

# Neches River Basin Risk Assessment Summary

## INTRODUCTION

In 1990, the Texas Department of Health (TDH; hereinafter Department of State Health Services (DSHS)) issued its first consumption advisory for the Neches River Basin, Fish and Shellfish Consumption Advisory 2 (ADV-2), from the U.S. Highway 96 Bridge near Evadale, Texas downstream to the Interstate Highway 10 Bridge near Beaumont, Texas. The advisory recommended consumption advice for all species of fish due to the presence of dioxins at concentrations that exceed DSHS guidelines for protection of human health. The Lower Neches River Basin dioxin contamination was linked to pulp and paper bleaching processes used by Temple-Inland Inc. In 1992, Temple-Inland Inc. informed the DSHS that the company had implemented controls over the processes that produced dioxins and postulated that fish downstream of the site would have reduced concentrations of dioxins. In 1995, following spring and fall of 1993 dioxin monitoring, the DSHS determined that dioxin concentrations in the Lower Neches River had decreased to an acceptable level and rescinded the consumption advisory on December 5, 1995 (Figure 1).

On November 2, 1995, the DSHS issued Fish and Shellfish Consumption Advisory 12 (ADV-12) for waters of the Neches River Basin (i.e., B.A. Steinhagen Reservoir and Sam Rayburn Reservoir). ADV-12 also included waters of Caddo Lake and Toledo Bend Reservoir. ADV-12 recommended consumption advice for freshwater drum, largemouth bass, and white bass (only B.A. Steinhagen Reservoir) due to the presence of mercury at concentrations that exceed DSHS guidelines for protection of human health (Figure 2).

On March 8, 2010, the DSHS issued Fish and Shellfish Consumption Advisory 41 (ADV-41) for the Neches River from the State Highway 7 Bridge west of Lufkin, Texas downstream to the U.S. Highway 96 Bridge near Evadale, Texas. The advisory recommended consumption advice for flathead catfish, freshwater drum, gar (all species), largemouth bass, spotted bass, and white bass due to the presence of mercury at concentrations that exceed DSHS guidelines for protection of human health (Figure 2). In 2010, the DSHS also initiated studies to investigate potential polychlorinated dibenzo-*p* dioxins and/or dibenzofurans (hereinafter PCDDs/PCDFs; or dioxins) fish tissue contamination in B.A. Steinhagen Reservoir and Sam Rayburn Reservoir. The potential dioxin fish contamination was previously identified through a national-level fish tissue contaminant screening survey, the National Study of Chemical Residues in Lake Fish Tissue (or National Lake Fish Tissue Study; NLFTS). The study design also allowed the SALG to re-evaluate the extant 15-year-old mercury fish consumption advisory for B.A. Steinhagen and Sam Rayburn Reservoirs. This document summarizes the results of surveys of the Neches River Basin conducted in 2007–2011 by the DSHS and addresses the public health implications of consuming fish from the Neches River Basin and suggests actions to reduce potential adverse health outcomes.

## METHODS

From June 2007 through April 2011 DSHS staff collected 1100 fish samples from the Neches River Basin (i.e. Neches River, 2007; B.A. Steinhagen Reservoir, 2010; and Sam Rayburn Reservoir, 2010–2011). DSHS risk assessors used contaminant data from these fish to assess the potential for adverse human health outcomes from consuming fish from these waters. Specific information related to sample collection, contaminant analyses, and risk assessment methodology is described in the individual risk assessments for each water body.

## RESULTS

Table 1 present the results for mercury analyses of selected fishes collected from the Neches River Basin. Table 4 contains summary results for dioxins in select fishes collected from the Neches River Basin. The table summaries present the number of fish samples containing a specific contaminant /number tested, the arithmetic mean concentration  $\pm$  1 standard deviation (68% of samples should fall within one standard deviation of the arithmetic mean in a sample from a normally-distributed population), and, in parentheses under the arithmetic mean and standard deviation, the minimum and the maximum concentrations. In the tables, results may be reported as not detected (ND), below detection limit (BDL) for estimated concentrations, or as concentrations at or above the reporting limit (RL). This summary does not display the results for metals other than mercury, pesticides, semivolatile organic contaminants (SVOCs), and volatile organic contaminants (VOCs) because these contaminants were not present at concentrations of public health concern in fish collected from the Neches River Basin.

### Mercury

#### **Blue catfish**

One-hundred seven blue catfish ranging from 14.4 to 37.5 inches total length (TL) ( $\bar{X}$  – 23.2 inches TL) were analyzed for mercury. One-hundred percent of the blue catfish samples examined were of legal size ( $\geq$  12 inches TL). Mercury concentrations ranged from 0.031 to 1.332 mg/kg with a mean of  $0.266 \pm 0.199$  (Table 1). Mercury concentrations in blue catfish were positively related to TL ( $r^2 = 0.446$ ,  $n = 107$ ,  $p < 0.0005$ ). Mercury concentrations for blue catfish samples  $\geq$  30 inches TL ranged from 0.345 to 1.332 mg/kg with a mean of  $0.653 \pm 0.322$ . The 95% upper confidence limit of the arithmetic mean (UCLAM) for blue catfish  $\geq$  30 inches TL was 0.884 mg/kg.

#### **Flathead catfish**

Sixty flathead catfish ranging from 17.2 to 41.7 inches TL ( $\bar{X}$  – 24.3 inches TL) were analyzed for mercury. Ninety-seven percent of the flathead catfish samples examined were of legal size ( $\geq$  18 inches TL). Mercury concentrations ranged from 0.117 to 2.406 mg/kg with a mean of  $0.439 \pm 0.334$  (Table 1). Mercury concentrations in flathead catfish were positively related to TL ( $r^2 = 0.379$ ,  $n = 60$ ,  $p < 0.0005$ ). Mercury concentrations for flathead catfish samples  $\geq$  27 inches

TL ranged from 0.247 to 2.406 mg/kg with a mean of  $0.788 \pm 0.547$ . The 95% UCLAM for blue catfish  $\geq 27$  inches TL was 1.135 mg/kg.

#### **Largemouth bass**

Three-hundred twenty nine largemouth bass ranging from 11.1 to 24.6 inches TL ( $\bar{X}$  – 16.7 inches TL) were analyzed for mercury. Eighty-nine percent of the largemouth bass samples examined were of legal size ( $\geq 14$  inches TL). Mercury concentrations ranged from 0.097 to 1.979 mg/kg with a mean of  $0.560 \pm 0.267$  (Table 1). Mercury concentrations in largemouth bass were positively related to TL ( $r^2 = 0.277$ ,  $n = 329$ ,  $p < 0.0005$ ). Mercury concentrations for largemouth bass samples  $\geq 16$  inches TL ranged from 0.201 to 1.979 mg/kg with a mean of  $0.660 \pm 0.287$ . The 95% UCLAM for largemouth bass  $\geq 16$  inches TL is 0.702 mg/kg.

#### **Spotted bass**

Thirty two spotted bass ranging from 9.4 to 17.7 inches TL ( $\bar{X}$  – 13.0 inches TL) were analyzed for mercury. Currently, there is no minimum length limit for spotted bass in Texas waters. Mercury concentrations ranged from 0.159 to 1.025 mg/kg with a mean of  $0.425 \pm 0.229$  (Table 1). Mercury concentrations in spotted bass were positively related to TL ( $r^2 = 0.251$ ,  $n = 32$ ,  $p < 0.005$ ). Mercury concentrations for spotted bass samples  $\geq 14$  inches TL ranged from 0.193 to 1.025 mg/kg with a mean of  $0.616 \pm 0.282$ . The 95% UCLAM for spotted bass  $\geq 14$  inches TL is 0.805 mg/kg. The mercury–TL linear regression model for spotted bass predicted that spotted bass  $> 16$  inches TL contain mercury concentrations equivalent to the  $HAC_{nonca}$  for mercury.

### **Dioxins**

#### **Flathead catfish**

Thirty-four flathead catfish were analyzed for dioxins. Dioxin concentrations ranged from not detected (ND) to 16.240 ng/kg with a mean of  $1.980 \pm 4.014$  (Table 4). The 95% UCLAM for flathead catfish was 3.381 ng/kg.

#### **Longnose gar**

Twenty-one longnose gar were analyzed for dioxins. Dioxin concentrations ranged from not detected (ND) to 7.215 ng/kg with a mean of  $1.485 \pm 2.472$  (Table 4). The 95% UCLAM for longnose gar was 2.610 ng/kg.

#### **Smallmouth buffalo**

Seventeen smallmouth buffalo were analyzed for dioxins. Dioxin concentrations ranged from 0.003 to 21.162 ng/kg with a mean of  $4.240 \pm 6.790$  (Table 4). The 95% UCLAM for smallmouth buffalo was 7.731 ng/kg.

### **DISCUSSION**

The DSHS prepared individual risk assessments –which is standard DSHS protocol– for waters of the Neches River Basin (i.e. B.A. Steinhagen Reservoir, Neches River, and Sam Rayburn Reservoir) to establish consumption limits for each water body. But through subsequent review

of previous East Texas fish consumption advisories and assessment of the contaminant data from a river basin perspective, the DSHS risk assessors established that it is likely that fishers and their families will harvest and eat fish from all of these waters and the same species of fish from the Neches River, B.A. Steinhagen Reservoir, and Sam Rayburn Reservoir, all within the Neches River Basin, show a consistent pattern of dioxin and mercury contamination. These findings justify a comprehensive risk assessment for the Neches River Basin that considers an overall contaminant exposure for fishers and their families as a plausible risk assessment approach to protect public health. Similar judgment was used by the DSHS when the agency issued ADV-12 in 1995 for Caddo Lake, B.A. Steinhagen Reservoir, Sam Rayburn Reservoir, and Toledo Bend Reservoir. The DSHS risk assessors determined that a comprehensive risk assessment for the Neches River Basin based on a reasonable maximum exposure scenario for dioxin and mercury fish concentrations from combined B.A. Steinhagen Reservoir, Neches River, and Sam Rayburn Reservoir data was appropriate for protection of public health. The DSHS risk assessors are also of the opinion that a comprehensive fish advisory would provide clear, easily understandable consumption guidance and protect those that may consume fish from waters of the entire Neches River Basin.

### **Mercury**

The DSHS assessed mercury concentrations in fishes from Neches River Basin waters in 1995, 2007, and 2010–2011. This assessment utilized data from 2007–2011 to evaluate mercury concentration in fishes from the Neches River Basin. Mean mercury concentrations that equaled or exceeded the  $HAC_{nonca}$  for mercury were observed in the following species of fish: blue catfish, flathead catfish, and largemouth bass. Positive relationships between mercury concentration and total length (TL) and mercury concentration and age were observed in many fish from the Neches River Basin, indicating that mercury concentrations increase as fish grow (figures presented in the individual water body risk assessments). The DSHS risk assessors utilized mean mercury concentrations, 95% UCLAM mercury concentrations and/or regression model predicted mercury concentrations to recommend consumption limits for blue catfish, flathead catfish, largemouth bass, and spotted bass (Tables 2 and 3). The DSHS risk assessors used mean mercury concentrations and 95% UCLAM to recommend consumption limits for all other species of fish from the Neches River Basin (Tables 2 and 3). Because the developing nervous system of the human fetus and young children may be especially susceptible to adverse systemic health effects associated with consuming mercury-contaminated fish, the DSHS risk assessors recommend more conservative consumption guidance for this sensitive subpopulation.

### **Dioxins**

The DSHS assessed dioxins concentrations in fishes from the Lower Neches River, Neches River, and B.A. Steinhagen and Sam Rayburn Reservoirs in 1990 and 1993, 2007, and 2010–2011, respectively. This assessment utilized data from 2007–2011 to evaluate dioxin concentrations in fishes from the Neches River Basin. Mean dioxin concentrations that equaled or exceeded the  $HAC_{nonca}$  for dioxins were observed in smallmouth buffalo from the Neches River Basin. The DSHS risk assessors utilized mean and 95% UCLAM dioxin concentrations to recommend consumption limits based on systemic and cancer health outcomes for flathead catfish,

longnose gar, and smallmouth buffalo (Tables 5–8). Because the developing nervous system of the human fetus and young children may be especially susceptible to adverse systemic health effects associated with consuming dioxin-contaminated fish, the DSHS risk assessors recommend more conservative consumption guidance for this sensitive subpopulation.

## **CONCLUSIONS**

The DSHS risk assessors prepare risk assessments to determine public health hazards from consumption of fish and shellfish harvested from Texas waters by recreational or subsistence fishers. If necessary, the DSHS may suggest strategies for reducing risk to the health of those who may eat contaminated fish or seafood to risk managers at the DSHS.

This risk assessment addressed the public health implications of consuming fish from the Neches River Basin, located in Angelina, Hardin, Houston, Jasper, Nacogdoches, Polk, Sabine, San Augustine, Trinity, and Tyler Counties, Texas. Risk assessors from the DSHS conclude from the present characterization of potential adverse health effects from consuming fish from the Neches River Basin that:

1. Blue catfish > 30 inches TL, flathead catfish > 27 inches TL, largemouth bass > 16 inches TL, and spotted bass > 16 inches TL, contain mercury concentrations that exceed the DSHS guidelines for protection of human health. Therefore, consumption of these species of fish poses an apparent risk to human health (Tables 1–3).
2. Flathead catfish, longnose gar, and smallmouth buffalo contain PCBs and/or PCDDs/PCDFs, either singly or in combination that exceeds the DSHS guidelines for protection of human health. Regular or long-term consumption of these fish from the Neches River Basin may increase the likelihood of systemic or carcinogenic health risks. Therefore, consumption of these species of fish poses an apparent risk to human health (Tables 4–8).
3. Carcinogenic health risks associated with PCDDs/PCDFs for smallmouth buffalo from the Neches River Basin exceed DSHS guidelines for protection of human health. The theoretical life time cancer risk exceeds 1 in 10,000 people exposed.

## **RECOMMENDATIONS**

Risk managers at the DSHS have established criteria for issuing fish consumption advisories based on approaches suggested by the United States Environmental Protection Agency. Risk managers at the DSHS may decide to take action to protect public health if a risk assessment confirms that people can eat four or fewer meals per month (adults: eight-ounces per meal; children: four-ounces per meal) of fish or shellfish from waters under investigation. Risk management recommendations may be in the form of consumption advice or a ban on possession of fish from the affected water body. Fish or shellfish possession bans are enforceable under subchapter D of the Texas Health and Safety Code, part 436.061(a). Declarations of prohibited harvesting areas are enforceable under the Texas Health and Safety Code, Subchapter D, parts 436.091 and 436.101. Fish consumption advice issued by DSHS

carries no penalty for noncompliance. Consumption advisories, instead, inform fishers and their families of potential health hazards associated with consuming contaminated fish or shellfish from Texas waters. With this information, fishers and their families can make informed decisions about whether and/or how much – contaminated fish or shellfish they wish to consume. The DSHS concludes from this risk assessment that consuming fish from the Neches River Basin **poses an apparent hazard to public health**. Therefore, DSHS risk assessors recommend that:

1. People should not consume smallmouth buffalo from the Neches River Basin.
2. Pregnant women, women who may become pregnant, women who are nursing infants, and children less than 12 years of age or who weigh less than 75 pounds should not consume blue catfish > 30 inches TL, flathead catfish, gar (all species), largemouth bass > 16 inches TL, and spotted bass > 16 inches TL.
3. Women past childbearing age and adult men may consume up to one eight-ounce meal per month of flathead catfish or gar (all species) from the Neches River Basin.
4. Women past childbearing age and adult men may consume up to two eight-ounce meals per month of blue catfish > 30 inches TL, largemouth bass > 16 inches TL, or spotted bass > 16 inches TL.
5. The issuance of consumption advice for hybrid striped bass is not necessary because TPWD has discontinued stocking of hybrid striped bass in Sam Rayburn Reservoir. The TPWD gill net surveys have documented low, decreasing catch rates ( $\leq 1.2$ / net night) of hybrid striped bass from 2005–2009 and none collected in 2011. The hybrid striped bass samples collected in this study are presumably remnants of the last stocking by TPWD in 2000. The average lifespan of a hybrid striped bass is five to six years.
6. As resources become available, the DSHS should continue to monitor fish from the Neches River Basin for changes or trends in contaminants or contaminant concentrations that would require a change in consumption advice.

## ADVISORY RECOMMENDATIONS

The advisory area recommended in the comprehensive fish advisory below will remain unchanged from current consumption advisories for Neches River Basin waters. The comprehensive fish advisory will include the following major revisions: 1) The comprehensive advisory will recommend consumption advice for six species of fish; 2) Dioxin concentrations of human health concern were found in flathead catfish, gar, and smallmouth buffalo. Previous DSHS studies of B.A. Steinhagen Reservoir and Sam Rayburn Reservoir did not examine fish for dioxins; and 3) The consumption rates recommended for women of childbearing age and children < 12 are more conservative than previous consumption advisories recommending no consumption for women of childbearing age and children < 12 rather than limited consumption not to exceed two four-ounce meals per month for children < 12 and varied recommendations for women of childbearing age.

**Advisory Area:** The Neches River and all contiguous waters from the State Highway 7 Bridge west of Lufkin, Texas downstream to the U.S. Highway 96 Bridge near Evadale, Texas including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir (Figure 3).

**Contaminant of Concern:** Dioxins and mercury

Species	Women of Childbearing Age and Children < 12	Women Past Childbearing Age and Adult Men <sup>1</sup>
Blue catfish > 30 inches	<b>DO NOT EAT</b>	2 meals/month
Flathead catfish	<b>DO NOT EAT</b>	1 meal/month
Gar (all species)	<b>DO NOT EAT</b>	1 meal/month
Largemouth bass > 16 inches	<b>DO NOT EAT</b>	2 meals/month
Smallmouth buffalo	<b>DO NOT EAT</b>	<b>DO NOT EAT</b>
Spotted bass > 16 inches	<b>DO NOT EAT</b>	2 meals/month

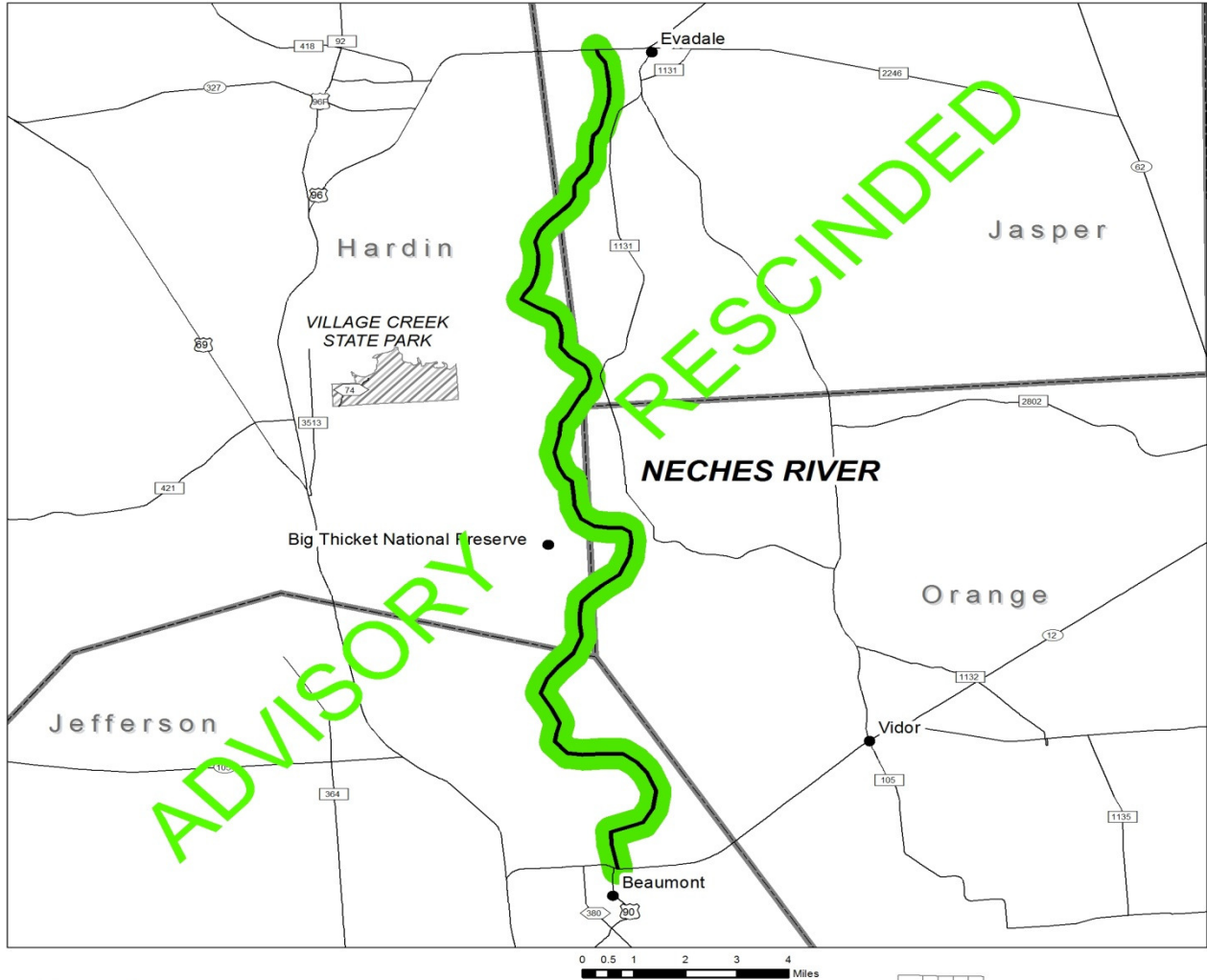
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<sup>1</sup> A meal is eight ounces of fish.

Figure 1. Rescinded Lower Neches River Advisory

## Neches River

Hardin, Jasper, Jefferson and Orange Counties  
 ADV-2 Issued September 19, 1990  
 ADV-13 Rescinded December 5, 1995



**Advisory Area:**

The Neches River and all contiguous waters south of the U.S. 96 bridge near Evadale to the Interstate 10 bridge near Beaumont

**Advisory Rescinded:**

Fish tissue samples collected from the Neches River in the area covered by ADV-2 indicate that concentrations of dioxin have decreased to an acceptable level. Additional analysis of these fish tissue samples did not indicate any other contaminants of concern. Therefore, the fish consumption advisory (ADV-2 Issued September 19, 1990) is hereby rescinded effective December 5, 1995 by ADV-13.



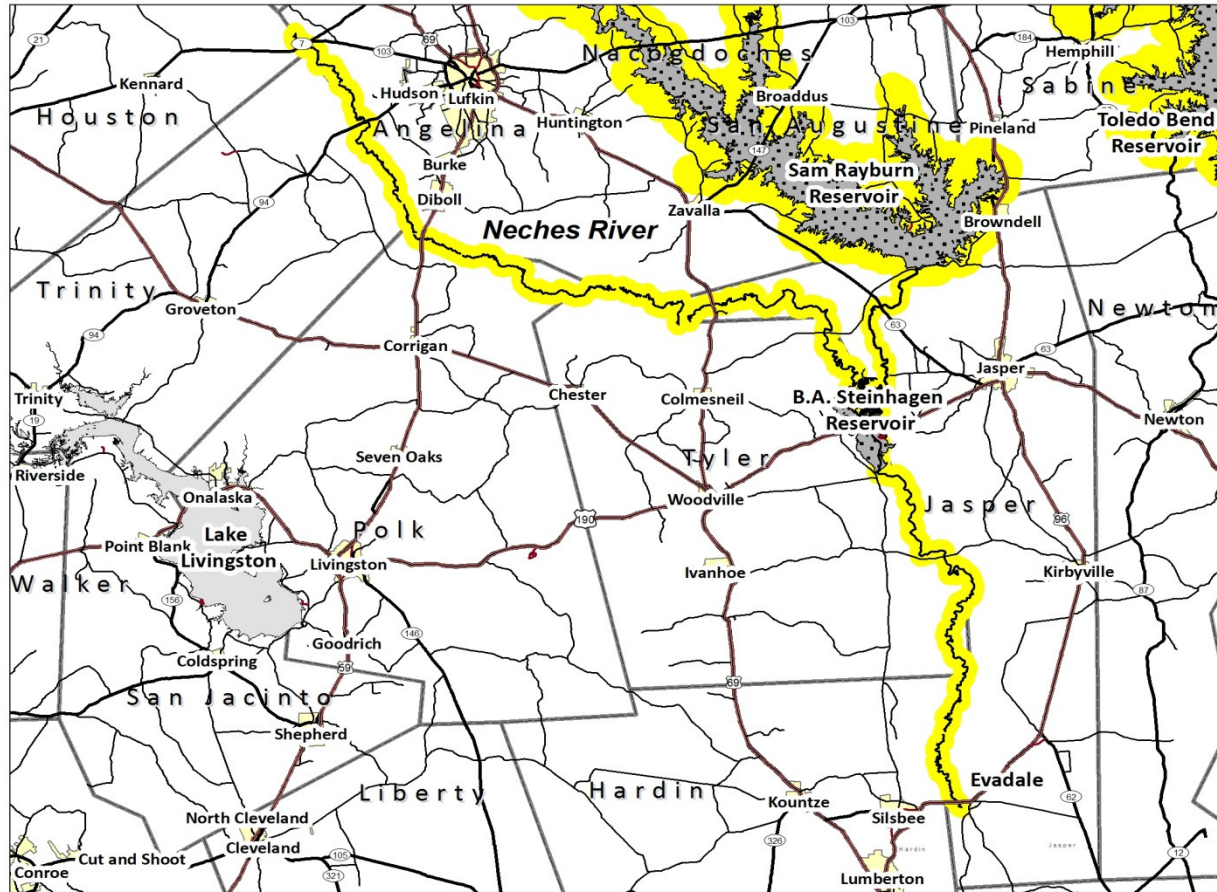


Figure 2. Current Advisories

## Neches River Basin

Angelina, Hardin, Houston, Jasper, Nacogdoches, Polk, Sabine, San Augustine, Trinity, and Tyler Counties  
 ADV-12 Issued November 2, 1995 includes waters outside the Neches River Basin (i.e., Caddo Lake and Toledo Bend Reservoir)

ADV-41 Issued March 8, 2010



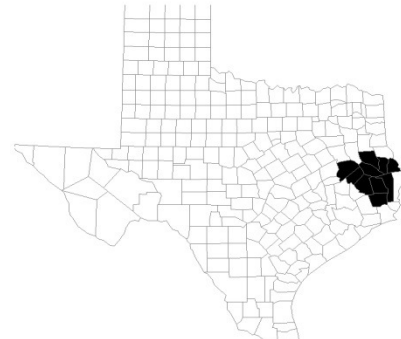
**Contaminant of Concern:**

Mercury (Hg)

**ADV-12 Advisory Area:**

All waters of B.A. Steinhagen Reservoir, Caddo Lake, Sam Rayburn Reservoir, and Toledo Bend Reservoir

Species Affected	Children < 12 <sup>1</sup>	Women Past Childbearing Age and Adult Men <sup>2</sup>
Freshwater drum	2 meals/month	2 meals/month
Hybrid striped bass*	1 meal/month	1 meal/month
Largemouth bass	2 meals/month	2 meals/month
White bass*	1 meal/month	1 meal/month



**ADV-41 Advisory Area:**

The Neches River and all contiguous waters from the State Highway 7 Bridge west of Lufkin downstream to the U.S. Highway 96 Bridge near Evadale

Species Affected	Women of Childbearing Age	Children < 12 <sup>1</sup>	Women Past Childbearing Age and Adult Men <sup>2</sup>
Flathead catfish	DO NOT EAT	2 meals/month	2 meals/month
Freshwater drum	DO NOT EAT	2 meals/month	2 meals/month
Gar (all species)	DO NOT EAT	2 meals/month	2 meals/month
Largemouth bass	DO NOT EAT	2 meals/month	2 meals/month
Spotted bass	DO NOT EAT	2 meals/month	2 meals/month
White bass	DO NOT EAT	2 meals/month	2 meals/month

<sup>1</sup>A meal is four ounces of fish.

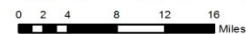
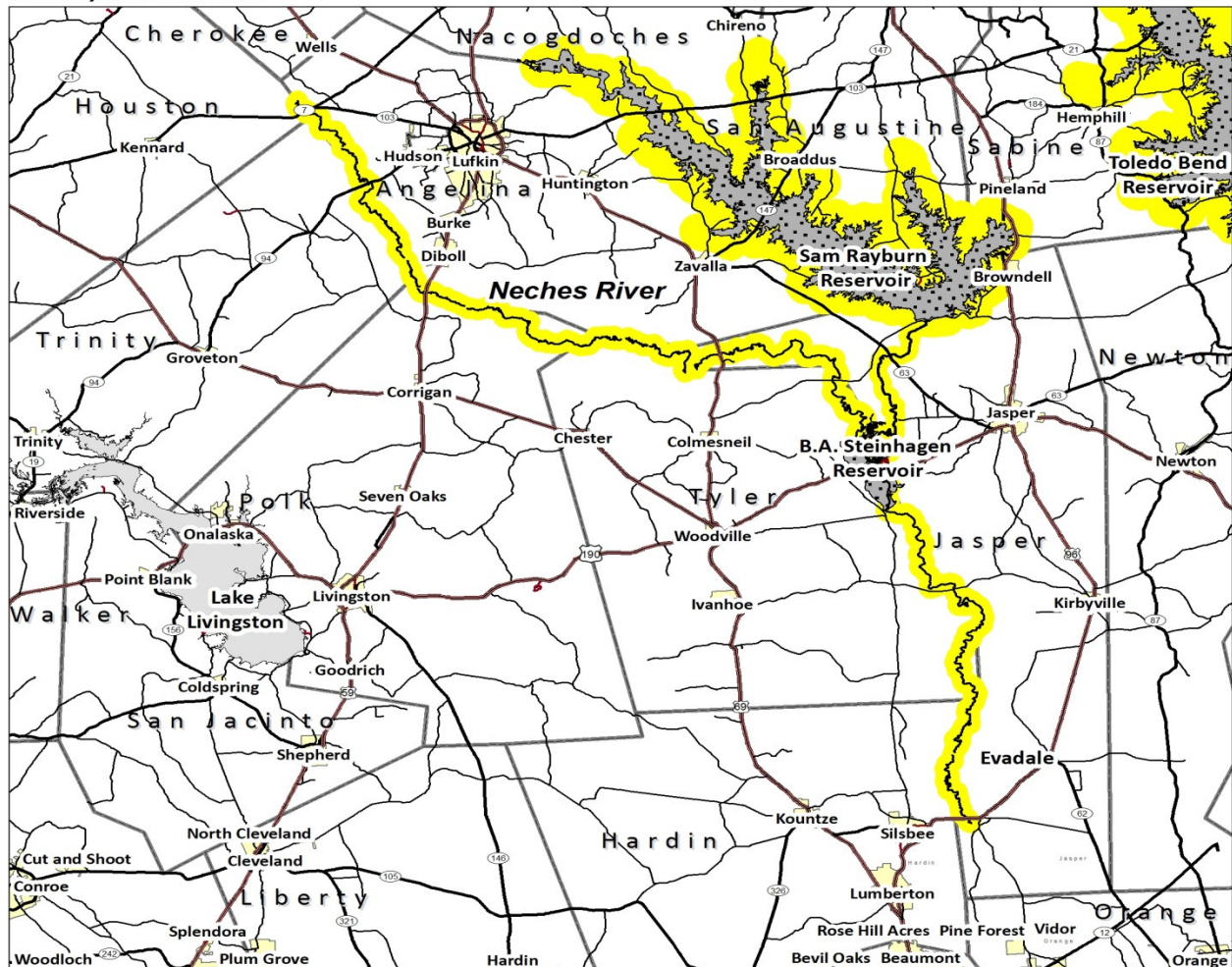
<sup>2</sup>A meal is eight ounces of fish.

\*The hybrid striped bass and white bass consumption advisory applies only to B.A. Steinhagen Reservoir.

Figure 3. Recommended Advisory

## Neches River Basin

Angelina, Hardin, Houston, Jasper, Nacogdoches, Polk, Sabine, San Augustine, Trinity, and Tyler Counties  
 ADV-51 Issued Month Day, 2013 Rescinding ADV-12 Consumption Advice for B.A. Steinhagen and Sam Rayburn Reservoirs



**Advisory Area:**

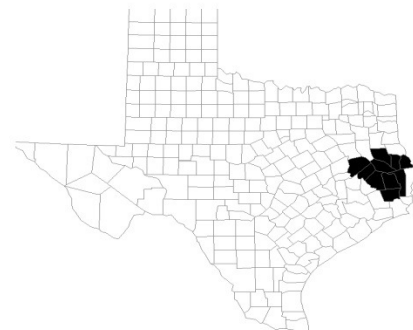
The Neches River and all contiguous waters from the State Highway 7 Bridge west of Lufkin, Texas downstream to the U.S. Highway 96 Bridge near Evadale, Texas including B.A. Steinhagen Reservoir and Sam Rayburn Reservoir

**Contaminant of Concern:**

Mercury (Hg)

Species Affected	Women of Childbearing Age and Children < 12	Women Past Childbearing Age and Adult Men <sup>1</sup>
Blue catfish > 30 inches	<b>DO NOT EAT</b>	2 meals/month
Flathead catfish	<b>DO NOT EAT</b>	1 meal/month
Gar (all species)	<b>DO NOT EAT</b>	1 meal/month
Largemouth bass > 16 inches	<b>DO NOT EAT</b>	2 meals/month
Smallmouth buffalo	<b>DO NOT EAT</b>	<b>DO NOT EAT</b>
Spotted bass > 16 inches	<b>DO NOT EAT</b>	2 meals/month

<sup>1</sup> A meal is eight ounces of fish.



## DATA TABLES

<b>Table 1. Mercury (mg/kg) in select fishes collected from the Neches River Basin 2007–2011.</b>				
<b>Species</b>	<b># Detected/ # Sampled</b>	<b>Mean Concentration ± S.D. (Min-Max)</b>	<b>Health Assessment Comparison Value (mg/kg)</b>	<b>Basis for Comparison Value</b>
<b>Blue catfish</b>				
All blue catfish	107/107	0.266±0.199 (0.031- <b>1.332</b> <sup>2</sup> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
Blue catfish < 30"	97/97	0.226±0.130 (0.031- <b>0.767</b> )		
Blue catfish > 30"	10/10	<b>0.653</b> ±0.322 (0.345- <b>1.332</b> )		
<b>Flathead catfish</b>				
All flathead catfish	60/60	0.439±0.334 (0.117- <b>2.406</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
Flathead catfish < 27"	48/48	0.352±0.178 (0.117- <b>1.010</b> )		
Flathead catfish > 27"	12/12	<b>0.788</b> ±0.547 (0.247- <b>2.406</b> )		
<b>Gar (all species)</b>				
All gar	55/55	0.517±0.381 (0.171- <b>2.522</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
<b>Hybrid striped bass</b>				
All hybrid striped bass	8/8	0.541±0.270 (0.111- <b>0.799</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
<b>Freshwater drum</b>				
All freshwater drum	134/134	0.372±0.265 (0.078- <b>1.116</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
Freshwater drum < 16"	55/55	0.204±0.130 (0.078-0.630)		
Freshwater drum > 16"	79/79	0.490±0.272 (0.104- <b>1.116</b> )		
<b>Largemouth bass</b>				
All largemouth bass	329/329	0.560±0.267 (0.097- <b>1.979</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
Largemouth bass < 16"	152/152	0.443±0.184 (0.097- <b>1.059</b> )		
Largemouth bass > 16"	177/177	<b>0.660</b> ±0.287 (0.201- <b>1.979</b> )		
<b>Spotted bass</b>				
All spotted bass	32/32	0.425±0.229 (0.159- <b>1.025</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day
Spotted bass < 14"	21/21	0.325±0.106 (0.159-0.573)		
Spotted bass > 14"	11/11	0.616±0.282 (0.193- <b>1.025</b> )		
<b>White bass</b>				
All white bass	80/80	0.456±0.203 (0.186- <b>1.045</b> )	0.7	ATSDR chronic oral MRL: 0.0003 mg/kg-day

<sup>2</sup> Emboldened numbers denote that mercury concentrations equal and/or exceed the DSHS HAC value for mercury.

**Table 2. Hazard quotients (HQs) for mercury in fish collected from the Neches River Basin assuming exposure equivalent to the arithmetic mean mercury concentration. Table 5 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.<sup>3</sup>**

Species	Number (N)	Mean (mg/kg)	Hazard Quotient	Meals per Week
Blue catfish	107	0.266	0.38	2.4
Blue catfish < 30"	97	0.226	0.32	2.9
Blue catfish > 30"	10	<b>0.653<sup>4</sup></b>	<b>1.00<sup>5</sup></b>	<b>0.9<sup>6</sup></b>
Channel catfish	96	0.187	0.27	3.5
Crappie	100	0.275	0.39	2.4
Flathead catfish	60	0.439	0.63	1.5
Flathead catfish < 27"	48	0.352	0.50	1.8
Flathead catfish > 27"	12	<b>0.788</b>	<b>1.13</b>	<b>0.8</b>
Freshwater drum	134	0.372	0.53	1.7
Freshwater drum < 16"	55	0.204	0.29	3.2
Freshwater drum > 16"	79	0.490	0.70	1.3
Gar	55	0.517	0.74	1.3
Hybrid striped bass	8	0.541	0.77	1.2
Largemouth bass	329	0.560	0.80	1.2
Largemouth bass < 16"	152	0.443	0.63	1.5
Largemouth bass > 16"	177	<b>0.660</b>	<b>1.00</b>	<b>0.9</b>
Smallmouth buffalo	42	0.338	0.48	1.9
Spotted bass	32	0.425	0.61	1.5
Spotted bass < 14"	21	0.325	0.46	2.0
Spotted bass > 14"	11	0.616	0.88	1.1
Sunfish	57	0.204	0.29	3.2
White bass	80	0.456	0.65	1.4

<sup>3</sup> DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.

<sup>4</sup> Emboldened numbers denote that mercury concentrations equal and/or exceed the DSHS HAC value for mercury.

<sup>5</sup> Emboldened numbers denote that the HQ for mercury is  $\geq 1.0$ .

<sup>6</sup> Emboldened numbers denote that the calculated allowable meals for an adult are  $\leq$  one meal per week.



**Table 3. Hazard quotients (HQs) for mercury in fish collected from the Neches River Basin assuming exposure equivalent to the 95% UCLAM mercury concentration. Table 5 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.<sup>7</sup>**

Species	Number (N)	95% UCLAM (mg/kg)	Hazard Quotient	Meals per Week
Blue catfish	107	0.304	0.43	2.1
Blue catfish < 30"	97	0.253	0.36	2.6
Blue catfish > 30"	10	<b>0.884</b>	<b>1.26<sup>8</sup></b>	<b>0.7<sup>9</sup></b>
Channel catfish	96	0.211	0.30	3.1
Crappie	100	0.313	0.45	2.1
Flathead catfish	60	0.526	0.75	1.2
Flathead catfish < 27"	48	0.404	0.58	1.6
Flathead catfish > 27"	12	<b>1.135</b>	<b>1.62</b>	<b>0.6</b>
Freshwater drum	134	0.418	0.60	1.5
Freshwater drum < 16"	55	0.239	0.34	2.7
Freshwater drum > 16"	79	0.551	0.79	1.2
Gar	55	0.621	0.89	1.0
Hybrid striped bass	8	<b>0.767</b>	<b>1.10</b>	<b>0.8</b>
Largemouth bass	329	0.589	0.84	1.1
Largemouth bass < 16"	152	0.472	0.67	1.4
Largemouth bass > 16"	177	<b>0.702</b>	<b>1.00</b>	<b>0.9</b>
Smallmouth buffalo	42	0.404	0.58	1.6
Spotted bass	32	0.508	0.73	1.3
Spotted bass < 14"	21	0.373	0.53	1.7
Spotted bass > 14"	11	<b>0.805</b>	<b>1.15</b>	<b>0.8</b>
Sunfish	57	0.248	0.35	2.6
White bass	80	0.501	0.72	1.3

<sup>7</sup> DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.

<sup>8</sup> Emboldened numbers denote that the HQ for mercury is  $\geq 1.0$ .

<sup>9</sup> Emboldened numbers denote that the calculated allowable meals for an adult are  $\leq$  one meal per week.

**Table 4. PCDDs/PCDFs toxicity equivalent (TEQ) concentrations (ng/kg) in select fishes collected from the Neches River Basin, 2007–2011.**

Species	# Detected / # Sampled	Mean Concentration ± S.D. (Min-Max)	Health Assessment Comparison Value (ng/kg)	Basis for Comparison Value
Flathead catfish	27/34	1.980±4.014 (ND-16.240)	2.33	ATSDR chronic oral MRL: $1.0 \times 10^{-9}$ mg/kg/day  EPA slope factor: $1.56 \times 10^5$ per mg/kg/day
Longnose gar	16/21	1.485±2.472 (ND-7.215)	3.49	
Smallmouth buffalo	17/17	<b>4.240</b> ±6.790 (0.003-21.162)		

**Table 5. Hazard quotients (HQs) and hazard indices (HIs) for PCBs (mg/kg) and/or PCDDs/PCDFs (ng/kg) in select fishes collected from the Neches River Basin, 2007–2011 assuming exposure equivalent to the arithmetic mean PCB and PCDD/PCDF concentrations. Table 5 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults.<sup>10</sup>**

Contaminant/Species	Number (N)	Mean	Hazard Quotient	Meals per Week
<b>Flathead catfish</b>				
PCBs	15	0.020	0.44	2.1
PCDDs/PCDFs	34	1.980	0.85	1.1
<b>Hazard Index (meals per week)</b>			<b>1.29<sup>11</sup></b>	<b>0.7<sup>12</sup></b>
<b>Longnose gar</b>				
PCBs	10	0.036	0.78	1.2
PCDDs/PCDFs	21	1.485	0.64	1.5
<b>Hazard Index (meals per week)</b>			<b>1.41</b>	<b>0.7</b>
<b>Smallmouth buffalo</b>				
PCBs	6	0.033	0.71	1.3
PCDDs/PCDFs	17	<b>4.240</b>	<b>1.82</b>	<b>0.5</b>
<b>Hazard Index (meals per week)</b>			<b>2.53</b>	<b>0.4</b>

<sup>10</sup> DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.

<sup>11</sup> Emboldened numbers denote that the HQ or HI is  $\geq 1.0$ .

<sup>12</sup> Emboldened numbers denote that the calculated allowable meals for an adult are  $\leq$  one meal per week.

Table 6. Hazard quotients (HQs) and hazard indices (HIs) for PCBs (mg/kg) and/or PCDDs/PCDFs (ng/kg) in select fishes collected from the Neches River Basin, 2007–2011 assuming exposure equivalent to the 95% UCLAM PCB and PCDD/PCDF concentrations. Table 6 also provides suggested weekly eight-ounce meal consumption rates for 70-kg adults. <sup>13</sup>				
Contaminant/Species	Number (N)	95% UCLAM	Hazard Quotient	Meals per Week
<b>Flathead catfish</b>				
PCBs	15	0.029	0.63	1.5
PCDDs/PCDFs	34	<b>3.381</b>	<b>1.45<sup>14</sup></b>	<b>0.6<sup>15</sup></b>
Hazard Index (meals per week)			<b>2.08</b>	<b>0.4</b>
<b>Longnose gar</b>				
PCBs	10	<b>0.064</b>	<b>1.38</b>	<b>0.7</b>
PCDDs/PCDFs	21	<b>2.610</b>	<b>1.12</b>	<b>0.8</b>
Hazard Index (meals per week)			<b>2.50</b>	<b>0.4</b>
<b>Smallmouth buffalo</b>				
PCBs	6	<b>0.059</b>	<b>1.27</b>	<b>0.7</b>
PCDDs/PCDFs	17	<b>7.731</b>	<b>3.31</b>	<b>0.3</b>
Hazard Index (meals per week)			<b>4.58</b>	<b>0.2</b>

<sup>13</sup> DSHS assumes that children under 12 years of age and/or those that weigh less than 35 kg eat four-ounce meals.

<sup>14</sup> Emboldened numbers denote that the HQ or HI is  $\geq 1.0$ .

<sup>15</sup> Emboldened numbers denote that the calculated allowable meals for an adult are  $\leq$  one meal per week.

<b>Table 7. Calculated theoretical lifetime excess cumulative cancer risk from consuming select fishes collected in 2007–2011 from the Neches River Basin containing PCBs and PCDDs/PCDFs and the suggested consumption rate (eight-ounce meals/week) for 70 kg adults who regularly eat fish from the Neches River Basin over a 30-year period.<sup>16</sup> Theoretical lifetime excess cumulative cancer risks calculated using the arithmetic mean.</b>				
Species/Contaminant	Number (N)	Theoretical Lifetime Excess Cancer Risk		Meals per Week
		Risk	1 excess cancer per number of people exposed	
<b>Flathead catfish</b>				
PCBs	15	7.5E-06	133,410	12.3
PCDDs/PCDFs	34	5.7E-05	17,626	1.6
<b>Cumulative Cancer Risk</b>		6.4E-05	15,569	1.4
<b>Longnose gar</b>				
PCBs	10	1.3E-05	74,978	6.9
PCDDs/PCDFs	21	4.3E-05	23,502	2.2
<b>Cumulative Cancer Risk</b>		5.6E-05	17,893	1.7
<b>Smallmouth buffalo</b>				
PCBs	6	1.2E-05	82,399	7.6
PCDDs/PCDFs	17	<b>1.2E-04<sup>17</sup></b>	<b>8,231</b>	<b>0.8<sup>18</sup></b>
<b>Cumulative Cancer Risk</b>		<b>1.3E-04</b>	<b>7,484</b>	<b>0.7</b>

<sup>16</sup> DSHS assumes that children under 12 years of age and/or those who weigh less than 35 kg eat 4-ounce meals.

<sup>17</sup> Emboldened numbers denote calculated excess lifetime cancer risk after 30 years exposure is greater than 1.0E-04.

<sup>18</sup> Emboldened numbers denote that the calculated allowable meals for an adult are  $\leq$  one meal per week.



<b>Table 8. Calculated theoretical lifetime excess cumulative cancer risk from consuming select fishes collected in 2007–2011 from the Neches River Basin containing PCBs and PCDDs/PCDFs and the suggested consumption rate (eight-ounce meals/week) for 70 kg adults who regularly eat fish from the Neches River Basin over a 30-year period.<sup>19</sup> Theoretical lifetime excess cumulative cancer risks calculated using the 95% UCLAM.</b>				
Species/Contaminant	Number (N)	Theoretical Lifetime Excess Cancer Risk		Meals per Week
		Risk	1 excess cancer per number of people exposed	
<b>Flathead catfish</b>				
PCBs	15	1.1E-05	93,029	8.6
PCDDs/PCDFs	30	<b>1.1E-04<sup>20</sup></b>	<b>9,158</b>	<b>0.8<sup>21</sup></b>
<b>Cumulative Cancer Risk</b>		<b>1.2E-04</b>	<b>8,337</b>	<b>0.8</b>
<b>Longnose gar</b>				
PCBs	10	2.4E-05	42,241	3.9
PCDDs/PCDFs	21	7.5E-05	13,372	1.2
<b>Cumulative Cancer Risk</b>		<b>9.8E-05</b>	<b>10,157</b>	<b>0.9</b>
<b>Smallmouth buffalo</b>				
PCBs	6	2.2E-05	45,904	4.2
PCDDs/PCDFs	17	<b>2.2E-04</b>	<b>4,514</b>	<b>0.4</b>
<b>Cumulative Cancer Risk</b>		<b>2.4E-04</b>	<b>4,110</b>	<b>0.4</b>

<sup>19</sup> DSHS assumes that children under 12 years of age and/or those who weigh less than 35 kg eat 4-ounce meals.

<sup>20</sup> Emboldened numbers denote calculated excess lifetime cancer risk after 30 years exposure is greater than 1.0E-04.

<sup>21</sup> Emboldened numbers denote that the calculated allowable meals for an adult are  $\leq$  one meal per week.