



Project ID #16-0373

Proctor Creek Fish Tissue Screening

Fulton County, GA

Project Date: April 20, 2016

Project Leader: Susan Dye
Ecology Section
Field Services Branch
Science & Ecosystem Support Division
USEPA – Region 4
980 College Station Road
Athens, Georgia 30605-2720

The activities described in this report are accredited under the US EPA Region 4 Science and Ecosystem Support Division ISO/IEC 17025 accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation AT-1644.



Requestor:


Cynthia Edwards
Water Protection Division
USEPA Region 4
61 Forsyth St. SW
Atlanta, GA 30303-8960

Analytical Support:

Analytical Services Branch
Science & Ecosystem Support Division
USEPA Region 4
980 College Station Road
Athens, GA 30605-2720

Approvals:


SESD Project Leader:



Susan Dye
Ecology Section
Field Services Branch

2/17/17
Date

Approving Official:



Stacey Box, Chief
Ecology Section
Field Services Branch

2/17/17
Date

Table of Contents

1.0	Introduction	4
2.0	Methods	4
2.1	Site Description	4
2.2	Study Design.....	4
2.3	Sampling Methods	5
2.4	Data Analysis.....	6
3.0	Results.....	6
3.1	Fish Tissue Data.....	6
3.1.1	Organics	6
3.1.2	Metals	7
3.2	Quality Control.....	7
4.0	Discussion	7
5.0	Conclusions	9
6.0	References	10
	Tables.....	11
	Figures.....	15
	Appendix.....	16

1.0 Introduction

This study is part of a larger project monitoring water quality over time in the Proctor Creek watershed, in order to document current conditions and identify any issues beyond the known fecal coliform exceedances (USEPA 2015a). Sediment and water chemistry data collected in September 2015 identified the upper watershed of Proctor Creek as having elevated concentrations of contaminants associated with urban environments, including organochlorine pesticides, PCBs and polycyclic aromatic hydrocarbons (PAHs) (USEPA 2016b). Since these compounds can bioaccumulate up the food chain, often starting with small organisms in the substrate that provide food for benthic feeders, fish in Proctor Creek may have increased concentrations of these organic contaminants stored in their tissue. If concentrations in fish tissue are above certain thresholds, fish consumption advisories may be warranted to reduce exposure to people who consume these fish. This study provides screening-level data as a first step to assess risk to human health from eating fish caught in the upper reaches of Proctor Creek.

2.0 Methods

2.1 Site Description

The Proctor Creek watershed (HUC 031300020101) is located within the City of Atlanta in Fulton County, GA. Its headwaters begin near the city center, then the stream flows northwest for approximately 9 miles to its confluence with the Chattahoochee River just west of Interstate-285 (Figure 1). The Chattahoochee (HUC 03130001) joins the Flint River at the Georgia-Florida border to form the Apalachicola, then drains across the Florida panhandle to the Gulf of Mexico. Sampling locations for the Proctor Creek Watershed Monitoring project are listed in Table 1 and shown in Figure 2.

The headwaters of Proctor Creek, most of which are either piped underground or channelized aboveground, receive urban runoff from the west side of downtown Atlanta. Combined sewer overflow (CSO) facilities are located along the two tributaries entering Proctor Creek from the downtown area: North Avenue CSO and the decommissioned Greensferry CSO (Figure 2). Proctor Creek widens at the confluence of the tributary which receives effluent from the North Avenue CSO facility, likely due to the increased stream discharge during storm events. This location is known to be a fishing spot for local residents.

2.2 Study Design

This study was conducted in accordance with the methods outlined in the Proctor Creek Fish Tissue Screening Quality Assurance Project Plan (USEPA 2016a). The sampling location was selected based on data collected during previous sampling efforts in Proctor Creek as well as personal communication with local community members. The selected location is both a known fishing hole and a potential hotspot for pesticides and other contaminants. Previous data have shown elevated concentrations of the pesticides chlordane and heptachlor epoxide in several locations in the downtown Atlanta area (USEPA 2016b, USEPA 2016c). Specifically, alpha- and gamma-chlordane were found in the sediment in the Proctor Creek tributary at Lindsay Street (PC10), and gamma-chlordane and/or heptachlor epoxide have been found in the surface water

downstream of the decommissioned Greensferry CSO facility (PC2) and in the main channel of Proctor Creek at Burbank (PC1) and North Avenue (PC3), at concentrations above the 7Q10 water quality standard. Additionally, there were detections of 4,4'-DDT, dieldrin, PCB Aroclors 1254 and 1260, and PAHs in the sediment, primarily in the downtown area. The local fishing spot is downstream of most of these locations; thus, there is concern about the potential level of pesticides, PCBs and PAHs in fish that are caught here and consumed by people in the community. While not previously detected at levels of concern, metals were also included in this screening due to their potential to bioaccumulate.

The sampling reach selected for this study includes the fishing spot located at North Avenue, at the confluence of the tributary which receives effluent from the North Avenue CSO (PC4) with the main channel of Proctor Creek. The full sampling reach extended approximately 250 meters, which spanned both upstream and downstream of North Avenue (PC3; Figure 2). Fish collection took place on April 20, 2016 and fish processing was performed in the SESD laboratory on April 21, 2016. Frozen, composited tissue samples were then homogenized on May 6, 2016 and submitted for laboratory analysis.

2.3 Sampling Methods

Fish were collected using backpack electrofishers, dip nets and seines in accordance with the SESD Operating Procedure for Fish Sampling, SESDPROC-512-R4 (USEPA 2015b). Sampling reach endpoints were recorded using handheld global positioning devices (SESDPROC-110-R4, USEPA 2015c). Target species were determined based on feeding guild as well as the number and size of individuals caught. Individuals were then sorted into composite samples, such that the smallest individual of each composite was no less than 75% of the total length of the largest (USEPA 2000, GAEPD 2016). Three composites each of redbreast sunfish (*Lepomis auritus*) and green sunfish (*Lepomis cyanellus*), both predators, and one composite each of benthic-feeding brown bullhead catfish (*Ameiurus nebulosus*) and white sucker (*Catostomus commersonii*) were collected (Table 2). Five individuals were included in each composite of sunfish, while only 3 catfish and 2 suckers were included in those samples due to the low number of those species caught. Each individual was identified to species and measured (total length), with results recorded in the logbook.

Fish were stored in clean plastic bags on ice, then transported back to the SESD laboratory for processing within 24 hours of collection. Sunfish were scaled, heads and entrails removed, and left on the backbone with skin and belly flap. Catfish and suckers were filleted, including the belly flap with the rib cage removed. Catfish were skinned and suckers were scaled before filleting. These procedures are meant to replicate the preparation by consumers, in order to analyze the tissues which are most likely to be consumed (GAEPD 2016).

Filleted, composited fish tissue samples were weighed, sealed in clean plastic bags, then frozen at -20°C until further processing. Each composite sample was homogenized using a high-speed blender and dry ice pellets according to the SESD Operating Procedure for Tissue Sample Handling and Processing, SESDPROC-714-R1 (USEPA 2015d). Homogenized samples were then divided into aliquots of sufficient weight for each analysis, wrapped in aluminum foil, and frozen at -20°C until laboratory analysis. Samples were analyzed for routine level pesticides,

PCBs and PAHs (a subset of the semi-volatile organic analyses), the full scan of total recoverable metals including mercury, as well as % lipids and % moisture (USEPA 2016d). However, there was insufficient tissue for PAH analysis of the brown bullhead catfish composite sample, or metals analysis of the catfish or white sucker samples.

2.4 Data Analysis

Concentrations of different forms of DDT (*i.e.*, 4,4'-DDE, 4,4'-DDT, etc.) were summed to provide a value for total DDT, and concentrations of alpha- and gamma-chlordane, oxychlordane and trans-nonachlor were summed to provide a value for total chlordane for each sample. Data for individual PAHs detected (acenaphthene, fluoranthene and phenanthrene) were weighted by multiplying each concentration by its toxicity equivalency factor (TEF) relative to benzo[a]pyrene, then summed to provide a value for total PAHs for each sample (Table 5-6, USEPA 2000). This value is expressed as a potency equivalency concentration, which can be compared to the screening value for benzo[a]pyrene, since those for other PAHs do not currently exist. Results were compared to screening values (SV) for recreational fishers, in both the noncarcinogenic (toxic) and carcinogenic categories (Table 5-3, USEPA 2000). Results were also compared to trigger values provided by Georgia Environmental Protection Division (GAEPD 2016), which are used to determine fish consumption guidelines. However, this study was designed primarily as a screening tool, so data may not necessarily be used to establish such recommendations.

3.0 Results

3.1 Fish Tissue Data

3.1.1 Organics

All organic analytes detected in fish tissue samples are shown in Table 3, while analytes not detected in any samples are listed in the Appendix with the range of reporting limits for each. Minimum reporting limits were below all associated screening values and trigger values, and therefore sufficient to determine any exceedances. Contaminants of concern are summarized in Table 4a, with components of total DDT and total chlordane also listed individually. Applicable screening values for each contaminant are provided for both carcinogenic and noncarcinogenic (toxic) effects based on recreational fishing consumption rates. These screening values indicate the level above which additional sampling is recommended to investigate potential risks to human health. Samples collected in this study did not contain total PAHs, total DDT or total chlordane at levels above the respective screening values. However, dieldrin, heptachlor epoxide and total PCBs were above the screening value for carcinogenic effects in all samples, and total PCBs were above the screening value for noncarcinogenic effects in several samples.

Comparison to GAEPD trigger values (Table 4b) shows that dieldrin, heptachlor epoxide and total PCBs were in the range of concentrations corresponding to fish consumption recommendations of no more than 1 meal per week for several species, due to risk of toxic effects (T). However, three composite samples are necessary in order to determine fish consumption guidelines based on mean concentrations (GAEPD 2016), and there was only one composite each

of the the brown bullhead catfish and white sucker. The green sunfish composites can be considered replicates, as their mean lengths were within 10% of each other (USEPA 2000). The redbreast sunfish composite samples ranged 3 size classes, with more than 10% difference in their mean lengths, but mean contaminant concentrations were above the trigger values for all three contaminants listed above. Thus, levels of both dieldrin and total PCBs in green sunfish, and levels of heptachlor epoxide and total PCBs in redbreast sunfish, may prompt a recommended limit of 1 meal per week. Dieldrin content in redbreast sunfish could further prompt a recommendation of no more than 1 meal per month for that species. No samples were above the trigger values for recommendation against any consumption of fish.

3.1.2 Metals

All metals detected in fish tissue samples are shown in Table 5, while those not detected are listed in the Appendix with the range of reporting limits for each. Minimum reporting limits were below all associated screening values and trigger values, and therefore sufficient to determine any exceedances. Table 6 lists applicable EPA screening values based on recreational fishing consumption rates (USEPA 2000), as well as trigger values established by the State to determine consumption recommendations for both carcinogenic and noncarcinogenic (toxic) effects (GAEPD 2016). While arsenic was above the EPA screening value for carcinogenic effects, it was not above the trigger values established by GAEPD. No other metals were above the respective screening or trigger values; thus, no metals were at levels of concern in the two species of fish analyzed.

3.2 Quality Control

Quality control activities associated with fish collection and laboratory processing operations included thermometers for sample freezers, dry ice blanks, and equipment rinse blanks for blenders used in the tissue homogenization procedure. Thermometer readings indicate that samples were at or below -10°C when received by the SESD Analytical Support Branch (ASB). All samples arrived at ASB in good condition and with a complete chain of custody. Dry ice and equipment rinse blanks were below the reporting limit for all parameters analyzed.

4.0 Discussion

Fish tissue data correspond to previous surface water and sediment data (USEPA 2016b, 2016c), in that there were detections of PAHs, DDT, chlordane, dieldrin, heptachlor epoxide and PCBs, but metals were at relatively low levels. PAHs and metals do not appear to be a concern in fish tissue, since these were detected at their highest concentrations in sediment samples collected primarily in this vicinity (North Avenue, North Avenue CSO, and Hollowell Parkway), but were well below the screening value (if detected at all) in fish tissue. DDT was only found in sediment collected upstream from this location at Burbank Drive (PC1), and also does not appear to be a risk to human health via fish consumption. Chlordane was detected in various forms in all fish species analyzed, but total concentrations were below both EPA screening values for recreational fishers (USEPA 2000) and GAEPD trigger values for consumption recommendations (GAEPD 2016). Dieldrin appears to be the contaminant with the highest bioaccumulation potential in this

sampling reach, followed by heptachlor epoxide and PCBs, according to concentrations in the fish collected during this study.

Dieldrin is an organochlorine pesticide that was used for agricultural pest control, and later for residential termite treatment, with usage discontinued in 1987. Heptachlor epoxide is a breakdown product of both chlordane and heptachlor, which are also organochlorine pesticides used in similar applications and banned in the 1980s. PCBs are no longer manufactured in the United States, but can exist in certain electrical transformers and capacitors still in use. The main PCB aroclor detected in this watershed is Aroclor 1260, which was formerly used as an electrical insulator as well as in hydraulic fluids, dedusting agents and plasticizers. These chemicals are all extremely persistent in the environment, with potential to bioaccumulate in aquatic organisms to levels that can be harmful to humans as toxins and probable carcinogens (USEPA 2000).

Results of this study may be sufficient for Georgia Department of Natural Resources to list green and redbreast sunfish at consumption recommendations of no more than 1 meal per week (1/WK) and 1 meal per month (1/MO), respectively. Mean concentrations of dieldrin and PCBs in green sunfish samples were above trigger values for the 1/WK category. Mean concentrations of dieldrin, heptachlor epoxide and PCBs in redbreast sunfish samples were above trigger values for the 1/WK category, and dieldrin levels were also above the 1/MO trigger value. Protocols followed during fish collection, processing and data analysis match requirements of the State for assessing fish tissue contaminants with regard to consumption advisories. While redbreast sunfish composites were not 'similarly-sized' replicates (GAEPD 2016), all three replicates were above the threshold concentration for a consumption limit of one meal per month due to potentially toxic levels of dieldrin. The three composites included individuals which spanned a medium to large size range of 102-197 mm, compared to the maximum length of 240 mm for this species (Page & Burr 2011).

This study was designed to provide a screening of fish tissue in the stream reach where high levels of contaminants have been found. However, there were relatively low numbers of fish caught in this sampling reach and only smaller-sized individuals of the two benthic feeders: brown bullhead catfish and white suckers. These data are an indication of which contaminants may be at levels of concern in fish tissue in Proctor Creek, but concentrations may also be higher in larger or longer-lived individuals. Green sunfish can reach a maximum length of 310 mm (Page & Burr 2011), yet individuals collected in this study ranged from 100-140 mm. This may help to explain lower concentrations of dieldrin and heptachlor epoxide in green sunfish compared to redbreast, although PCB levels were similar between the two species regardless of size. A larger size class of green sunfish may contain higher levels of contaminants, and potentially alter the recommended consumption limit for that species.

It is also possible that fish feeding in this reach with known contaminants may migrate to the lower watershed over time, as they grow and move to deeper water, or periodically move throughout the watershed to forage or breed (Dingle 1996). Food sources such as benthic macroinvertebrates can also drift downstream (Merritt et al. 2008), thereby transporting contaminants in the food web to the lower watershed. Thus, it may be advisable to conduct a follow-up, intensive survey to investigate pesticides and PCBs in larger individuals both at the current study location, if possible, as well as further downstream. Visual observations at Kerry

Circle (PC7) and Spring Street (PC12) during quarterly sampling events suggest that fish in the Centrarchidae family (sunfish and bass) may be abundant in the downstream reaches of Proctor Creek. If resources are available, follow-up sampling could include other species not collected in the current study, as well as larger catfish and potentially larger sunfish.

5.0 Conclusions

Results of this screening study indicate that the pesticides dieldrin and heptachlor epoxide, as well as PCBs, are at levels of potential concern in fish populations of Proctor Creek. Concentrations were above both EPA screening values and GAEPD trigger values for recreational fishing consumption rates in both redbreast and green sunfish collected in the upper section of the watershed. Fish consumption advisories may be issued by the State for these two species, depending on listing requirements. Samples of other species, including benthic-feeding catfish, were insufficient to determine whether additional consumption advisories may be warranted. Depending on the availability of project funds, follow-up sampling is recommended to assess larger individuals, other species not collected during this screening, and other sampling locations in the lower watershed.

6.0 References

- Dingle, H. 1996. Migration: The Biology of Life on the Move. Oxford University Press, New York, NY.
- GAEPD. 2016. Georgia Department of Natural Resources Fish Consumption Guidance. Watershed Protection Branch, Environmental Protection Division, Georgia Department of Natural Resources, Atlanta, GA.
- Merritt, R.W., K.W. Cummins and M.B. Berg. 2008. An Introduction to the Aquatic Insects of North America. Fourth Edition. Kendal Hunt Publishing Company, Dubuque, IA.
- Page, L.M. and B.M. Burr. 2011. Peterson Field Guide to Freshwater Fishes of North America North of Mexico. Second Edition. Houghton Mifflin Harcourt, New York, NY.
- USEPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories: Volume 1, Fish Sampling and Analysis, Third Edition. EPA 823-B-00-007. Office of Science and Technology, Office of Water, Washington, D.C.
- USEPA. 2015a. Proctor Creek Watershed Monitoring, Quality Assurance Project Plan. SESD Project ID #15-0425. Region 4, SESD, Athens, GA.
- USEPA. 2015b. Operating Procedure for Fish Field Sampling, SESDPROC-512-R4, Region 4, SESD, Athens, GA.
- USEPA. 2015c. Operating Procedure for Global Position System, SESDPROC-110-R4, Region 4, SESD,
- USEPA. 2015d. Operating Procedure for Tissue Sample Handling and Processing, SESDPROC-714-R1, Region 4, SESD, Athens, GA.
- USEPA. 2016a. Proctor Creek Fish Tissue Screening, Quality Assurance Project Plan. SESD Project ID #16-0373. Region 4, SESD, Athens, GA.
- USEPA. 2016b. Proctor Creek Watershed Monitoring: First Quarterly Sampling Report. United States Environmental Protection Agency. Region 4, SESD, Athens, GA.
- USEPA. 2016c. Proctor Creek Watershed Monitoring: Third Quarterly Sampling Report. United States Environmental Protection Agency. Region 4, SESD, Athens, GA.
- USEPA. 2016d. SESD Analytical Services Branch Laboratory Operations and Quality Assurance Manual (ASB LOQAM). United States Environmental Protection Agency. Region 4, SESD, Athens, GA.

Table 1: Sampling locations in the mainstem (MAIN) and tributaries (TRIB) of Proctor Creek. Fish for this screening were collected in a reach that encompassed station PC3, North Avenue.

Station ID	Station Name	Location Type	Location Description	Location (Decimal Degrees)	
				Latitude	Longitude
PC1	Burbank	MAIN	Proctor Creek at Burbank Drive	33.75710	-84.42892
PC2	Greensferry	TRIB	Tributary downstream of decommissioned Greensferry CSO	33.76075	-84.42691
PC3	North Avenue	MAIN	Proctor Creek at North Avenue	33.76800	-84.42769
PC4	North CSO	TRIB	Tributary downstream of North Avenue CSO outfall	33.76863	-84.42689
PC5	Hollowell	MAIN	Proctor Creek at Hollowell Parkway	33.77199	-84.42990
PC6	Hortense	MAIN	Proctor Creek at Hortense Place	33.77562	-84.44072
PC7	Kerry Circle	MAIN	Proctor Creek at Kerry Circle	33.79214	-84.45208
PC8	James Jackson	MAIN	Proctor Creek at James Jackson Parkway	33.79461	-84.47417
PC9	Northwest	MAIN	Proctor Creek at Northwest Drive	33.79931	-84.48682
PC10	Lindsay Street	TRIB	Tributary at Lindsay Street Park	33.76941	-84.41611
PC11	Grove Park	TRIB	Tributary at Grove Park	33.77406	-84.44029
PC12	Spring Street	TRIB	Tributary at Spring Street	33.78849	-84.46597
PC13	AD Williams	TRIB	Tributary at Northwest Drive	33.79633	-84.48602
PC14	Lillian Cooper	TRIB	Tributary at Lillian Cooper Shepherd Park	33.79799	-84.47842
PC15	West Highlands	TRIB	Tributary at Hollingsworth Boulevard	33.79076	-84.44724
PC3	North Avenue (fish tissue)	MAIN	Fish sampling reach: upstream end	33.76763	-84.42785
			Fish sampling reach: downstream end	33.76890	-84.42834

Table 2: Fish species collected, with total lengths of individuals and summary statistics for each tissue sample composite. Size of the smallest individual is shown as a percentage of the largest individual within each composite.

Fish Species	Sample ID	Individual Total Length (mm)					Mean Length (mm)	Smallest Ind. (% of Largest)	Composite Wet Weight (g)
		1	2	3	4	5			
redbreast sunfish (<i>Lepomis auritus</i>)	RDS-TI1	175	197	177	165	150	173	76.1	343
	RDS-TI2	165	143	133	154	157	150	80.6	208
	RDS-TI3	122	110	102	115	120	114	83.6	85
green sunfish (<i>Lepomis cyanellus</i>)	GSF-TI1	130	116	107	100	101	111	76.9	73
	GSF-TI2	133	135	118	127	115	126	85.2	100
	GSF-TI3	140	119	109	120	109	119	77.9	95
brown bullhead catfish (<i>Ameiurus nebulosus</i>)	BRB-TI1	140	134	113	---	---	129	80.7	24
white sucker (<i>Catostomus commersonii</i>)	WHS-TI1	186	168	---	---	---	177	90.3	56

Table 3: Fish tissue data for pesticides, PCBs and PAHs, in mg/kg wet weight. Detections are highlighted in grey for clarity.

Analyte	Units	Sample ID							
		RDS-TI1	RDS-TI2	RDS-TI3	GSF-TI1	GSF-TI2	GSF-TI3	BRB-TI1	WHS-TI1
% Lipids	%	4.0	3.8	5.6	2.9	1.8	2.4	1.4	3.4
4,4'-DDE (p,p'-DDE)	mg/kg	0.013	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0039 U	< 0.0040 U
4,4'-DDT (p,p'-DDT)	mg/kg	0.011	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0039 U	< 0.0040 U
Acenaphthene	mg/kg	< 0.067 U	< 0.067 U	0.0077 J,Q-2	< 0.067 U	< 0.073 U	< 0.067 U	-	< 0.067 U
Dieldrin	mg/kg	0.16	0.12	0.14	0.076	0.080	0.097	0.039	0.063
Fluoranthene	mg/kg	< 0.067 U	0.0095 J,Q-2	0.012 J,Q-2	< 0.067 U	< 0.073 U	< 0.067 U	-	< 0.067 U
Heptachlor epoxide	mg/kg	0.047	0.039	0.049	0.027	0.025	0.031	0.013	0.014
Oxychlordane	mg/kg	0.011	0.0090	0.010	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0039 U	< 0.0040 U
PCB-1260 (Aroclor 1260)	mg/kg	0.14 J,CRa,I-5	0.092 J,CRa,I-5	0.075 J,I-5,CRa	0.076 J,CRa,I-5	0.12 J,CRa,I-5	0.17 J,CRa,I-5	0.10 J,CRa,I-5	0.045 J,I-5,CRa
Phenanthrene	mg/kg	< 0.067 U	0.016 J,Q-2	0.020 J,Q-2	0.0068 J,Q-2	< 0.073 U	< 0.067 U	-	< 0.067 U
alpha-Chlordane	mg/kg	0.014	0.011	0.013	0.0065	0.0062	0.0068	0.010	0.011
gamma-Chlordane	mg/kg	< 0.0039 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	< 0.0040 U	0.0063	0.0061
trans-Nonachlor	mg/kg	0.015	0.0092	0.0099	0.0058	0.0077	0.0076	0.0042	< 0.0040 U

U = The analyte was not detected at or above the reporting limit.

J = The identification of the analyte is acceptable; the reported value is an estimate.

CRa = Results estimated due to the Aroclor present being weathered/degraded.

I-5 = Mixture of Aroclors in sample; predominant Aroclors reported.

Q-2 = Result greater than MDL but less than MRL.

Table 4: (a) Fish tissue data compared to EPA screening values for carcinogenic and noncarcinogenic (toxic) effects (USEPA 2000). Values shown are for consumption rates based on recreational fishing. (b) Fish tissue data compared to GAEPD trigger values for carcinogenic (C) and toxic (T) effects (GAEPD 2016). Values indicate threshold concentrations for recommendations of 1/WK = one meal per week; 1/MO = one meal per month; and DE = do not eat. Highlighted sample concentrations correspond to the highlighted screening or trigger values *in the same row*. Composite sample means are shown for redbreast and green sunfish (n=3). BD = below detection.

(a)	ANALYTE (mg/kg wet weight)	EPA Screening Value		Sample ID									
		carcinogenic	toxic	redbreast sunfish			green sunfish			catfish	sucker		
				RDS-TI1	RDS-TI2	RDS-TI3	GSF-TI1	GSF-TI2	GSF-TI3	BRB-TI1	WHS-TI1		
	Total PAHs	0.00547	---	BD	0.0000255	0.0002197	0.0000068	BD	BD	---	BD		
	4,4'-DDE			0.013	BD	BD	BD	BD	BD	BD	BD		
	4,4'-DDT			0.011	BD	BD	BD	BD	BD	BD	BD		
	Total DDT	0.117	2	0.0240	BD	BD	BD	BD	BD	BD	BD		
	alpha-Chlordane			0.0140	0.0110	0.0130	0.0065	0.0062	0.0068	0.0100	0.0110		
	gamma-Chlordane			BD	BD	BD	BD	BD	BD	0.0063	0.0061		
	Oxychlordane			0.0110	0.0090	0.0100	BD	BD	BD	BD	BD		
	trans-Nonachlor			0.0150	0.0092	0.0099	0.0058	0.0077	0.0076	0.0042	BD		
	Total Chlordane	0.114	2	0.0400	0.0292	0.0329	0.0123	0.0139	0.0144	0.0205	0.0171		
	Dieldrin	0.0025	0.2	0.160	0.120	0.140	0.076	0.080	0.097	0.039	0.063		
	Heptachlor epoxide	0.00439	0.052	0.047	0.039	0.049	0.027	0.025	0.031	0.013	0.014		
	Total PCBs	0.02	0.08	0.140	0.092	0.075	0.076	0.120	0.170	0.100	0.045		

(b)	ANALYTE (mg/kg wet weight)	GAEPD Trigger Value			Sample ID									
		1/WK	1/MO	DE	redbreast sunfish			green sunfish			catfish	sucker		
					RDS-TI1	RDS-TI2	RDS-TI3	GSF-TI1	GSF-TI2	GSF-TI3	BRB-TI1	WHS-TI1	redbreast sunfish	green sunfish
	4,4'-DDE (C)	1.60	4.80	16.01	0.013	BD	BD	BD	BD	BD	BD	BD		
	4,4'-DDT (C)	1.60	4.80	16.01	0.011	BD	BD	BD	BD	BD	BD	BD		
	4,4'-DDT (T)	1.17	3.50	11.67	0.011	BD	BD	BD	BD	BD	BD	BD		
	Chlordane (C)	1.56	4.67	15.56	0.0400	0.0292	0.0329	0.0123	0.0139	0.0144	0.0205	0.0171		
	Chlordane (T)	1.17	3.50	11.67	0.0400	0.0292	0.0329	0.0123	0.0139	0.0144	0.0205	0.0171		
	Dieldrin (C)	0.12	0.35	1.17	0.160	0.120	0.140	0.076	0.080	0.097	0.039	0.063	0.140	0.084
	Dieldrin (T)	0.03	0.10	0.34	0.160	0.120	0.140	0.076	0.080	0.097	0.039	0.063	0.140	0.084
	Heptachlor epoxide (C)	0.06	0.18	0.60	0.047	0.039	0.049	0.027	0.025	0.031	0.013	0.014	0.045	0.028
	Heptachlor epoxide (T)	0.03	0.09	0.30	0.047	0.039	0.049	0.027	0.025	0.031	0.013	0.014	0.045	0.028
	Total PCBs (C)	0.27	0.82	2.72	0.140	0.092	0.075	0.076	0.120	0.170	0.100	0.045	0.102	0.122
	Total PCBs (T)	0.10	0.30	1.00	0.140	0.092	0.075	0.076	0.120	0.170	0.100	0.045	0.102	0.122

Table 5: Fish tissue data for metals, in mg/kg wet weight. Detections are highlighted in grey for clarity.

Analyte	Units	Sample ID					
		RDS-TI1	RDS-TI2	RDS-TI3	GSF-TI1	GSF-TI2	GSF-TI3
% Moisture	%	76	76	77	77	78	78
Antimony	mg/kg	0.040	< 0.040 U	< 0.027 U	< 0.040 U	< 0.037 U	< 0.035 U
Arsenic	mg/kg	< 0.038 U	0.050	0.037	< 0.040 U	< 0.037 U	0.045
Barium	mg/kg	0.56	0.54	0.51	0.81	0.74	0.73
Calcium	mg/kg	6900	6400	6100	6400	7400	5200
Copper	mg/kg	< 0.38 U	< 0.40 U	< 0.66 U	0.80	< 0.37 U	0.89
Iron	mg/kg	4.0	4.3	< 6.6 U	5.1	5.1	4.3
Lead	mg/kg	< 0.038 U	0.062	0.044	0.15	0.19	0.14
Magnesium	mg/kg	370	370	370	350	380	340
Manganese	mg/kg	< 1.9 U	< 2.0 U	< 3.3 U	3.1	2.4	< 1.7 U
Mercury	mg/kg	0.097	0.077	0.062	0.075	0.11	0.11
Potassium	mg/kg	3300	3300	3200	3200	3200	3300
Selenium	mg/kg	0.12	0.42	0.43	0.38	0.29	0.35
Sodium	mg/kg	670	630	640	660	700	620
Strontium	mg/kg	6.7	6.3	5.8	6.2	7.4	5.2
Zinc	mg/kg	15	14	14	16	16	14

U = The analyte was not detected at or above the reporting limit.

Table 6: Fish tissue metals data compared to EPA screening values for carcinogenic (C) and non-carcinogenic (T) effects, for consumption rates based on recreational fishing (USEPA 2000), and to GAEPD trigger values (GAEPD 2016). Trigger values indicate threshold concentrations for recommendations of 1/WK = one meal per week; 1/MO = one meal per month; and DE = do not eat. Samples above screening values are highlighted in yellow. No samples were above trigger values. BD = below detection.

ANALYTE (mg/kg wet weight)	EPA Screening Value	GAEPD Trigger Value			Sample ID					
					redbreast sunfish			green sunfish		
		1/WK	1/MO	DE	RDS-TI1	RDS-TI2	RDS-TI3	GSF-TI1	GSF-TI2	GSF-TI3
Antimony		0.93	2.80	9.33	0.040	BD	BD	BD	BD	BD
Arsenic (C)	0.026	0.36	1.09	3.63	BD	0.050	0.037	BD	BD	0.045
Arsenic (T)	1.2	0.70	2.10	7.00	BD	0.050	0.037	BD	BD	0.045
Beryllium		4.67	14.00	46.67	BD	BD	BD	BD	BD	BD
Cadmium	4.0	2.33	7.00	23.33	BD	BD	BD	BD	BD	BD
Chromium III		3500	10500	35000	BD	BD	BD	BD	BD	BD
Chromium VI		7	21	70	BD	BD	BD	BD	BD	BD
Copper		93.33	280.00	933.33	BD	BD	BD	0.80	BD	0.89
Mercury	0.4	0.23	0.70	2.33	0.097	0.077	0.062	0.075	0.11	0.11
Nickel		46.67	140.00	466.67	BD	BD	BD	BD	BD	BD
Selenium	20	11.67	35.00	116.67	0.12	0.42	0.43	0.38	0.29	0.35
Silver		11.67	35.00	116.67	BD	BD	BD	BD	BD	BD
Thallium		0.16	0.49	1.63	BD	BD	BD	BD	BD	BD
Zinc		700	2100	7000	15	14	14	16	16	14

Figure 1: Study site location in Fulton County, GA. The Proctor Creek watershed drains to the Chattahoochee River, which flows across the Florida panhandle to the Gulf of Mexico.

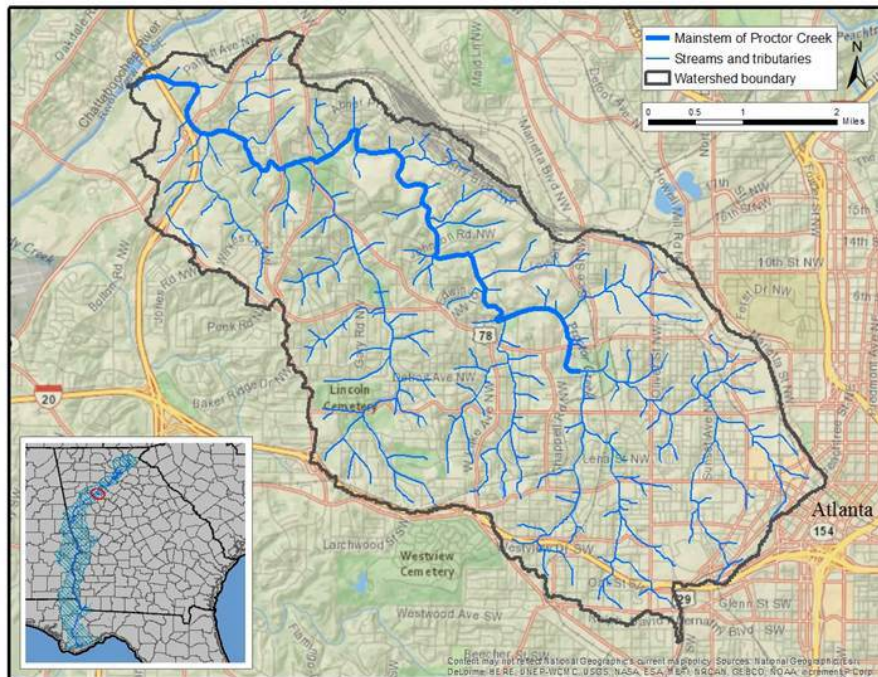
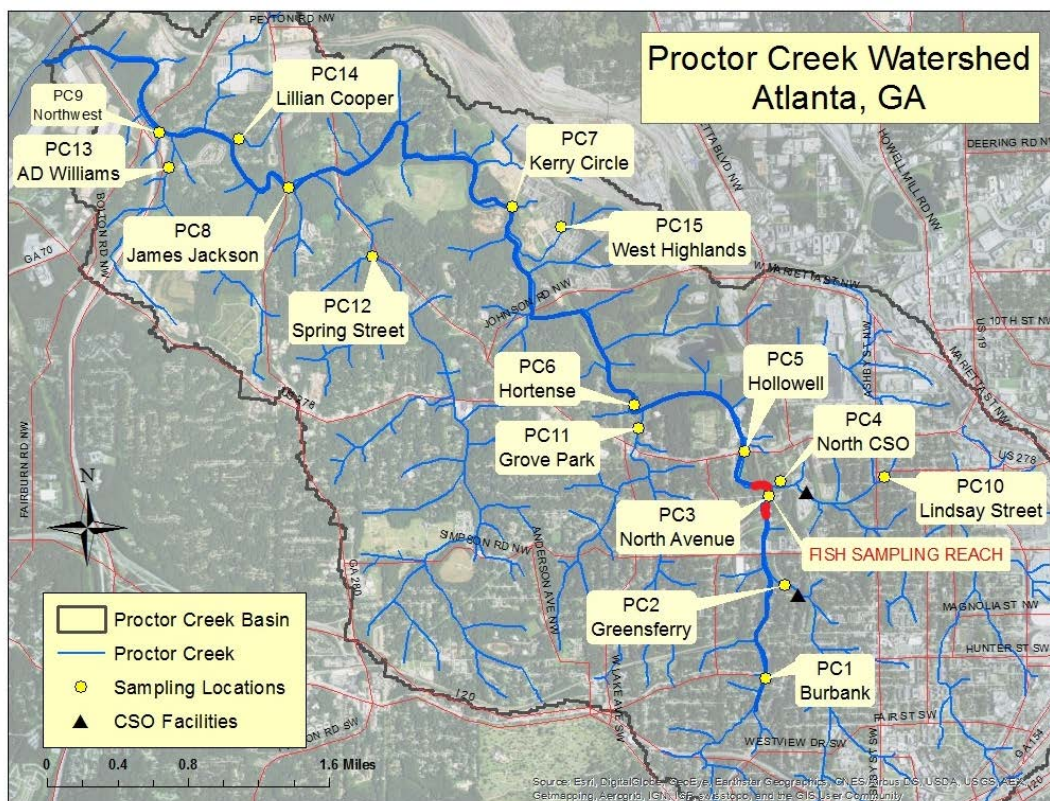


Figure 2: Map of sampling locations in the Proctor Creek watershed. The darker blue line indicates the mainstem of Proctor Creek, with tributaries shown in lighter blue. The fish sampling reach, in red, extended upstream and downstream of North Avenue (PC3). See Table 1 for station descriptions.



Appendix: Table of organic analytes (a) and metals (b) not detected in any samples at the range of minimum reporting limits (MRLs) indicated.

(a)

Analyte	MRL (mg/kg)
4,4'-DDD (p,p'-DDD)	0.0039-0040
Aldrin	0.0039-0040
alpha-BHC	0.0039-0040
beta-BHC	0.0039-0040
delta-BHC	0.0039-0040
gamma-BHC (Lindane)	0.0039-0040
Endosulfan I (alpha)	0.0039-0040
Endosulfan II (beta)	0.0039-0040
Endosulfan Sulfate	0.0039-0040
Endrin	0.0039-0040
Endrin aldehyde	0.0039-0040
Endrin ketone	0.0039-0040
Heptachlor	0.0039-0040
Methoxychlor	0.0039-0040
cis-Nonachlor	0.0039-0040
Toxaphene	0.2
PCB-1016 (Aroclor 1016)	0.046-0.18
PCB-1221 (Aroclor 1221)	0.092-0.36
PCB-1232 (Aroclor 1232)	0.046-0.18
PCB-1242 (Aroclor 1242)	0.046-0.18
PCB-1248 (Aroclor 1248)	0.046-0.18
PCB-1254 (Aroclor 1254)	0.046-0.18
PCB-1262 (Aroclor 1262)	0.046-0.18
PCB-1268 (Aroclor 1268)	0.025

(b)

Analyte	MRL (mg/kg)
Aluminum	3.5-6.6
Beryllium	0.10-0.20
Cadmium	0.013-0.020
Chromium	0.17-0.33
Cobalt	0.17-0.33
Molybdenum	0.35-0.66
Nickel	0.35-0.66
Silver	0.17-0.33
Thallium	0.027-0.040
Titanium	0.17-0.33
Vanadium	0.17-0.33
Yttrium	0.10-0.20

END OF DOCUMENT