Letter Health Consultation

Offsite Fish Sample Review near the American Creosote Superfund Site

DeRidder, Louisiana

Prepared by the

Louisiana Department of Health
Section of Environmental Epidemiology and Toxicology

Non-Certified

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

LETTER HEALTH CONSULTATION

AMERICAN CREOSOTE SITE, DERIDDER

BEAUEGARD PARISH, LOUISIANA

EPA FACILITY ID: LAN000604293

May 4, 2021

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

John Bel Edwards
GOVERNOR

Dr. Courtney N. Phillips
SECRETARY

State of Louisiana
Louisiana Department of Health
Office of Public Health

Michael Hebert, Remedial Project Manager
U.S. Environmental Protection Agency, Region 6
1201 Elm Street, Suite 500
Dallas, Texas 75270-2102

Subject: Review of offsite data collected near American Creosote, DeRidder, LA.

Dear Michael Hebert,

The Louisiana Department of Health/Office of Public Health/Section of Environmental Epidemiology and Toxicology (DHH/OPH/SEET) has evaluated the Phase 1 and Phase 2 fish samples collected as part of the Remedial Investigation by the Environmental Protection Agency (EPA) from the area surrounding the American Creosote DeRidder Site in Beauregard Parish, Louisiana. The following letter provides the results of SEET's assessment of the fish samples.

Background

American Creosote is a 55-acre tract of land, south of the City of DeRidder in Beauregard Parish, Louisiana. Historically, the site was owned by the Shreveport Creosoting Company that operated a creosote timber treatment facility from the early 1920s to 1945. There are reports that other wood treatment operations continued onsite until 1956 or 1957. The property was dormant until its purchase by the Central Manufacturing Company in September 1992. The site has five identified source areas of contamination: a concrete structure of a former retort house, a concrete foundation of a former vat, an unlined wastewater pit, aggregated areas of contaminated soil, and a pile of creosote solids[1] (see **Figure 1**). Analyses of sediment, soil, and surface water performed on samples from the surrounding wetlands, the unnamed drainage ditch/stream that flows from onsite to offsite, and the attached tributaries shows contamination of polycyclic aromatic hydrocarbons (PAHs) and metals.[2]

Currently, the areas surrounding the site are residential, industrial, and commercial. The site is bordered to the north by a rural road, to the east by heavy brush, to the south by undeveloped land, and to the west by the Timber Rock Railway spur (formerly owned by BNSF). Hardened creosote has formed sections of asphaltic surficial patches along the BNSF railroad right of way (ROW) from the center of the track and stretches until it reaches an intermittent stream that passes below the railroad spur from east to west. This intermittent stream then flows into an unnamed pond to the southwest and then to the contiguous wetland area, eventually reaching Palmetto Creek which is accessible by the public.[3] The southeastern portion of the site drains into a private pond that is next to a neighborhood. The northern edge of this pond has hardened creosote following the surface water drainage pathway from the site. Due to the concern of the residents, the EPA collected fish

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

samples from the southeast pond, from Palmetto Creek to the south, and from another private pond about 0.5-mile south of American Creosote (see **Figure 2**).[1, 2]

The 2013-2017 American Community Survey (ACS) estimated population within a one-mile radius of American Creosote is about 1,598. Fifty percent of the population is white, 47% is black, 1% is Native American, and 1% reported being of two or more races. Of the total population, 56% percent is male and 44% is female. Seventy-six percent of the population is 18 or older and 24% percent is between the ages of zero – 17 years of age.[4]

The American Creosote site is fenced off with "no trespassing" signage, preventing exposure to contaminants onsite.[5] The surface water pathways that flow offsite from American Creosote into the contiguous wetlands and surrounding residential ponds provide a potential exposure pathway if fish were to be consumed from these water bodies. **Figure 2** shows the fish sample locations from private ponds and Palmetto Creek.

Discussion

Fish tissue samples were screened using the Louisiana Fish Advisory Program's Tissue Screening Levels (TSLs) and the Environmental Protection Agency's Fish Tissue Residential Screening Levels (RSLs). LDH calculated TSLs for contaminants that were above the EPA fish tissue RSLs. Contaminants exceeding TSLs do not mean a health threat is present but require further evaluation. The Section of Environmental Epidemiology and Toxicology (SEET) follows the Louisiana Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish.[6] SEET calculated TSLs for contaminants that did not have a published TSL following the Tissue Screening Level Guidelines for Issuance of Public Health Advisories for Selected Contaminants (see Appendix A).[7] If a contaminant had toxicity values for both carcinogenic and non-carcinogenic health effects, TSLs were calculated for both and the more conservative value was chosen.[6] **The primary goal of the state recreational fish advisory program is to develop advisories to inform the public about the potential hazards involved in regularly eating fish and shellfish caught from publicly accessible waterbodies. It is important to note that the majority of the fish samples examined in this assessment were collected on private property. The assessment assumes weekly consumption of fish from these areas over a period of 30 years. The protocol requires that default assumptions of exposure be used if site-specific exposure information is not available.[6] It is unclear whether these private ponds contain enough edible sized fish to support the default exposure assumptions.**

Table 1 summarizes the fish tissue sampling results and the screening levels used to assess them. A total of twelve fish that were a minimum of 12 inches in length were sampled and analyzed for polycyclic aromatic hydrocarbons (PAHs), semi-volatile organic compounds (SVOCs), pesticides, and metals (see **Figure 2**).[3] Phase 1 included 4 bass, 3 catfish and 1 bluegill collected on November 5, 2019. Seven of these fish samples were collected from the private ponds on the east offsite area (EOA); one sample was collected from Palmetto Creek to the south. Phase 2 sampling included 4 bass collected from a private pond 0.5 mile to the south of American Creosote.

Phase 1 results found mercury concentrations in the east offsite area ponds that were above the TSL in all bass samples. Mercury concentrations in catfish and bluegill collected from the east offsite area ponds were far below the mercury screening level. The one bass sample collected from Palmetto Creek was also above the mercury TSL. Mercury is a naturally occurring element in the environment that is released through natural processes and human activities. As a result, there are trace amounts of mercury throughout waterbodies which are transformed by bacteria into methylmercury, a form very harmful to developing fetuses or young children. Larger fish, usually in higher trophic levels that feed on other fish, tend to accumulate more methylmercury than smaller fish.[8] Currently, there is no indication of any mercury source at the American Creosote Works site.[9] Historical activities at the site that would be directly responsible for release of mercury into the environment have not been identified.[9]

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

Arsenic was also detected in all samples. Arsenic speciation was not conducted as part of the laboratory analyses, preventing the evaluation of health risks related to inorganic arsenic portions. Over 90% of arsenic found in edible seafood tissue is present in the non-toxic organic form and is removed by the body. Studies have found that organic arsenic in seafood does not present health risks.[10]

Recommended meal limits due to elevated mercury levels in bass are based on non-carcinogenic health risks. If the EOA ponds were considered a public water body, LDH would recommend that no more than 3 meals of bass per month from this pond should be consumed by the general population and children over seven and no more than one meal of bass per month for women of child bearing age and children under the age of seven (**Table 2**). The EPA's Human Health Risk Assessment concluded that the EOA ponds are not large enough to support one meal per week. Therefore, the recommendations made for this pond in this assessment are likely overprotective.[11] The one bass sample collected from Palmetto Creek exceeded the mercury TSL, but the sample size is too small to provide thorough insight into mercury's presence in fish for this water body.

In Phase 2, four additional bass samples were collected on April 29, 2020 from a pond 0.5-mile south of American Creosote between Butler and Crosby Road (see **Figure 2 and Table 1**). Contaminants that exceeded screening levels were mercury and n-Nitrosodimethylamine (NDMA) in all four bass samples.

All of the NDMA detections qualified as "J" or estimated values. Out of an abundance of caution, Lifetime Excess Cancer Risk (LECR) was calculated based on the maximum detected concentration of NDMA assuming a weekly exposure for 30 years averaged over a lifetime. This cancer risk is an estimate of the incremental probability of an individual developing cancer over a lifetime as a result of an exposure to a potential carcinogen.[6] The calculated lifetime cancer risk of NDMA in bass (2.3E-03) collected from the southern pond was greater than the EPA's acceptable cancer risk range of 10^{-6} to 10^{-4}, the probability of the general population contracting cancer in a lifetime (**Table 4**). The southern pond's owner has reported that he does not consume fish from his pond, which means that the exposure pathway for mercury and NDMA are incomplete. However, these levels are a concern should fish be consumed from the pond in the future. Mercury results for the southern pond are shown in **Table 2** with consumption limit recommendations. The levels of NDMA in bass would necessitate a recommendation for "no consumption" for both the sensitive group and general population of fish from this private pond (**Table 3-1**).

NDMA and n- Nitrosodi-n-propylamine Considerations

N-Nitrosodimethylamine (NDMA) was not analyzed in Phase 1 samples. Historically, NDMA was used to create rocket fuel but was banned due to dangerous levels occurring in the environment outside of many industrial sites. NDMA is classified as a B2 probable carcinogen.[12, 18] The primary human exposure route is through ingestion.[13]

N-Nitrosodi-n-propylamine was also detected in one bass sample in the southern pond but was below the LDH TSL. It is also classified as B2 probable carcinogen and its effects on humans are not well studied. [15, 17] It is a man-made chemical that is produced during some manufacturing processes, present in some weed killers, and can also form in the stomach during digestion of nitrite-treated foods such as cheeses and cured meats. Routes of exposure are primarily through ingestion, or breathing in vapors near a waste disposal site.[15]

NDMA and n-Nitrosodi-n-propylamine are not site-related contaminants and therefore will not be addressed by the EPA under CERCLA. The source of the NDMA is unknown at this time.

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

Conclusions

- Mercury levels found in bass collected from the EOA ponds and Palmetto Creek pose potential health concerns.
- Mercury was detected in bass at levels of potential health concern and n-Nitrosodimethylamine was detected at levels that are a health concern in the southern pond. This is an incomplete exposure pathway as the owner reported that he does not consume fish from his pond.
- NDMA and n-Nitrosodi-n-propylamine are not related to activities at the American Creosote DeRidder NPL site and were not included in the analysis of fish sampled during the Phase 1 Remedial Investigation.[11]
- The resident of the EOA ponds stocks his fish, which could indicate the mercury levels are from the waterbody the fish previously inhabited.

Recommendations

- LDH recommends additional sampling of fishable waterbodies that receive surface water run-off from the American Creosote DeRidder site, if further findings conclude there is site-related mercury contamination.
- LDH recommends the owners continue to refrain from consuming fish from the southern pond.
- LDH recommends that if bass are consumed from the east offsite area ponds, no more than three meals per month of bass is recommended for adults and children over seven due to elevated mercury levels.
- Women of childbearing age and children less than seven are recommended to not consume more than one bass meal per month from the EOA ponds due to elevated mercury levels.

LDH encourages anyone with concerns or questions to contact the Section of Environmental Epidemiology and Toxicology at 1 – (888)-293-7020 or online at http://ldh.la.gov/index.cfm/subhome/22.

Sincerely,

Chelsea Bourgeois

Chelsea Bourgeois, MPH
Health Risk Assessor
LDH/Office of Public Health

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

References

1. Environmental Protection Agency. June 2020. *Data Evaluation Technical Memorandum Phase 1 Field Activities. American Creosote DeRidder Superfund Site Remedial Investigation DeRidder, Beauregard Parish, LA.* Available at URL: https://edms.deq.louisiana.gov/app/doc/view.aspx?doc=12204953&ob=yes&child=yes . Accessed November 2020.

2. Environmental Protection Agency. July 2017. *HRS Document Record Cover Sheet*. Available at URL: https://edms.deq.louisiana.gov/app/doc/view.aspx?doc=11592400&ob=yes&child=yes. Accessed November 2020.

3. Environmental Protection Agency. October 2020. *Data Evaluation Technical Memorandum Phase 2 Field Activities. American Creosote DeRidder Superfund Site Remedial Investigation DeRidder, Beauregard Parish, LA.*

4. United States Environmental Protection Agency. 2013-2017. EJScreen. *American Community Survey*. Available at Accessed November 2020.

5. Environmental Protections Agency. *POLREP #1 – Removal Action American Creosote DeRidder A6KM DeRidder, LA.* March 2020. Available at URL: https://edms.deq.louisiana.gov/app/doc/view.aspx?doc=12151105&ob=yes&child=yes. Accessed November 2020.

6. Louisiana Department of Health, Louisiana Department of Environmental Quality. 2012. *Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish.* Accessed November 2020.

7. LDEQ, LDH, LDWF, LDAF. March 2012. *Tissue Screening Level Guidelines for Issuance of Public Health Advisories for Selected Contaminants and Supporting Documentation.* URL: https://deq.louisiana.gov/assets/docs/Water/Fish_Swim_Advisories/TSL_Documentation_March_2012.pdf. Accessed November 2020.

8. Agency for Toxic Substances and Disease Registry. April 1999. *Toxic Substances Portal-Mercury*. Available at: https://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=113&tid=24. Accessed December 2020.

9. EA, Engineering, Science, and Technology, Inc. April 2021. *Remedial Investigation Report, Revision 01 American Creosote, DeRidder Superfund Site Remedial Investigation EPA Region 6 Remedial Action Contract 2.* Accessed May 2021.

10. Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Arsenic. *Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.* Accessed December 2020.

11. EA, Engineering, Science, and Technology, Inc. April 2021. *Human Health Risk Assessment Revision 01 American Creosote, DeRidder Superfund Site Remedial Investigation EPA Region 6Remedial Action Contract 2.* Accessed May 2021.

12. Agency for Toxic Substances and Disease Registry. August 2020. *Public Health Site Assessment Tool. CVs and Health Guidelines. Nitrosodimethylamine, n-.* Available at:

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

https://csams.cdc.gov/PHAST/HealthGuidelines/Contaminant?CASRN=62-75-9&ID=40 Accessed November 2020.

13. EPA. *Technical Fact Sheet N-Nitroso-dimethylamine (NDMA).* November 2017. Available at: https://www.epa.gov/sites/production/files/2017-10/documents/ndma_fact_sheet_update_9-15-17_508.pdf. Accessed November 2020.

14. ATSDR. *Toxic Substances Portal – n – Nitrosodimethylamine. December 1989. Public Health Statement for N-Nitrosodimethylamine.* Available at: https://www.atsdr.cdc.gov/phs/phs.asp?id=882&tid=173. Accessed November 2020.

15. Agency for Toxic Substances and Disease Registry. *Public Health Statement n-Nitrosodi-propylamine CAS# 7440-07-45*. Available at: https://www.atsdr.cdc.gov/ToxProfiles/tp142-c1-b.pdf. Accessed November 2020.

16. EPA. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories Volume 1(2018).* Accessed November 2020.

17. U.S. EPA Integrated Risk Information System. *N-nitrosodi-n-propylamine. Chemical Information Summary. (1987)* Available at: https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/0177_summary.pdf#nameddest=rfd. Accessed November 2020.

18. U.S. EPA Integrated Risk Information System. *N-nitrosodimethylamine. Chemical Information Summary. (1987)* Available at: https://cfpub.epa.gov/ncea/iris2/chemicalLanding.cfm?substance_nmbr=45. Accessed November 2020.

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

Tables

TABLE 1: Mercury and NDMA Screening Results

Species	Remedial Investigation Phases	Location Description	Sample ID	Mercury (mg/kg)	NDMA (µg/kg)	Q
Bass	Phase 1	East Offsite Area Pond	EOAB-BASS-01-W	**0.322**	NA	
			EOAB-BASS-02-W	**1.030**	NA	
			EOAB-BASS-03-W	**0.963**	NA	
			Average	**0.772**		
		Palmetto Creek	EOAMC-BASS-01-W	**0.560**	NA	
			Average	**0.560**		
	Phase 2	Southern pond	EOAMP-BASS-01-W	**0.326**	**55**	J
			EOAMP-BASS-02-W	**0.339**	**250**	J
			EOAMP-BASS-03-W	**0.366**	**25**	J
			EOAMP-BASS-04-W***	**0.304**	**32.5**	J
			Average	**0.334**	**90.63**	
Catfish	Phase 1	East Offsite Area Pond	EOAB-CAT-01-W***	0.083	NA	
			EOAB-CAT-02-W	0.013	NA	
			EOAB-CAT-03-W	0.014	NA	
			Average	0.036	NA	
Bluegill	Phase 1		EOAB-GIL-01-W	0.019	NA	
			Average	0.019		
			Screening Levels:	LDH Tissue Screening Levels	**0.23**	**11**

Louisiana Department of Health (LDH) Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish (May 2011).

Values exceeding the LDH TSLs are boldfaced.

J = Estimated value.

NA = not analyzed

mg/kg = Milligram(s) per kilogram.

µg/kg = micrograms per kilogram

TSL = Tissue Screening Level

***= Sample and duplicate were averaged.

Q = Qualifier

NDMA = N-nitrosodimethlylamine

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

TABLE 2: Mercury Results - Non-carcinogen Calculations

Exposure Unit	Species	Receptor	RfD or MRL (mg/kg-day)	BW (kg)	C (mg/kg)	CR (kg/day)	T (days per month)	MS (kg/meal)	ML* (meals/month)	Recommended Limit
EOA Pond	Bass	Adults & Children over 7	0.0003	70	0.77	0.027	30.44	0.227	3.66	No more than 3 meals/month
		WCBA & Children less than 7	0.0001	35	0.77	0.005	30.44	0.1135	1.22	No more than 1 meal per month
	Catfish	Adults & Children over 7	0.0003	70	0.036	0.583	30.44	0.227	78.22	No limit
		WCBA & Children less than 7	0.0001	35	0.036	0.097	30.44	0.1135	26.07	No limit
	Bluegill	Adults & Children over 7	0.0003	70	0.019	1.105	30.44	0.227	148.20	No limit
		WCBA & Children less than 7	0.0001	35	0.019	0.184	30.44	0.1135	49.40	No limit
Palmetto Creek	Bass	Adults & Children over 7	0.0003	70	0.56	0.038	30.44	0.227	5.03	No limit
		WCBA & Children less than 7	0.0001	35	0.56	0.006	30.44	0.1135	1.68	No more than 1 meal per month
Southern Pond	Bass	Adults & Children over 7	0.0003	70	0.33	0.064	30.44	0.227	8.53	No limit
		WCBA & Children less than 7	0.0001	35	0.33	0.011	30.44	0.1135	2.84	No more than 2 meals per month

RfD = Reference Dose used for WCBA and children less than seven since it takes into account vulnerable populations.
MRL = Minimal Risk Level is used for the general population.
BW = Body Weight
C = Species average chemical concentration
CR = Consumption Rate
T = Time-averageing period (= 365.25days/12 months)

MS = Meal Size
ML = Meal Limit
mg/kg-day = milligrams per kilogram per day
kg/day = kilograms per day
kg/meal = kilograms per meal
WCBA = women of childbearing age
EOA pond = East Offsite Area Pond

Equation 2:
ML = (CR x T)/ MS

Equation 4:
CR = (RfD or MRL x BW) / C

*Fractional MLs are rounded down to not exceed the maxium acceptable cancer risk or non-cancer risk hazard quotient to ensure public health is adequatley protected.(1)

(1) Louisiana Department of Health (LDH) Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish (May 2011).

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

TABLE 3

NDMA - Carcinogen Calculations									
Carcinogenic Health Effects for a Single Contaminant in Daily Consumption of Fish									
Exposure Unit	**Species**	**Receptor**	**R (unitless)**	**BW (kg)**	**AT (years)**	**CSF (mg/kg-day-1)**	**C (mg/kg)**	**ED (years)**	**CR (kg/day)**
Southern Pond	Bass	Adults	0.0001	70	70	51	0.09063	30	0.0035

R = Maximum acceptable lifetime risk
BW = Body Weight
AT = Averaging Time
CSF = Cancer Slope Factor
C= Average species concentration
ED = estimated duration

CR = Consumption Rate
mg/kg-day = milligrams per kilogram per day
kg/day = kilograms per day
kg/meal = kilograms per meal

Equation 1:
CR = (R x BW x AT) / (CSF x C x ED)

TABLE 3-1

Allowable Montlhy Meal Limit based on the Consumption Rate of NDMA						
Exposure Unit	**Species**	**Receptor**	**CR (kg/day)**	**T (days per month)**	**MS (kg/meal)**	**Meal Limit* (meals/month)**
Southern Pond	Bass	Adults	0.0035	30.44	0.227	0.47

T = Time-averageing period (= 365.25days/12 months)
MS = Meal Size
ML = Meal Limit
mg/kg-day = milligrams per kilogram per day
kg/day = kilograms per day
kg/meal = kilograms per meal

Equation 2:
ML = (CR x T)/MS
*Fractional MLs are rounded doen to not exceed the maximum acceptable cancer risk or non-cancer risk hazard quotient to ensure public health is equally protected (1).

(1) Louisiana Department of Health (LDH) Protocol for Issuing Public Health Advisories for Chemical Contaminants in Recreationally Caught Fish and Shellfish (May 2011).

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

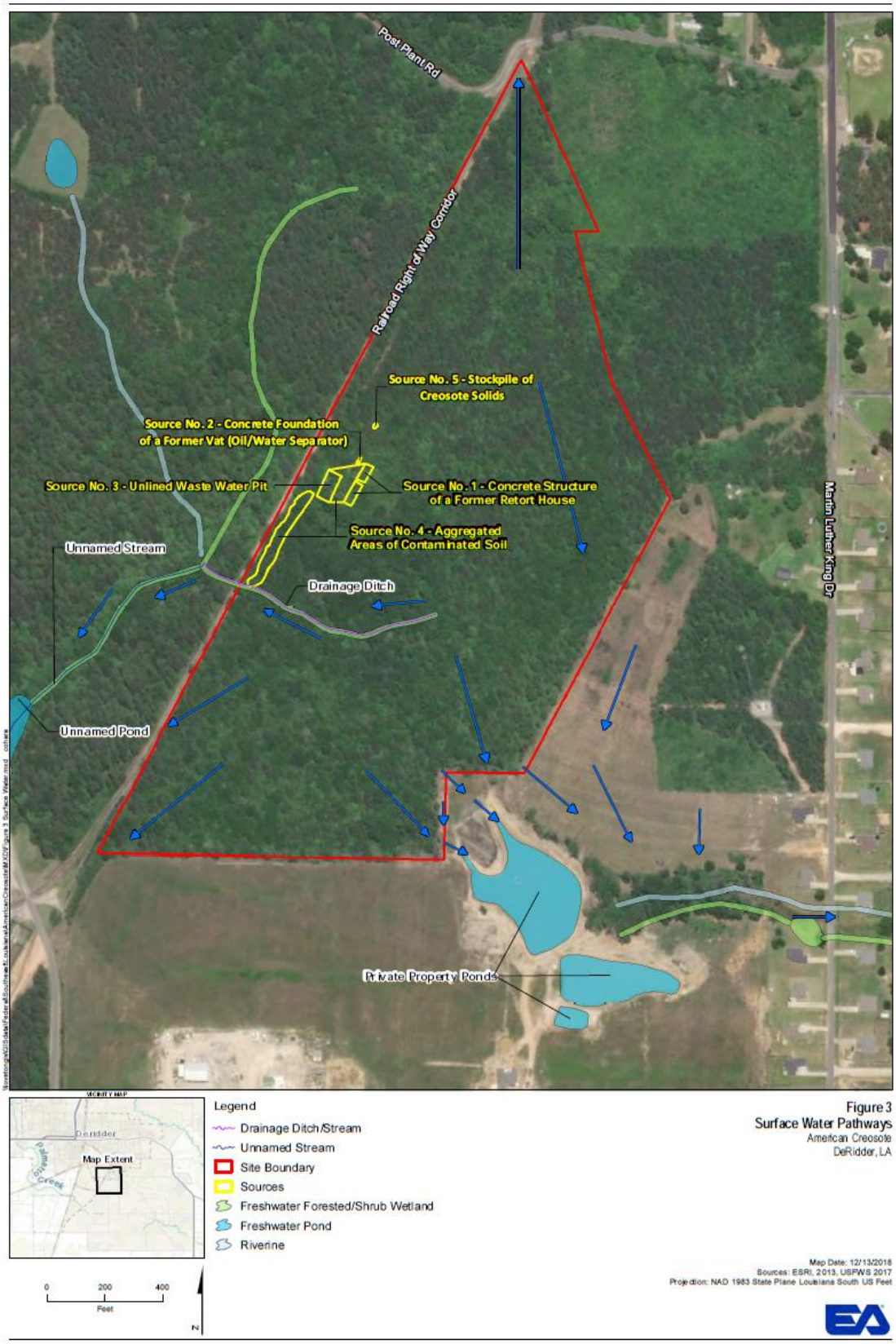
TABLE 4

Phase 2- Lifetime Excess Cancer Risk									
Exposure Unit - Southern Pond - Bass									
Contaminant		**Max_C**	**IR**	**CF**	**EF**	**BW**	**ID fish**	**CSF**	**LECR**
	Units	(mg/kg)	(mg/day)	(kg/mg)	unitless	(kg)	(mg/kg-day)	(mg/kg-day)	
NDMA	mg/kg	0.25	30000	1.00E-06	0.42	70	0.000045	51	**2.3E-03**

Shaded cells indicate a lifetime excess cancer risk greater than one per 10,000 people.	Max_C = Maximum concentration
NDMA = n-Nitrosodimethylamine	IR = Intake rate
mg/kg = milligrams per kilogram	EF = Exposure factor (30 years/70 years) = 0.42
kg = kilogram	BW = Body weight
mg/kg-day = milligrams per kilogram per day	CF= Conversion Factor
LECR = Lifetime Excess Cancer Risk	ID Fish = Adult fish ingestion dose
Adult LECR = 30 years	CSF = Cancer slope factor

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

Figure 1. Historical Source Areas and Surface Water Pathway



Non-Certified

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

Figure 2. Phase 1 and Phase 2 Remedial Investigation Fish Sampling Locations

Non-Certified

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

Appendix A.

Carcinogenic TSLs are calculated as follows:

$$\text{Carcinogenic TSL} = \frac{\text{TR x BW x AT x 365 days/year}}{\text{EF x ED (CSF x IRF)}}$$

Where:

Parameter	Definition (units)	Input Value
TSL	Tissue Screening Level (mg/kg)	Chemical Specific
TR	Target cancer risk	0.0004
BW	Body Weight (kg)	70
AT	Averaging Time (years)	70
EF	Exposure Factor (days/year)	365
ED	Exposure duration (years)	30
CSF	Cancer Slope Factor (risk per mg/kg-day)	Chemical Specific
IRF	Fish Ingestion Rate (kg/day)	0.03
N-Nitrosodimethylamine	CSF (per mg/kg-day)	51

Adult Lifetime Excess Risk Cancer Calculations

The adult fish ingestion dose can be estimated as follows:

$$ID_s = [(C)\ (IR)\ (CF)\ (EF)/BW)]$$

Where:
ID_s = Adult fish ingestion dose (mg/kg/day)
C = Contaminant concentration (mg/kg)
IR = Adult fish intake rate (mg/day)
EF = Exposure Factor (unitless) = (exposure frequency)(exposure duration)/(exposure time) =
[(1 days/week) (365 days/year) (30 years)] / [(70 years) (365 days/year)] = 0.42
BW = Adult body weight (kg)
CF= Conversion factor (10^{-6} kg/mg)

Variable	Value Used
C = Contaminant concentration	mg/kg
IR = Adult fish intake rate	30000 mg/day
CF = Conversion factor	10 -6 kg/mg
EF = Exposure factor (unitless)	0.42
BW = Adult body weight	70 kg
CSF = Cancer slope factor	51 mg/kg per day

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

The Lifetime Excess Cancer Risk (LECR) can be estimated as follows:

$$LECR = (ID_f)\ (CSF)\ (EF)$$

Where:
ID_f = Adult fish ingestion dose (mg/kg/day)
CSF = Cancer Slope Factor
EF=Exposure Factor (unitless) = (exposure frequency)(exposure duration)/(exposure time) =
[(1 days/week) (365 days/year) (30 years)] / [(70 years) (365 days/year)] = 0.42

Calculating Consumption Limits

First, the consumption rate (CR) is calculated for both non-carcinogenic contaminants and carcinogens separately. Then the CR is used to calculate a meal limit (ML).

Equation 1. Carcinogenic health effects for a single contaminant are calculated as presented below.

$$CR = (R * BW * AT)/ (CSF * C * ED)$$

Where:
R = Maximum acceptable lifetime risk ($1.00\ x10^{-4)}$
BW = Consumer Body Weight
AT = Averaging Time
CSF = Cancer Slope Factor
C = Species average of chemical concentration
ED = exposure duration

Equation 2. The below equation converts the maximum allowable CR derived from the above equations into the number of allowable meals:

$$ML = (CR * T)/ MS$$

Where:
ML = Meal limits
CR = Consumption Rate
T = Time-averaged period (365.25 days /12 months)

Equation 4. Non-Carcinogenic health effects for a single contaminant are calculated as follows:

$$CR = (RfD \text{ or } MRL * BW) / C$$

Where:
CR = Maximum allowable seafood Consumption Rate (kg/day)
RfD = Reference Dose (mg/kg-day) – accounts for vulnerable populations (women of childbearing age and children less than seven).
Minimal Risk Level (mg/kg-day) – used for the general population.

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.

BW= Consumer Body Weight (kg)
C = Species average chemical concentration (mg/kg or ppm) = arithmetic mean

This publication was made possible by Grant Number CDC-RFA-TS20-2001 from the Agency for Toxic Substances and Disease Registry. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Agency for Toxic Substances and Disease Registry, or the Department of Health and Human Services.