the detection limit (3 ppb) to 19.5 ppb. Eighteen participants had

non-detectable levels of PCBs in their blood. Ten participants had levels between 3 and 10 ppb. One participant had a level of 19.5 ppb. The mean level was 3.3 ppb (using 1.5 ppb as the default value for non detects). The individual who had the highest value had been occupationally exposed while working at Sangamo Electric impregnating capacitors with PCBs from 1965-1966.

## **Discussion**

Serum PCB levels in the EI participants were very similar to those in previous studies of the general U.S. population, and less than anticipated for this group of fish consumers. The general population mean serum PCB level ranges from 0.9 to 1.5 ppb. The mean for the Lake Hartwell EI (3.3 ppb) was slightly above the mean background, but much lower than other fish eating populations. One study in Alabama reported a mean PCB level of 17.2 ppb in a fish eating population. Another study of a fish eating population living in Michigan found a mean of 16.0 ppb, similar to what was found in the Alabama study (ATSDR, 2000). The mean PCB levels for the Lake Hartwell EI, were closer to the U.S. background than to other fish eating populations. This was an unexpected result. Although survey results indicate that about half of the EI participants were aware of the fish advisory, all participants in the blood draw had eaten fish from the Twelve Mile Creek and Seneca River areas of Lake Hartwell in the past year.

There may be several reasons why the serum PCB levels were lower than what was expected. PCB levels in fish samples collected from Lake Hartwell remain high, and people report to continue to eat fish caught in the lake. A 1993 SCDNR survey indicated 70% of people in this survey reported eating fish caught in the Lake. Because the majority of questionnaires were distributed through the schools and not targeted to people who are more likely to fish (at bait and tackle shops for example), the most at risk population was not targeted. Ninety-two of the people who responded reported they did not eat fish in the last year. In addition, the response rate on the questionnaires was poor. The majority of people reported (69 %) eating catfish, the least contaminated fish. It is possible that since a majority of people reported eating catfish, we did not collect serum samples from people who frequently ate the most contaminated fish. There was also some uncertainty whether or not people reported eating fish frequently that were caught in the least contaminated part of the lake. Since this was a recall questionnaire, respondents may have also overestimated the frequency and amount of fish they caught and ate from the lake. The number of EI participants was very small (30) when compared to the surrounding population (336,000), less than 1% of people living in the counties around the lake.



There was a large amount of uncertainty regarding where people fish, what species they catch, and how much fish they eat. There is also a large amount of variability in these parameters. Some people eat mostly catfish from the main part of the lake, while some eat mostly crappie from bays (ATSDR, 1999).

The population in the EI was also fairly young, with the mean age of 35 years old. Since the survey was distributed at local schools in the area, it was expected that parents of children currently in school would be younger. The younger population may be reflective of serum levels for a particular age group and not necessarily for a specific fish eating population. Generally, PCB serum concentrations increase with age (ATSDR 2000).

The survey results did indicate that people living in the area are aware of the advisory. Of the people who responded to the survey, nearly 60% were aware of the advisory. In the 1993 SCDNR creel survey, all participants indicated that they were aware of the advisory. Creel surveys are done in person, which may be why everyone reported that they were aware of the advisory. South Carolina has no dedicated resources for fish advisory outreach activities. We do provide copies of our advisories to all OB/GYN offices in the state, nurse midwives, about 700 people on our statewide mailing list, and all local SCDHEC offices. Additional outreach activities may be warranted to increase the awareness of the advisories.

An added benefit obtained from the questionnaires was information on the mean daily consumption and portion size. It is recognized that this information is self-reported and may be biased. This information is useful to compare to what is used to develop fish consumption advisories in South Carolina. The mean daily consumption was reported to be 97 grams/day, and the median was 15 grams/day. Whether one looks at the mean or the median, the daily consumption is less than what is used to develop our fish consumption advisories (227 grams/day). In addition, the median portion size of 11 ounces, is not much larger than the 8-ounce portion used in our fish consumption advisory calculations.

## **Conclusions**

Based on the information obtained from the screening questionnaire, a large number of people were aware of the fish consumption advisory for Lake Hartwell and most did not eat the fish from the Seneca River arm of Lake Hartwell. Only a small portion, about 8% admitted to eating fish caught in the lake in the past year. Most of these people knew about the advisory, but 39% did not. A third of these people ate fish at least monthly.

Additional outreach activities may be needed to increase knowledge about the current fish consumption advisory, the potential hazards of consuming contaminated fish, and ways to minimize exposure.

Serum PCB levels in EI participants were very similar to those in previous studies of the general U.S. population, and less than anticipated for this group of fish consumers. None of those whose blood was sampled had levels excessively high, but the sample size was small.

We would not expect any health effects based on the results of this EI, however, there are some uncertainties associated with this EI. First the number of study participants was very small, much less than 1 % of the area population. The targeted population was people who ate fish, however, 92% of the school surveys reported not eating any fish in the last year. The best population for this investigation may not have been recruited for this EI. Since we did not sample serum from many, if any, heavy fish eaters, we cannot say with any certainty, what serum PCB levels would be for this population. What can be said is for people who eat small to moderate amounts of fish (one to two meals a month), PCBs serum levels should be low and that no health effects would be expected from this exposure. This may be especially important for the most popular type of fish people reported to eat, catfish. Typically, PCB levels are lower in catfish than bass. We recommend that people not eat more than one meal of catfish from the lake, and the low PCB serum concentrations may be reflective of people eating some of the least contaminated fish.

ATSDR classifies sites as to their public health hazard category. Under ATSDR's classification system the exposure pathway evaluated during this investigation would be classified as no apparent public health hazard. The exposure from this pathway appears to be minimal and health effects are unlikely, however, there are uncertainties associated with this investigation. This investigation did not evaluate any other potential exposure pathways associated with the site.

### **Recommendations**

1. Continue to provide fish advisory information for Lake Hartwell to residents of South Carolina.
2. Link fish advisory information (from SCDHEC's web page) to other relevant sites like COE's Lake Hartwell, or wherever information is available on fishing at Lake Hartwell.

## **Public Health Action Plan**

SCDHEC currently, with limited resources, provides the advisory information to a fairly wide audience in the state. Information is provided to physicians, nurse midwives, Women, Infants, Children (WIC) clinics, SCDNR, and through our fairly extensive mailing list.

SCDHEC will continue to provide fish advisory information for Lake Hartwell to residents of South Carolina.

SCDHEC will contact the Army Corps of Engineers to determine if it is possible to provide an internet link from the COE Lake Hartwell page to the SCDHEC fish consumption advisory page.

**Preparer of Report**

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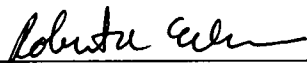
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Certification

The Lake Hartwell Fish Consumption Exposure Investigation report was prepared by the South Carolina Department of Health and Environmental Control, Division of Health Hazard Evaluation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedure existing at the time the exposure investigation was begun.



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ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this Public Health Assessment and concurs with its findings.



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Lead, CAT, SPAB, DHAC, ATSDR

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**APPENDIX A**

Lake Hartwell Fish and Turtle Interview Questionnaire  
South Carolina Department of Health and Environmental Control  
Division of Health Hazard Evaluation  
Agency for Toxic Substances and Disease Registry

Gender of participant (please circle):

- a. male
- b. female

Person answering this questionnaire (please circle all that apply):

- a. self
- b. other (please specify relationship to participant: \_\_\_\_\_)

(Sentences in bold italic are to be read to interviewee. Children may have a parent assist them in questions and answer)

*This questionnaire is voluntary and confidential to the full extent legally possible. It should take approximately 30 minutes to complete. Information collected as part of this questionnaire will be used to help interpret results from your blood test for PCB levels.*

*Please answer all questions to the best of your ability. Even if you are unsure of the exact answer, please give your best answer. If you are unsure of the meaning of any question, please ask me for an explanation. If there is any question you really do not wish to answer, we can skip that question and go to the next question.*

**Personal:**

1. *How long have you lived in Pickens, Anderson or Oconee Counties?*

- Less than 1 year
- 1-5 years
- 6-10 years
- 11+ years
- Not a resident

2. *What is the highest grade or year of school you have completed?*

- Never attended school or kindergarten only
- Grades 1 through 8 (Elementary school)
- Grades 9 through 11 (Some high school)
- Grade 12 or GED (High school graduate)
- College 1 year to 3 years (Some college or technical school)
- College 4 years or more (College graduate)

3. *How old are you?*

\_\_\_\_\_ (Years) (Put 99 if they do not wish to answer)

4. *What is your race or ethnic background?*

- Black
- White
- Other: \_\_\_\_\_



5. *In what range is your yearly household income before taxes?*

- <\$10,000  
 \$10,000-\$29,999  
 \$30,000-\$49,999  
 50,000-\$69,999  
 \$70,000+

6. *How many people live in your household?* \_\_\_\_\_

7. *Do you have any children?*

- Yes  
 No

*If yes, how many children do you have?* \_\_\_\_\_

*What are their ages?* \_\_\_\_\_

*Do they live with you?*

- Yes  
 No

### **Knowledge and Understanding of Fish Consumption Advisory:**

*We are asking these questions to track your knowledge and understanding of the fish consumption advisory. There are no right or wrong answers.*

8. *Are there any fish that people catch in 12-Mile Creek and Seneca River that are not safe to eat?*

- Yes  
 No (skip to question 14)

*If yes, what fish do people catch in 12-Mile Creek or Seneca River that are not safe to eat?*

List names:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

9. *Why are they not safe to eat?*

10. *What would happen if you eat them?*

11. *If you eat those fish mentioned above and don't have a reaction to them in a day or two, does that mean that they are safe to eat?*

- Yes  
 No  
 Do not know

12. *How would you know if the fish caught were safe to eat?*

13. *Are there ways to make the fish caught safer to eat?*

- No  
 Yes. What are they?

14. *For the fish caught in 12 Mile Creek and Seneca River, would you say that eating them:*

- Have no health risk at all  
 Have a slight health risk  
 Have a serious health risk

15. *Please answer yes, no, or don't know for each of the following questions:*

- a. *Do you think the fish you catch in 12-Mile Creek and Seneca River are contaminated?*  
 Yes     no     do not know
- b. *Do you believe that eating fish caught in 12-Mile Creek or Seneca River poses a risk to your health?*  
 Yes     no     do not know

16. *What is the main reason that you fish in 12-Mile Creek or Seneca River?*

17. *Regarding the fish or turtles that you catch, do you do any of the following?*

- |                 |                                 |                                    |                                |
|-----------------|---------------------------------|------------------------------------|--------------------------------|
| Eat:            | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Never |
| Toss back:      | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Never |
| Throw in trash: | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Never |
| Give away:      | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Never |
| Sell:           | <input type="checkbox"/> Always | <input type="checkbox"/> Sometimes | <input type="checkbox"/> Never |

If fish or turtles are being given away or sold:  
*To whom is it sold or given?*

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18. *If yes to eat fish or turtles...*

*What would it take for you to stop eating fish or turtle from 12 Mile Creek or Seneca River Arm?*

19. *If you had another nearby place to catch "clean" fish that had no contamination would you fish there instead?*

- Yes, I definitely would     Yes, probably     Maybe     Probably not     Definitely not

20. *South Carolina DHEC has issued a fish consumption advisory that recommends that you should not eat ANY fish from 12-Mile Creek or Seneca River areas. Were you aware of this advisory before participating in this survey?*

- a.  Yes  
b.  No

21. *Did you know that for this advisory, the Seneca River Arm includes all the creeks and streams that flow in the Seneca River? This includes Keowee River, Martin Creek, Coneross Creek, 18 Mile Creek, Seneca Creek, and Camp Creek?*
- a.  Yes
- b.  No
22. *What recommendations are you aware of?*
23. *How did you learn about the advisory?*
24. *Last year this pamphlet (show EPA Brochure) was given out to tell people about the fish consumption advisory for Lake Hartwell. Did you get a copy?*
- Yes, I got a copy and read it
- I saw a copy but did not read it
- I did not see this pamphlet
25. *Since you learned about the advisory, have you made any changes in your habits of eating fish from Twelve-Mile Creek or Seneca River?*
- a.  Yes
- b.  No (please go to question 27)
26. *What changes have you made since you learned of the fish consumption advisory? Check all that apply:*
- No longer eat the fish or turtles I catch
- Eat less of the fish or turtles I catch
- Eat more of the fish or turtles I catch
- Clean or cook the fish or turtles differently
- Fish in different locations
- Fish less often
- Fish more often
- Change the type of fish I catch
- Other:
27. *State whether you agree, disagree or have no opinion about these statements:*
- a. *The advisory provides me with enough information to decide whether or not to eat the fish or turtles from 12-Mile Creek or Seneca River.*
- Agree       Disagree       Have no opinion
- b. *Many of the health advisories are not needed or are exaggerated.*
- Agree       Disagree       Have no opinion

**Consumption History:**

28. *What kinds of fish and/or turtles do you eat from 12-Mile Creek or Seneca River?*

Fish:

- Striped bass  
 Hybrid bass  
 Largemouth bass  
 Catfish  
 Crappie  
 Bream  
 Red Eye or Spotted Bass  
 Others: \_\_\_\_\_

Turtles:

- Snapping  
 Spiny Softshell  
 Bellied Slider  
 Painted  
 River Cooter  
 Others: \_\_\_\_\_

29. *How do you get the fish and/or turtles you eat?*

- I catch it.  
 Someone else in my family catches it.  
 It is given to me. By whom? \_\_\_\_\_  
 I buy it.

*If you buy the fish and/or turtles locally, do you know where they were caught?*

- Yes location \_\_\_\_\_  
 No

*What kind of fish or turtles do you buy locally?*

Fish:

- Striped bass  
 Hybrid bass  
 Largemouth bass  
 Catfish  
 Crappie  
 Bream  
 Red Eye or Spotted Bass  
 Others: \_\_\_\_\_

Turtles:

- Snapping  
 Spiny Softshell  
 Bellied Slider  
 Painted  
 River Cooter  
 Others: \_\_\_\_\_

30. *I am going to ask you about how often you have eaten meals of turtles and/or specific types of fish from 12-Mile Creek or Seneca River. If helpful, please ask me to point to the picture of the type of fish on the poster.*

During the past 12 months, how many meals have you had per year, per week, or per month of...?

(One column for each row that best describes frequency)

|                       | None | Per year | Per month | Per week | Per day |
|-----------------------|------|----------|-----------|----------|---------|
| <b>Turtles:</b>       |      |          |           |          |         |
| Snapping              |      |          |           |          |         |
| Soft-shell            |      |          |           |          |         |
| Painted               |      |          |           |          |         |
| Yellow-bellied slider |      |          |           |          |         |
| River cooter          |      |          |           |          |         |
| Other                 |      |          |           |          |         |
| <b>Fish:</b>          |      |          |           |          |         |
| Catfish               |      |          |           |          |         |
| Striped bass          |      |          |           |          |         |
| Hybrid bass           |      |          |           |          |         |
| Largemouth bass       |      |          |           |          |         |
| Crappie               |      |          |           |          |         |
| Bream                 |      |          |           |          |         |
| Other:                |      |          |           |          |         |
|                       |      |          |           |          |         |

31. *Think back to the meals of fish or turtles from 12-Mile Creek or Seneca River that you have eaten during the past 3 months. Compared to the number of meals you've eaten during the last 12 months, would you say that you have...?*

- Eaten more fish or turtles during the last 3 months, or
- Eaten less fish or turtles during the last 3 months, or
- Eaten the same amount of fish or turtles
- Don't know.

32. Today is \_\_\_\_\_ (day of week). *Think about the meals of fish or turtles from 12 Mile or Seneca River that you have eaten during the past 7 days. Please think about the number of meals you have had and the types of fish or turtles you ate. Let's start with yesterday.*

Did you have a fish or turtle meal?    How many meals?    Type of fish or turtles?

- a. Yesterday? \_\_\_\_\_
- b. Previous day? \_\_\_\_\_
- c. Rest of the week? \_\_\_\_\_

30. *For how many years have you eaten fish or turtles from 12 Mile or Seneca River?*

- Less than 1 year
- 1-5 years
- 6-10 years
- 11+ years
- Don't know

33. *When you eat fish or turtles from 12-Mile Creek or Seneca River, about how much do you usually eat at one meal? (Show graphic representation of 1/2 pound serving)*  
 Number of cooked ounces (oz) \_\_\_\_\_

34. *If you eat turtles, how do you prepare it?*

35. *I am going to ask now about different methods used in your household during the last 12 months to prepare and eat fish from 12 Mile Creek or Seneca River. For each method please tell me if you usually, sometimes or never use this method.*

(Check only one column for each method)

| Do you....                             | usually | sometimes | never | Don't know |
|--|---------|-----------|-------|------------|
| a. Trim the fat?                       |         |           |       |            |
| b. Remove the skin?                    |         |           |       |            |
| c. Eat the whole fish?                 |         |           |       |            |
| d. Fillet the fish?                    |         |           |       |            |
| e. Fry?                                |         |           |       |            |
| f. Bake or broil the fish?             |         |           |       |            |
| g. Reuse oil or fat from cooking fish? |         |           |       |            |
| h. Make sauces or gravy?               |         |           |       |            |

36. *For the fish or turtles from 12-Mile Creek or Seneca River that are eaten during the past 12 months approximately what percentage were caught by you or a member of your household?*

0%  
 25%  
 50%  
 75%  
 100%

35. *Please look at the map of Lake Hartwell and point to the locations where fish or turtles were caught. Please start with the most frequent area. As you point to the spots, I will circle the same areas on the smaller map in this questionnaire.*

(Use a letter "A" for the most frequent location, a letter "B" for the next most frequent, etc. until all locations are identified. Below the map write the respective letter and the exact words used by interviewee. If no areas are identified, please state. Also identify if interviewee is an angler).

36. *With respect to all fish or turtles eaten during the past 12 months, about what percent came from:*

|                                     | Fish  | Turtles |
|-------------------------------------|-------|---------|
| 12-Mile Creek and Seneca River area | _____ | _____   |
| Rest of Lake Hartwell               | _____ | _____   |
| Other                               | _____ | _____   |

**Employment History:**

37. *Where do you currently work?*

38. *Describe briefly your job task.*

39. *Where have you worked in the past?*

40. *Have you worked with any of these chemicals in the past?*

PCBs

Pesticides what are they? \_\_\_\_\_

41. *At work do you use any equipment made before 1977?*

Yes

No

If yes, what are they?

42. *Do you live near a hazardous waste site?*

Yes

No

Don't know

If yes, where is it located?

**Hobbies:**

43. *What are your hobbies?*

44. *How often do you participate in the activity?*

45. *How long have you been doing so?*

46. *Would you like us to send the test results to your doctor?*

Yes

No

If yes, give us your Doctor's Name \_\_\_\_\_

Address \_\_\_\_\_

City, State Zip \_\_\_\_\_

*Thank you for participating in this interview. Do you have any questions?*

Direct to the next station to give a blood sample.

**APPENDIX B**



Child Questionnaire

**Personal:**

1. *How long have you lived in Pickens, Anderson or Oconee Counties?*

- Less than 1 year
- 1-5 years
- 6-10 years
- 11+ years
- Not a resident

2. *What grade in school are you currently in?* \_\_\_\_\_

3. *How old are you?*  
 \_\_\_\_\_ (Years) (Put 99 if they do not wish to answer)

4. *What is your race or ethnic background?*

- Black
- White
- Other: \_\_\_\_\_

**Consumption History:**

5. *I am going to ask you about how often you have eaten meals of turtles and/or specific types of fish from 12-Mile Creek or Seneca River. If helpful, please ask me to point to the picture of the type of fish on the poster.*

*During the past 12 months, how many meals have you had per year, per week, or per month of...?*

(One column for each row that best describes frequency)

|                       | None | Per year | Per month | Per week | Per day |
|-----------------------|------|----------|-----------|----------|---------|
| <b>Turtles:</b>       |      |          |           |          |         |
| Snapping              |      |          |           |          |         |
| Soft-shell            |      |          |           |          |         |
| Painted               |      |          |           |          |         |
| Yellow-bellied slider |      |          |           |          |         |
| River cooter          |      |          |           |          |         |
| <b>Fish:</b>          |      |          |           |          |         |
| Catfish               |      |          |           |          |         |
| Striped bass          |      |          |           |          |         |
| Hybrid bass           |      |          |           |          |         |
| Largemouth bass       |      |          |           |          |         |
| Crappie               |      |          |           |          |         |
| Bream                 |      |          |           |          |         |
| Other:                |      |          |           |          |         |

6. *Think back to the meals of fish or turtles from 12-Mile Creek or Seneca River that you have eaten during the past 3 months. Compared to the number of meals you've eaten during the last 12 months, would you say that you have...?*

- Eaten more fish or turtles during the last 3 months, or
- Eaten less fish or turtles during the last 3 months, or
- Eaten the same amount of fish or turtles
- Don't know.

7. Today is \_\_\_\_\_ (day of week). *Think about the meals of fish or turtles from 12 Mile or Seneca River that you have eaten during the past 7 days. Please think about the number of meals you have had and the types of fish or turtles you ate. Let's start with yesterday.*

Did you have a fish or turtle meal?    How many meals?    Type of fish or turtles?

- a. Yesterday? \_\_\_\_\_
- b. Previous day? \_\_\_\_\_
- c. Rest of the week? \_\_\_\_\_

30. *For how many years have you eaten fish or turtles from 12 Mile or Seneca River?*

- Less than 1 year
- 1-5 years
- 6-10 years
- 11+ years
- Don't know

8. *When you eat fish or turtles from 12-Mile Creek or Seneca River, about how much do you usually eat at one meal? (Show graphic representation of 1/2 pound serving)*  
 Number of cooked ounces (oz) \_\_\_\_\_

9. *Would you like us to send the test results to your doctor?*  
 Yes  
 No

If yes, give us your    Doctor's Name \_\_\_\_\_

Address \_\_\_\_\_

City, State Zip \_\_\_\_\_

*Thank you for participating in this interview. Do you have any questions?*

Direct to the next station to give a blood sample.

## APPENDIX C

**Consent Form for Participation**  
**Lake Hartwell Fish Consumption Exposure Investigation**

The South Carolina Department of Health and Environmental Control (DHEC) and the Agency for Toxic Substance and Disease Registry (ATSDR) are offering free blood tests for PCB. This will be for selected people who eat fish or turtles monthly or weekly from Twelve-Mile Creek and Seneca River and their adjoining tributaries and creeks. Along with free testing, limited information will be collected in a brief questionnaire. Your participation in this investigation will tell you the level of PCBs in your blood and will tell DHEC if PCB blood levels of you and others in your community are higher than that of the general population.

**Benefits**

I understand that I will benefit from participating by learning whether my child/ward or I have had elevated exposures to PCBs. If my blood levels are elevated, I will be contacted by DHEC. Information about eating fish from Lake Hartwell will be made available to me.

**Procedure**

I will be interviewed using a brief questionnaire that should take approximately 20 minutes. A phlebotomist (blood drawer) will take a sample of blood from a vein in my arm with a needle. PCB testing requires 10cc (about 2 teaspoons) of blood. This may cause a little pain but every effort will be made to minimize discomfort. Some people may have a small bruise where the needle enters the skin, but this will go away soon. Drawing blood usually takes no more than 10 minutes to complete. My blood will be tested at laboratories selected by ATSDR. The only tests that will be conducted on my blood will be for PCBs, total cholesterol and triglycerides. The blood sample will be destroyed at the completion of the investigation.

**Participation**

I understand that I am not required to participate. Even if I agree to participate and sign this form, I can stop my participation or my child's/ward's participation at any time without any consequences. I understand that I can refuse to answer any question during this interview without any consequences. I understand and agree that there is no medical treatment by DHEC or ATSDR based on the test results or in the event of injury from participation. I understand that I must sign this form to participate.

**Confidentiality**

Confidentiality will be protected to the full extent possible according to State and federal laws. I understand that if I participate, any forms containing my name or address will be kept in locked cabinets. Any grouped data analyses or reports will not include any information that may identify individuals.

**Results**

I understand that the results of my blood test will be provided in writing to me within approximately two months. I will receive an actual result number(s) in addition to reference values for interpretation. I

ID CODE \_\_\_\_\_

understand that if my results reveal an elevated value of PCBs, I may be contacted by DHEC about providing additional information.

**Consent**

The risk and benefits have been explained to me. I will be given a copy of this consent form. I hereby freely and voluntarily give my signed authorization for participating in the testing described above. If I have any additional questions in the future I may contact: Ann-Marie Donohoe, Division of Health Hazard Evaluation, SCDHEC, 1751 Calhoun Street, Columbia, SC 29201. Phone number: 803-898-0773, toll free 1-888-849-7241 or Dr. Robert Johnson, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road, NE, MS E-32, Atlanta, Georgia 30333

I, (print) \_\_\_\_\_, the undersigned, agree to blood sampling and completing questionnaire for:

ID CODE

( ) Myself \_\_\_\_\_

( ) My child/ward, \_\_\_\_\_, age- \_\_\_\_\_

( ) My child/ward, \_\_\_\_\_, age- \_\_\_\_\_

( ) My child/ward, \_\_\_\_\_, age- \_\_\_\_\_

( ) My child/ward, \_\_\_\_\_, age- \_\_\_\_\_

( ) My child/ward, \_\_\_\_\_, age- \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name of Participant: \_\_\_\_\_

Mailing Address: \_\_\_\_\_

\_\_\_\_\_

Home Telephone: \_\_\_\_\_ Best time to call: \_\_\_\_\_

Assent Form for Children  
(7-17 years old)

Statement to be read to children in the presence of the parent/guardian:

*"We want to find out if you have been exposed to PCBs that may be associated with eating fish or turtles from Twelve Mile Creek and Seneca River areas of Lake Hartwell. PCBs are things you cannot see and may affect your health. We have a questionnaire for you to complete with the assistance of your parent. It asks about the types of fish you've eaten and takes about 20 minutes to finish. To see if you have any PCBs in your body, we would like to take a little sample of blood from your arm by using a small needle. It may hurt only for a few seconds. It is considered very safe and your mother/father/guardian has said that it would be all right for you to do this."*

*"Do you have any questions?" "May we give you and your parent a questionnaire to answer?" "May we take a sample of your blood?"*

The above information has been read to me, and I want to participate.

Name of Child: \_\_\_\_\_ Signature of Child: \_\_\_\_\_

Name of Parent/Guardian: \_\_\_\_\_

Mailing Address: \_\_\_\_\_  
\_\_\_\_\_

Gender of child (please circle):

- a. male
- b. female

Person answering this questionnaire (please circle all that apply):

- a. child
- b. other (please specify relationship to participant: \_\_\_\_\_)

***(Sentences in bold italic are to be read to interviewee. Children may have a parent assist them in questions and answer)***

***This questionnaire is voluntary and confidential to the full extent legally possible. It should take approximately 30 minutes to complete. Information collected as part of this questionnaire will be used to help interpret results from your blood test for PCB levels.***

***Please answer all questions to the best of your ability. Even if you are unsure of the exact answer, please give your best answer. If you are unsure of the meaning of any question, please ask me for an explanation. If there is any question you really do not wish to answer, we can skip that question and go to the next question.***

# South Carolina

