Regional Ambient Fish Tissue Program

2013-2014 Data Assessment Report

Nebraska Department of Environmental Quality

Water Quality Assessment Section

June, 2015

ACKNOWLEDGEMENTS

I would like to thank Sue Dempsey of the Nebraska Department of Health and Human Services (NDHHS) for her expertise and assistance in preparing this report. I would also like to acknowledge the staff members of the Nebraska Game and Parks Commission (NGPC) and the Nebraska Department of Environmental Quality (NDEQ) who assisted with field collection activities in 2013 and 2014.

I also want to acknowledge Deanna Collier of the United States Environmental Protection Agency (EPA) Region VII laboratory for her support of Nebraska's fish tissue monitoring and assessment efforts. The EPA provides most of the funding for the field collection activities and provides laboratory analysis of the fish tissue samples at no charge to the State of Nebraska.

If you have questions or concerns after reading this report, please contact me at (402) 471-4264 or greg.michl@nebraska.gov for assistance.

Greg Michl
Program Coordinator

TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

I. EXECUTIVE SUMMARY

The Nebraska Department of Environmental Quality (NDEQ) annually collects fish for tissue analyses as part of the U.S. Environmental Protection Agency's (EPA) "Regional Ambient Fish Tissue Monitoring" (RAFTM) program. The EPA's Region VII laboratory in Kansas City, Kansas conducts the chemical analyses of these tissue samples. Historically samples have been analyzed for four heavy metals, nine pesticides and their breakdown products and three polychlorinated biphenyl compounds (PCBs). In 2013, EPA informed the Region VII States that with the exception of mercury, future analysis for all other contaminants would be discontinued due to their declining trends and/or non-detects in fish tissue samples. Overall this is very positive environmental news for this region. While mercury continues to be the major pollutant of concern in fish tissue statewide, numerous locations remain under "fish consumption advisories" for PCBs. The NDEQ is committed to continue PCB monitoring at those locations using a contract laboratory.

The EPA's primary monitoring and assessment objectives for the RAFTM program are:

- Provide states with data to answer the question "are the fish safe to eat?"
- Provide states with data needed to assess risk to humans from consuming contaminated fish and to post consumption advisories.
- Measure long-term trends in regional contaminants (e.g., pesticides, metals, PCBs, etc.) and monitor for emerging contaminants of concern.

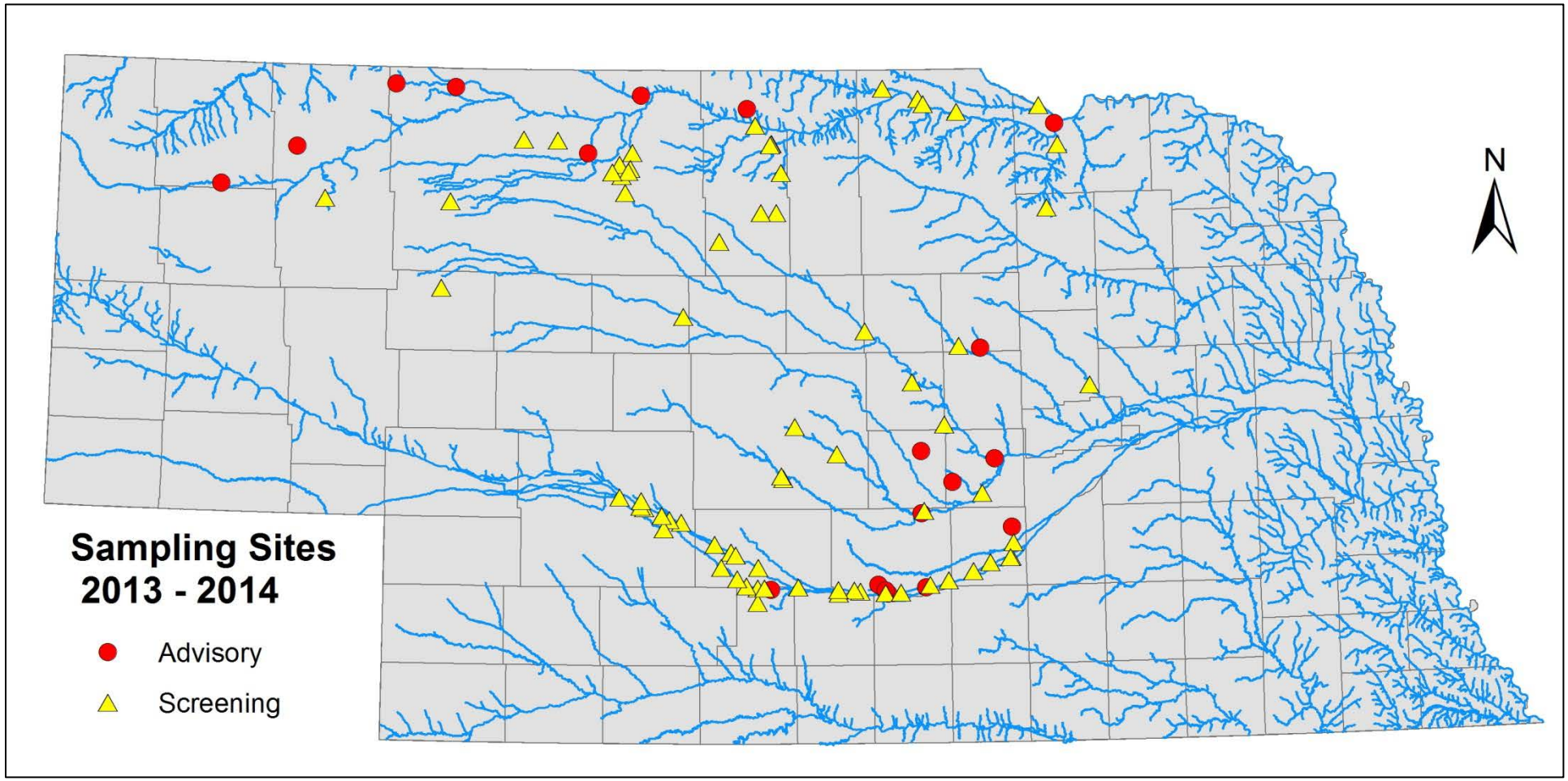
This report details the data assessment results for fish tissue samples collected in 2013 and 2014 throughout the Middle Platte, Loup, and Niobrara River basins. A total of 160 samples from 92 locations representing 11 different streams/rivers and 78 lakes/reservoirs were sampled in 2013 and 2014 (see Figure 1 and Methods Section for site descriptions).

Currently, Nebraska has 127 state-issued advisories. The primary contaminants of concern in fish in Nebraska and most other states continues to be mercury and PCBs. The EPA has issued a nationwide fish consumption advisory regarding mercury in all fish species. Women of child-bearing age and children under 15 years of age are the population most sensitive to the effects of mercury.

This report provides the public with an explanation of the State's fish tissue program. One of the primary goals of the program is to ensure the public has as much information as possible regarding the waterbodies that they use for fishing.

Because fish are a high quality protein, low in saturated fat, and high in omega-3 fatty acids food source, anglers should not be discouraged from consuming fish in moderation. In 2013, the Department of Health and Human Services (NDHHS) in cooperation with the Nebraska Game and Parks Commission (NGPC) and NDEQ jointly released an informational brochure on safely selecting and preparing locally caught, store bought and restaurant fish. For more information go to: www.nebraska.gov/eatsafefish .

Figure 1. Nebraska RAFTMP Monitoring Locations for 2013 and 2014 in the Middle Platte, Loup, and Niobrara River Basins.



II. INTRODUCTION

The "Regional Ambient Fish Tissue Program – 2013 and 2014 Data Assessment Report" is written to satisfy the federal fiscal year 2013-14 State of Nebraska-EPA Agreement, as well as provide information to other governmental agencies, professional organizations, and most importantly to the general public.

Fish tissue sampling in Nebraska was initiated in the late 1970s, primarily to identify potential pollution concerns throughout the State. Sampling consisted of collecting whole fish samples from major rivers at or near the bottom of their drainage area. In the late 1980s, along with the identification of pollutants, sampling was conducted to determine if there may be a public health concern. Fillet samples were then collected and analyzed as this is the portion of a fish that is most-often consumed. Waters heavily utilized by anglers were generally targeted.

It is important that anglers and others are informed of potential health risks associated with consuming contaminated fish from certain Nebraska waterbodies. Under the Region VII EPA Ambient Fish Tissue Monitoring Program (RAFTMP), the NDEQ, in association with its six-year rotating river basin monitoring approach (see Figure 2), collects fish from state waters annually. The Region VII EPA laboratory in Kansas City, Kansas, analyzes the NDEQ's fish samples to determine contaminant concentrations.

The EPA's stated objectives of the RAFTMP are:

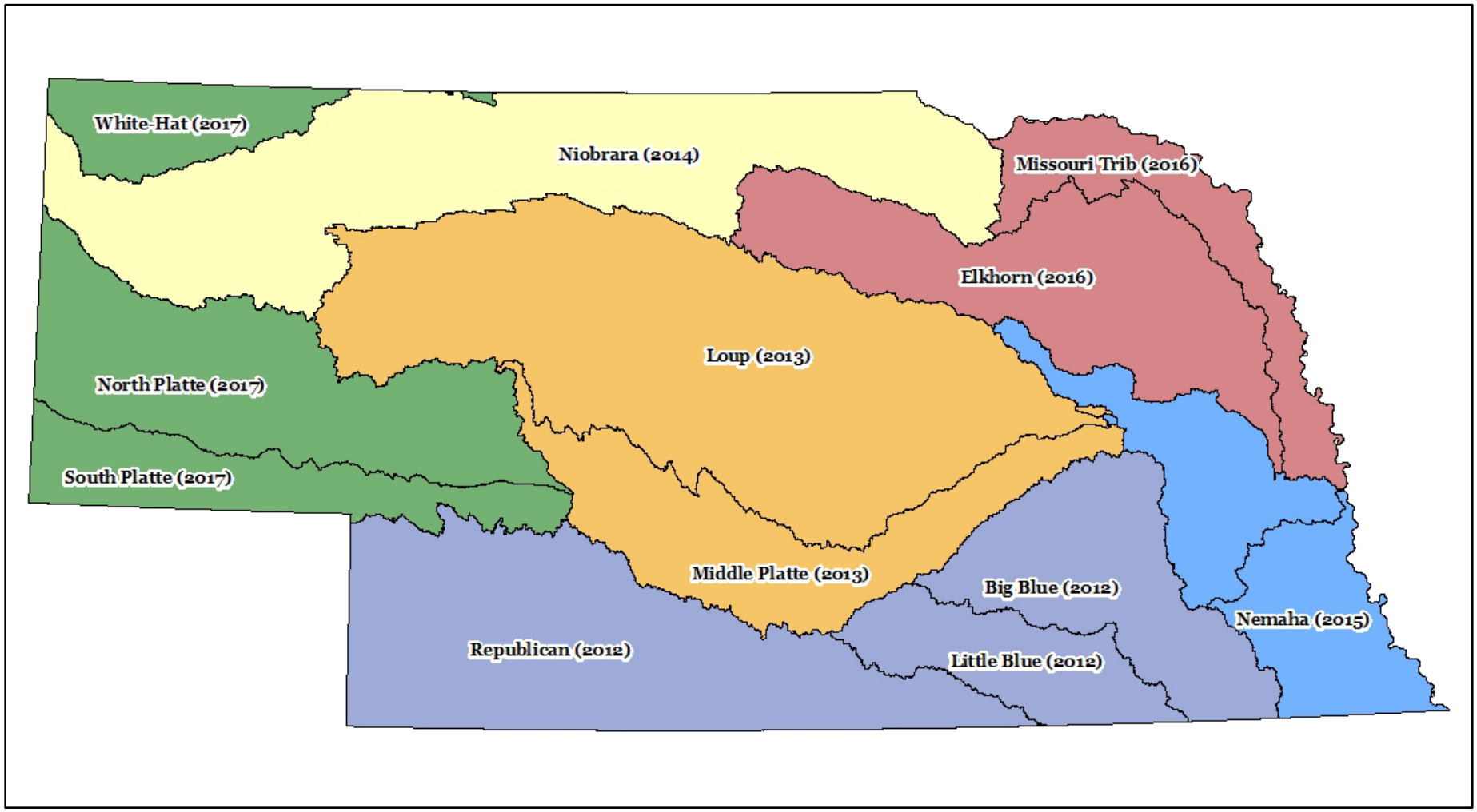
1. Provide states with data to answer the question "are the fish safe to eat?"
2. Provide states with data needed to assess risk to humans from consuming contaminated fish and to issue consumption advisories.
3. Measure long-term trends in regional contaminants (e.g., pesticides, metals, PCBs, etc.) and monitor for emerging contaminants of concern.

Waterbodies where RAFTMP sampling has revealed exceedances of health risk criteria and subsequent consumption advisories have been issued; are re-sampled following the rotating basin monitoring schedule. Re-sampled sites will be removed from the advisory list if their respective samples indicate contaminant levels below health risk criteria.

Currently the Nebraska Department of Health and Human Services (NDHHS), in cooperation with the NDEQ, the Nebraska Game and Parks commission (NGPC), and the Nebraska Department of Agriculture (NDA), issues fish consumption advisories for waterbodies where concentrations of contaminants may indicate a health risk for consumers. Using risk-based calculations, it is assumed that a consumer will ingest a weekly average of eight or more ounces of fish from the waterbody being assessed, every week for over 30 years. This very conservative approach is designed to not underestimate the risk and is referred to as a "reasonable maximum exposure duration" (EPA, 1991). The State issues advisories for mercury levels that equal or exceed 0.215 milligrams of mercury per kilogram of fish tissue, and for other contaminants when the cancer risk estimated equals or exceeds 0.0001 ($\geq$ 1 in 10,000) or when adverse noncancer health effects may be possible from ingesting fish. Although Nebraska does not issue fishing bans, advisories suggest that individuals consume less than an average of one, eight ounce meal of fish per week from identified waters.

While nearly every state in the U.S. has a monitoring program for fish tissue in place, differences exist in the way fish samples are analyzed and assessed between states. These differences create a lack of comparability between states and can cause confusion for people who enjoy fishing in their home state, shared waters, as well as in other states' waters.

Figure 2. Nebraska Fish Tissue Monitoring Program Schedule by River Basin.



For example, while one state may screen their fish samples for a particular set of contaminants, other states may analyze an entirely different group; and some states will analyze fish tissue only during years when adequate funding is available (EPA, 1999). Differences in parameter lists are generated as some contaminants have regional importance (pesticide usage based on cropping practices), while others (methylmercury) are of national interest. Contaminant lists are also formed based on the variety of industries and their use of chemicals within states. While differences are expected in the contaminant lists submitted for analyses from state to state, there is a strong possibility that several toxicants are overlooked by states due to their obscurity or due to a lack of funding for analytical support. Additionally, some contaminants (e.g. lead) lack reference dose information necessary to determine its toxic effects associated with consuming fish flesh, and assessments are rarely performed.

Like Nebraska, most states are utilizing a risk-based assessment (RBA) similar to that used by the EPA. In the assessment, in addition to determining if a contaminant poses a potential cancer risk, the potential for adverse health effects or noncarcinogenic effects are also assessed. For example, mercury is not considered to be a human carcinogen but exposure to high levels may be associated with adverse effects for the developing nervous system of young children or an unborn baby. Nebraska's "Policy for Issuing Nebraska Fish Consumption Advisories" (NDEQ, 2011) explains the rationale behind and the process employed to issue fish consumption advisories.

Risk assessments utilize standardized equations and estimated exposure parameters, such as ingestion rates and exposure durations, to quantify an individual's risk associated with exposure to a contaminant. These equations result in values that can be compared to published toxicity values generated from exposure studies in animals, and if available from epidemiological studies in humans. Below is the exposure parameters that Nebraska utilizes to estimate potential risk associated with ingestion of fish tissue.

Body Weight (BW) − is important because heavier individuals have the ability to assimilate more contaminants than individuals of smaller stature without experiencing adverse health effects. Therefore, children or adults of small stature are at greater risk when consuming fish at a similar rate as a larger individual. All states assume an overall average for consumer body weight when calculating risk - Nebraska utilizes 154 pounds (70 kg).

Ingestion Rate (IR) − fish ingestion rates of individuals in a population vary greatly and health risks increase with higher ingestion rates. The EPA has identified a value of eight ounces (0.227 kg) of fish fillet per 154 pound (70 kg) as an average weekly meal size for adults for the general populations (EPA, 2000). Nebraska utilizes the eight ounce average (0.227 kg).

Contaminant Absorption Factor (AF) − suggests how much of a contaminant, once ingested, is absorbed in the human body. Nebraska conservatively uses a factor of 1.0, reflecting complete absorption (i.e., no contaminant loss through storage, cooking, or excretion). Contaminant reduction factors are used by several states (including most Great Lakes States) to reduce PCB concentrations based on meal preparation procedures. All of the states that use reduction factors apply a 50% reduction for PCBs due to removal via filleting away fatty tissue and cooking in a way which allows fat to drip away from the flesh (i.e., grilling, broiling). Some states also apply reduction factors for dioxins and DDT.

Exposure Frequency (EF) − is an estimate of how often an individual is exposed to or is ingesting fish from a particular waterbody. Nebraska conservatively assumes that an individual may ingest fish from the same waterbody weekly.

Exposure Duration (ED) − is an estimate of how long an individual is exposed to or is ingesting fish from a particular waterbody. Nebraska utilizes what is referred to as a "reasonable maximum exposure duration" of 30 years (EPA, 1991). Advisories are issued under this assumption, but shorter exposure durations are more likely.

III. SAMPLING METHODS

Sampling sites for the RAFTM program are currently categorized into two different types. They are:

1) *Screening* – waterbodies selected for screening of contaminants of concern in fish tissue at locations that have never been monitored or have not been sampled for a relatively long period of time.
2) *Advisory* – waterbodies that were already under advisory which were re-sampled.

From July through October of 2013 and 2014, the NDEQ and the NGPC collected 160 fish samples from 92 locations (12 streams and 78 lakes). Seventy-three screening and 19 advisory sites were monitored in accordance with the RAFTMP within the Middle Platte, Loup, and Niobrara River basins (see Figure 2). Table 1 identifies each site sampled in 2013 and 2014.

In small streams, a backpack or pull-barge electo-fishing units were used to collect fish. To collect fish from larger streams, hoop nets, and/or a small aluminum boat designed for electro-fishing was used. The nets and electro-fishing gear were employed within a reach one mile above to one mile below the designated site location. Lake and reservoir sampling was conducted using larger electro-fishing boats and/or gill nets. Depending on conditions, direct or alternating current was used to shock the fish.

Beginning in 2013 and continuing through 2014, efforts were made to collect tissue samples from as many "angler-targeted" fish species at possible from screening and advisory sites. This included the collection of predator, generalists, and bottom-feeding species (i.e., largemouth and smallmouth bass, yellow perch, northern pike, walleye, bluegill, white and black crappie, channel and flathead catfish, and carp). All follow-up sampling at sites under consumption advisories targeted the species that previously exhibited contaminant concentrations above accepted risk criteria as well as other available species. To ensure data comparability, fish species collected during initial site visits are always targeted during follow-up investigations.

Samples collected from screening and advisory sites (see Figure 1) are a composite made up of three to five fish of the same species. In 2013, fillets (edible portions) were only retained for sites where the complete list of contaminants was analyzed. Whereas, biopsy tissue plugs removed from the dorsal muscle region of each fish were kept for all other samples in 2013 and 2014 since mercury was the only contaminant being analyzed. The size requirements of fish collected for analyses are provided in Table 2. In all samples, the total length of the smallest specimen was not to be less than 75 percent of the total length of the longest specimen.

Table 1. 2013 - 2014 Advisory and Screening Sites in Nebraska.

WATERBODY	COUNTY	SITE TYPE	# SPECIES/ SAMPLES COLLECTED
Ravenna Lake	Buffalo	Advisory	2
Bassway Strip Lake No. 5	Buffalo	Advisory	1
Kea Lake - WMA	Buffalo	Advisory	1
Cottonmill Lake	Buffalo	Advisory	1
Yanney Park Lake	Buffalo	Advisory	2
Valentine Mill Pond	Cherry	Advisory	3
Merritt Reservoir	Cherry	Advisory	5
Cottonwood Lake	Cherry	Advisory	2
Shell Lake	Cherry	Advisory	2
Box Butte Reservoir	Dawes	Advisory	2
Phillips Canyon Lake	Gosper	Advisory	1
Eagle Scout Lake	Hall	Advisory	2
North Loup Lake - SRA	Howard	Advisory	1
Farwell South Reservoir	Howard	Advisory	2
Cub Creek Lake	Keya Paha	Advisory	1
Niobrara River	Knox	Advisory	1
Walgren Lake	Sheridan	Advisory	3
Sherman Reservoir	Sherman	Advisory	3
Pibel Lake	Wheeler	Advisory	1
Grove Lake	Antelope	Screening	3
E. Br. Verdigre Creek - Grove Trout Rearing Station	Antelope	Screening	1
Beaver Creek	Boone	Screening	1
Keya Paha River	Boyd	Screening	1
Hull Lake	Boyd	Screening	1
Niobrara River	Boyd	Screening	1
Willow Lake - WMA	Brown	Screening	1
Cozad Lake - South Pine WMA	Brown	Screening	2
Long Pine Creek	Brown	Screening	1
Plum Creek	Brown	Screening	1
Keller Park No. 1	Brown	Screening	2
Keller Park No. 2	Brown	Screening	2
Bone Creek	Brown	Screening	2
Tower Lake	Brown	Screening	4
Wax Axe Lake - SRA	Buffalo	Screening	1
Windmill State Park Lake No. 1	Buffalo	Screening	1
Kea West Lake - WMA	Buffalo	Screening	1
Bufflehead Lake - WMA	Buffalo	Screening	1
Union Pacific Lake - SRA	Buffalo	Screening	1
Coot Shallows Lake - WMA	Buffalo	Screening	1
Sandy Channel Lake - SRA	Buffalo	Screening	2
Blue Hole Lake - WMA	Buffalo	Screening	2
South Loup River	Buffalo	Screening	1

Table 1. Continued.

WATERBODY	COUNTY	SITE TYPE	# SPECIES/ SAMPLES COLLECTED
Rat and Beaver Lake - WMA	Cherry	Screening	1
Big Alkali Lake	Cherry	Screening	3
Hackberry Lake	Cherry	Screening	3
Pelican Lake	Cherry	Screening	2
Watts Lake	Cherry	Screening	3
Clear Lake	Cherry	Screening	3
Cottonwood-Steverson Lake	Cherry	Screening	2
Dewey Lake	Cherry	Screening	5
Duck Lake	Cherry	Screening	1
Lord Lake	Cherry	Screening	2
Schoolhouse Lake	Cherry	Screening	2
Pressey Pond - WMA	Custer	Screening	1
Ansley City Lake	Custer	Screening	2
Melham Park Lake	Custer	Screening	2
South Loup River - Pressey WMA	Custer	Screening	1
Dogwood Lake - WMA	Dawson	Screening	2
Darr Lake - WMA	Dawson	Screening	1
Plum Creek Canyon Reservoir	Dawson	Screening	2
Gallager Canyon Reservoir - SRA	Dawson	Screening	3
West Cozad Lake - WMA	Dawson	Screening	2
Cozad Lake - WMA	Dawson	Screening	2
Midway Canyon Reservoir	Dawson	Screening	2
East Gothenburg Lake - WMA	Dawson	Screening	2
Johnson Lake	Gosper	Screening	2
Elwood Reservoir	Gosper	Screening	2
Tri-County Supply Canal - below J1 hydro	Gosper	Screening	1
Fry Lake - WMA	Grant	Screening	2
Mormon Island Middle Lake - SRA	Hall	Screening	1
L.E. Ray Lake	Hall	Screening	1
Mormon Island West Lake - SRA	Hall	Screening	2
Alda Rest Area Lake	Hall	Screening	1
Cheyenne Lake - SRA	Hall	Screening	1
Niobrara River	Holt	Screening	1
Middle Loup River	Howard	Screening	1
Missouri River	Knox	Screening	5
Verdigre Creek	Knox	Screening	1
West Gothenburg Lake - WMA	Lincoln	Screening	1
Brady Interchange Lake - WMA	Lincoln	Screening	1
Jeffery Reservoir	Lincoln	Screening	1
West Brady Lake - WMA	Lincoln	Screening	1
Fort McPherson Lake	Lincoln	Screening	1
West Maxwell Lake - WMA	Lincoln	Screening	1
Fremont Slough - WMA	Lincoln	Screening	1

Table 1. Continued.

WATERBODY	COUNTY	SITE TYPE	# SPECIES/ SAMPLES COLLECTED
Pawnee Slough Lake	Lincoln	Screening	2
Calamus Reservoir	Loup	Screening	3
Smith Lake	Sheridan	Screening	3
Bessey Pond	Thomas	Screening	1
Davis Creek Lake	Valley	Screening	3
Auble Pond	Valley	Screening	2
Lake Ericson	Wheeler	Screening	1

Table 2. Length Requirements for Fish Collected During RAFTMP Sampling.

FISH SPECIES	SIZE (Total Length)	FISH SPECIES	SIZE (Total Length)
Bluegill	6 – 8 inches	Largemouth Bass	15 – 20 inches
Buffalo	15 – 24 inches	Northern Pike	24 – 30 inches
Bullhead	8 – 12 inches	Sauger / Saugeye	12 – 18 inches
Carp	14 – 21 inches	Smallmouth Bass	10 – 18 inches
Channel Catfish	14 – 21 inches	Trout (any species)	10 – 14 inches
Crappie (black/white)	8 – 12 inches	Walleye	14 – 20 inches
Flathead Catfish	18 – 24 inches	White Bass	10 –12 inches
Freshwater Drum	10 – 18 inches		

Length and weight measurements of each fish used in a composite sample were recorded on a field sheet. Fillet samples were prepared in the field with the scales removed from scaled fish and skin removed from catfish and bullhead species. Biopsy tissue samples for mercury analysis were also collected by scraping the scales away from a small area near each fish's dorsal fin before removing the plug. Samples were frozen as soon as possible after collection. Samples collected by the NDEQ and NGPC were all analyzed at the Region VII EPA laboratory.

Parameter coverage and reporting limits for tissue samples analyzed are listed in Table 3. The EPA Region VII Laboratory utilizes reporting limits (RLs) in place of method detection limits (MDLs). RLs are higher than MDLs and believed to be more reliable in terms of identifying accurate, measurable data. The MDLs used previously required statistical interpretation of results that resulted in recording data points lower than the sensitivity of the measuring instrument.

Because of the higher cost of methylmercury analysis, the EPA Region VII Laboratory only measures for total mercury in fish tissue. Numerous studies have shown that more than 90 percent of the total mercury in fish tissue is methylmercury (EPA, 2009). Because this conservative assumption is protective of human health, Nebraska is supportive of this decision.

Table 3. Parameter Analysis and Target Reporting Limits of Fish Tissue Samples Analyzed by the EPA Region VII Laboratory During 2013. Only Mercury was Analyzed in 2014.

Contaminant	***Target Reporting Limit EPA Region VII (mg/kg)***
Analysis by Inductively Coupled Plasma Emission Spectroscopy	
Cadmium	0.06
Lead	0.17
Selenium	0.5
Analysis by Cold Vapor Atomic Absorption	
Mercury	0.0181
Analysis by Gas Chromatograph/Electron Capture	
Technical Chlordane	0.03
Heptachlor	0.003
Heptachlor Epoxide	0.003
Gamma Hexachlorocyclohexane (Lindane)	0.002
Dieldrin	0.003
DDT	0.005
DDD	0.004
DDE	0.005
PCB-1248	0.04
PCB-1254	0.03
PCB-1260	0.02
Hexachlorobenzene	0.001
Trifluralin	0.003
Pentachloroanisole**	0.001
1,2,4,5,-Tetrachlorobenzene *	0.004
Pentachlorobenzene *	0.001
Mirex *	0.003
Diazinon *	0.04

* Represents LOAEL or Lowest Observed Adverse Effect Level
**Toxicity values for pentachlorophenol used. Pentachloroanisole is a breakdown product of pentachlorophenol.

IV. RISK ASSESSMENT

The EPA's risk assessment methodology (EPA, 1989) is utilized by Nebraska for evaluating potential health risks associated with the ingestion of fish. The EPA method includes the following four steps:

1. Hazard Identification – A qualitative evaluation of the potential for a contaminant to cause an adverse health effect (i.e., birth defect, cancer) in animals or humans.
2. Dose-Response Assessment – A quantitative estimation of the relationship between the dose of a substance and the probability of an adverse health effect.
3. Exposure Assessment – The characterization of an individual's magnitude, frequency, and duration of exposure.
4. Risk Characterization – A combination of the dose-response and exposure assessment steps that provides a quantitative estimation of the risk for the exposed individual.

Hazard Identification

Contaminants selected by the EPA for assessment were determined based on known usage in the State and/or past detection in the State's waterbodies, and because exposure at high levels may be associated with adverse health effects (as indicated in EPA's IRIS - Integrated Risk Information System database) (EPA, 2012). Contaminants included in the risk assessment for all screening sites were: DDT and its breakdown products DDD and DDE, dieldrin, chlordane and its metabolites, Lindane, heptachlor, heptachlor epoxide, PCBs (Aroclor 1248, 1254, and 1260), hexachlorobenzene, trifluralin, pentachloroanisole, and the heavy metals of selenium, cadmium, lead, and mercury. Samples collected from trend sites were screened for each of the above contaminants plus 1,2,4,5-Tetrachlorobenzene, mirex, pentachlorobenzene, and diazinon; trend sites were not screened for chlordane metabolites.

Dose-Response Assessment

Two toxicity values are utilized to determine at what dose or level adverse noncarcinogenic effects and/or cancer may be anticipated from exposure to a contaminant. The concentration of a contaminant found in fish tissue is used to determine an intake (equivalent to an administered dose) for a consumer and this value is compared to its corresponding toxicity value(s) to determine if any risk may be present.

The first is referred to as an oral Reference Dose (RfD). A reference dose is an estimate of a daily exposure level for an individual to a contaminant that is likely not to be associated with adverse health effects. Chronic RfDs that are used in this report are designed to be protective for long-term exposure to a contaminant (seven years to a lifetime) and are protective for even sensitive populations such as small children. It should be noted that for many noncarcinogenic effects, the body has protective mechanisms that must be overcome before the adverse effect appears. In other words, no adverse effect is anticipated until a certain level of exposure to a contaminant is reached, referred to as a threshold level.

The second toxicity value utilized is referred to a Cancer Slope Factor (CSF). A cancer slope factor is an upper-bound estimate of the probability of a response (cancer) associated with the per unit intake of a contaminant over a lifetime. For carcinogens, it is believed that there is no level of exposure that is not associated with, however small, a probability of some carcinogenic response. This concept is referred to as non-threshold.

It should be noted that varying degrees of uncertainty surround the assessment of the adverse health effects in an exposed individual. For example, there is uncertainty in the dose-response data from

experiments on animal populations that are identical, used to predict effects in a diverse human population which display a wide range of sensitivities, and extrapolation of the data from high dose animal studies to low dose human environmental exposure. Because of this, the EPA risk assessment guidance recommends a conservative approach to data interpretation, resulting in toxicity values that are more likely to overestimate the true risk posed by exposure to a chemical.

Table 4 presents the contaminants that were assessed for in the State's waterbodies. The oral RfDs and CSFs used for these assessments are from the EPA Regional Screening Level (RSL) Summary Table (EPA, 2015).

Table 4. Fish Tissue Contaminants and Associated Risk Assessment Parameters - Reference Dose (RfD) and Cancer Slope Factors (CSF) (EPA, 2015).

CONTAMINANT	RfD (mg/kg/day)	CSF (mg/kg/day)
Aroclor 1254 – (PCB-1254)	0.00002	2.0
Cadmium	0.003	NA
Chlordane	0.0005	0.35
cis-Chlordane	0.0005	0.35
trans-Chlordane	0.0005	0.35
cis-Nonachlor	0.0005	0.35
trans-Nonachlor	0.0005	0.35
Oxychlordane	0.0005	0.35
DDD	NA	0.24
DDE	NA	0.34
DDT	0.0005	0.34
Dieldrin	0.00005	16.0
Heptachlor	0.0005	4.5
Heptachlor Epoxide	0.000013	9.1
Hexachlorobenzene	0.0008	1.6
Hexachlorohexane, gamma (Lindane)	0.0003	1.1
Lead	NA	NA
Methyl Mercury	0.0001	NA
Mirex	0.0002	18.0
Pentachloroanisole*	0.005	0.4
Pentachlorobenzene	0.0008	NA
Selenium	0.005	NA
1,2,4,5-Tetrachlorobenzene	0.0003	NA
Trifluralin	0.0075	0.0077

NA - Not applicable or not available

***** - Toxicity values for pentachlorophenol used. Pentachloroanisole is a breakdown product of pentachlorophenol.

Exposure Assessment

In the exposure assessment, several estimates and assumptions are required to describe the magnitude, frequency, duration, and routes of exposure to a contaminant. The estimates and assumptions that Nebraska has selected include the following:

- Consumption of contaminated fish tissue was the only route of exposure considered. Since the assessment only focuses on risk from contaminated fish, exposure to contaminants in surface water and sediments were not assessed.
- The detected contaminant concentration in the fish tissue assessed was assumed to be the concentration consumed. This approach is very conservative as some of the contaminant is likely lost during meal preparation and cooking, and some is excreted from the body without effect. It should be noted that the laboratory can only accurately quantify the concentration of a contaminant above a certain limit referred to as a reporting limit (RL). Contaminants not detected - or below the analytical RL are not included in the risk assessment calculations.
- For the purposes of advisory issuance, a 154 lbs (70 kg.) average body weight was used, consistent with EPA guidance (EPA, 2000).
- The average weekly meal size identified for a 154 lb (70 kg) adult in the general population is eight ounces (0.227 kg) of uncooked fish fillet (EPA, 2000). For the purposes of advisory issuance, Nebraska uses this eight ounce weekly average meal ingestion rate.

Results of the dose-response and exposure assessments are combined to characterize human health risks. Estimated intakes for contaminants assessed are determined using the equation below:

$$\text{Intake (mg/kg/day)} = \frac{(CC)(IR)(EF)(ED)(AF)}{(BW)(AT)}, \text{ where}$$

CC = Contaminant Concentration in fish tissue - mg/kg

* IR = Ingestion Rate - weekly 8 oz. (0.227 kg)

EF = Exposure Frequency -52 weeks/year

*ED = Exposure Duration - 30 years

AF = Absorption Factor - 1.0 (total absorption)

*BW = Body Weight -154 lbs. (70 kg)

*ATnc = Averaging Time -1,560 weeks/30 years for noncarcinogenic (nc) effects

* Note: Advisory determinations were based on a 154 lb. (70 kg) consumer ingesting 8 oz. (0.227 kg) weekly meal portions over a 30 year exposure duration. Carcinogenic effects are still averaged over a lifetime of 70 years (3,640 weeks) because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

Risk Characterization

Intakes estimated in the previous step are then compared to published toxicity values for each contaminant identified. As mentioned previously, the toxicity value utilized to assess adverse noncarcinogenic effects is the oral Reference Dose (RfD). The intake is divided by this value to determine a Hazard Quotient (HQ) for the contaminant.

Hazard Quotient (HQ) = Intake (mg/kg-day)/RfD (mg/kg-day)

If more than one contaminant is present in the fish tissue, then the HQs are summed to derive a Hazard Index (HI). If the HI is less than 1.0, then adverse noncarcinogenic effects are not anticipated. If the HI equals or exceeds 1.0, then an advisory is issued.

For a contaminant that may also be associated with a Cancer Risk (CR), the estimated intake is multiplied by its specific Cancer Slope Factor (see Table 4).

Cancer Risk (CR) = Intake (mg/kg-day) x CSF $(mg/kg\text{-}day)^{-1}$

The resulting CR estimate represents the probability of an individual developing cancer during their lifetime as a result of exposure to the potential carcinogen. If more than one potential carcinogen is present in fish tissue, then the risk estimates are summed. Advisories are issued if the estimated CR equals or exceeds 0.0001 (1 in 10,000). The current CR estimate for women in the United States for all cancer types is 1 in 3 and for men is 1 in 2 (ACS, 2010).

While mercury (methylmercury) is a contaminant accounted for in the HI, Nebraska also utilizes a fish tissue residue criterion (TRC) in place of a water column criterion for the protection of human health. This criterion was established based on the EPA's risk-based equation (EPA, 2001) calculated as:

$$TRC = \frac{BW \times RfD}{FI}, \quad \text{where}$$

TRC = "fish" tissue residue criterion in mg/kg

BW = body weight: 154 lbs. (70 kg)

RfD = reference dose of 0.0001 mg/kg body weight/day

FI = fish intake: 8 oz. (0.227 kg) weekly (equal to 0.0324 kg/day)

The resulting TRC represents the mercury (0.215 mg/kg) concentration in fish tissue that should not be exceeded on the basis of a consumption rate of eight ounces (0.227 kg) per week. Advisories are issued if the mercury concentration in fish tissue equals or exceeds the TRC of 0.215 mg/kg. This criterion is more stringent than EPA's recommended value of 0.3 mg/kg because Nebraska utilizes a higher consumption rate, eight ounces (0.227 kg) per week as compared to their six ounces (0.170 kg) per week.

V. CRITERIA FOR ISSUING A FISH CONSUMPTION ADVISORY

Authority

At the federal level, both the Food and Drug Administration (FDA) and EPA have jurisdictional authority and roles relating to the regulation and control of toxic or deleterious substances in fish and shellfish. The Federal Food, Drug, and Cosmetic Act (FFDCA) is the principal authority for both the FDA and EPA to take action in regulating the safety of fish as a human food source. Under the FFDCA, federal action can be taken to prevent fish that are unsafe or unfit for human consumption from moving in interstate commerce. However, federal jurisdiction does not extend to fish that are not in interstate commerce. It is left up to each state to protect the health of its citizens by controlling and regulating fish consumption from local fisheries within the state.

Under the FFDCA, the FDA regulation of contaminants has proceeded through the use of action levels that serve as guidance in evaluating contaminants in fish. However, these levels may not be appropriate for states to use in regulating the consumption of contaminated fish since action levels are based on national needs and national fish consumption rates, and consumption rates by local fishermen may not reflect national averages. The action levels also considered economic impacts to commercial industries when they were developed.

In Nebraska, the NDHHS has primary responsibility for issuing public health advisories. Because fish consumption advisories involve other agencies, the NDHHS will issue advisories in collaboration with the NDEQ, NGPC, and NDA.

Health Risk Assessment Method

The EPA risk assessment methods (EPA, 1989) were used in this report to assess potential human health risks from exposure to contaminants in fish tissue. When the estimated cancer risk equals or exceeds 0.0001 ($\geq$ 1 in 10,000) or when adverse noncancer health effects may be possible from ingesting fish (Hazard Index $\geq$ 1.0), advisories are issued. Advisories are also issued for mercury levels that equal or exceed 0.215 milligrams of mercury per kilogram of fish tissue.

Sampling Location Requirements

Fish tissue samples are collected annually from selected rivers and lakes in accordance with Nebraska's six-year rotating basin monitoring approach. Sites where previous RAFTMP sampling has revealed high levels of contaminants in fish tissue and advisories have been issued are re-sampled every six years. If conditions have improved, the advisories are removed and the site will be considered for re-sampling in the future.

Screening sites have historically been selected based on the angling pressure they receive and located within one of the targeted river basins. This approach is still followed, but since 2006 the RAFTM program has allowed for sampling of additional sites across a wider variety of resource classes (e.g., small to large streams, rivers, lake and reservoirs, including those in urban areas).

Advisory Criteria

The public is made aware of health risks through an advisory issued by the NDHHS and published on the NDEQ and NGPC websites. Advisories are issued for specific waterbodies when fish tissue analyzed (fillets and/or biopsy plugs from 3-5 fish samples of a single species) are found to:

1) have mercury concentrations ≥ 0.215 mg/kg; or

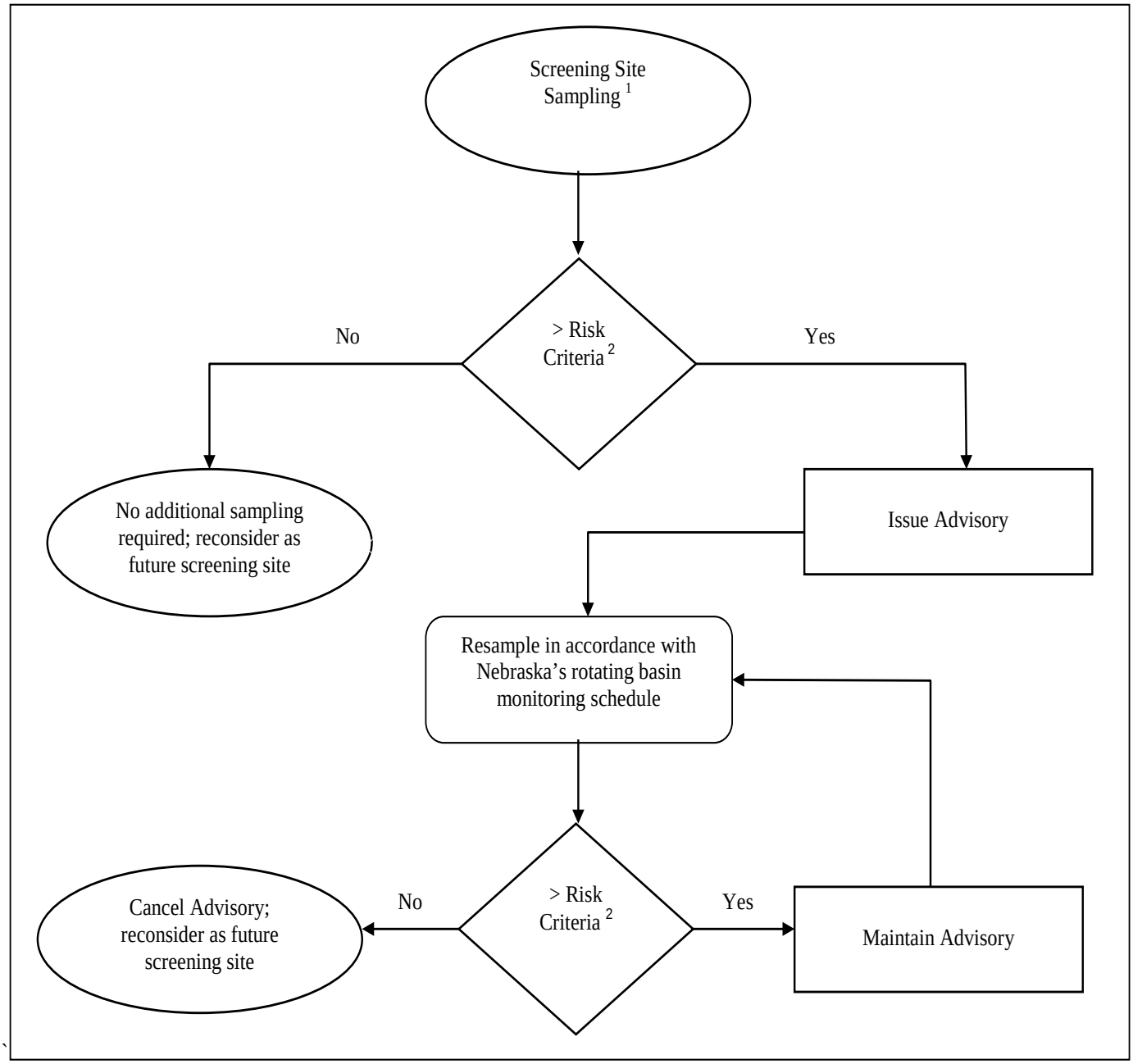
2) when ingested may be associated with adverse health effects, a Hazard Index (summation of Hazard Quotients) ≥ 1.0; or

3) when ingested may be associated with an excess Cancer Risk ≥ 1 in 10,000.

Although advisories are issued for only the fish species analyzed, it should be noted that other species of fish inhabiting the same waterbody, may bioconcentrate similar levels of contaminants. In rivers and streams, advisory issuances are for segments of that waterbody as defined in Title 117 – Nebraska Surface Water Quality Standards (NDEQ, 2014). Stream segments define specific portions of streams which are relatively homogeneous in regard to their physical conditions (e.g., flow, temperature, substrate, channel characteristics) (NDEQ, 1992). Advisory issuances for lakes/reservoirs always pertain to the entire waterbody. The fish species analyzed and risk criteria violated are listed in the advisory.

Once an advisory is issued for a waterbody it will remain in effect until additional sampling of that same fish species indicates that a health concern no longer exists. If a sample collected from an advisory waterbody exceeds risk criteria, the advisory will remain in effect for at least another six years, or until it is re-sampled. This process will repeat itself if the samples continue to exceed criteria. If the single fillet sample collected from an advisory waterbody is below risk criteria, then the advisory will be removed. Figure 2 provides a diagram of the processes involved in assigning and removing fish consumption advisories in Nebraska.

Figure 2. Monitoring Scheme for the Nebraska Fish Tissue Monitoring Program.



[1] Sampling scheme applies to all screening and advisory sites; single fillet/biopsy plug sample – comprised of 3-5 fish/sample of a single species – often >5 fish/sample are necessary for bluegill, crappie, etc., due to size.

[2] The *Risk Criteria* established by the Nebraska Fish Tissue Advisory Committee include fish tissue that: (1) are found to have mercury concentrations $\geq$ 0.215 mg/kg, (2) have contaminant concentrations that may be associated with adverse health effects (Hazard Index $\geq$ 1.0) or (3) may be associated with an excess Cancer Risk $\geq$ 1 in 10,000 when ingested.

VI. RESULTS AND DISCUSSION

2013-2014 Sampling Effort and Purpose

RAFTMP sampling is conducted to examine trends in fish tissue contamination and to identify potential human health concerns associated with fish consumption. In 2013-2014, the NDEQ and NGPC collected a total of 160 samples from 92 different sites within the Middle Platte, Loup, and Niobrara River basins (Figure 1). At the 73 *screening* and 19 *advisory* sites sampled, tissue samples from one to five species were collected depending on what could be obtained (See Table 1). In all, fish were collected from 12 different streams and 78 lakes/reservoirs.

Contaminants of Concern

Methylmercury and PCBs are the contaminants of primary concern in Nebraska fish. Dieldrin is also frequently detected in fish tissue samples, but by itself dieldrin concentrations rarely cause human health risk criteria to be exceeded. However, given the cumulative risk calculations that Nebraska produces, dieldrin concentrations may contribute towards the overall risk. DDE (a breakdown product of DDT) continues to appear frequently in small concentrations in fish tissue samples. Like DDE, many other contaminants are routinely detected in small concentrations and are insignificant contributors to the overall risk calculation.

Methylmercury − Mercury occurs naturally at low levels in rocks, soil, sediments, air, and water. In addition, mercury can be released into the environment from mining operations, sanitary landfills, fossil fuel combustion, municipal refuse incineration, industrial waste discharges, and from certain fungicides. Mercury occurs in aquatic systems in three forms: elemental (metallic), organic (methylated), and inorganic (mercurous and mercuric salts) compounds. The organic form, methylmercury (Me-Hg), is the most toxic to both aquatic organisms and humans. In the environment, elemental mercury is oxidized to inorganic mercury that is then converted into Me-Hg by certain microorganisms. Mercury poses a threat to humans as it is stored in the tissues of aquatic organisms in the methylated form (EPA, 1995). Fish absorb Me-Hg from aquatic organisms they eat, and from the water passing over their gills. Predacious fish such as walleye, northern pike, and largemouth bass reside at the top of the aquatic food chain and are prone to exhibiting higher Me-Hg concentrations than less predacious fish such as carp or suckers. Long-term exposure, even to small background concentrations, will lead to higher concentrations in the flesh. Therefore, large fish typically have higher mercury concentrations than small fish.

Exposure to high levels of mercury have been shown to adversely affect the developing nervous system (EPA, 2001). Women of child-bearing age, pregnant women, and children less than 15 years of age are the targeted population of concern. Although mercury is included in the calculation of the Hazard Index because of its prevalence in the environment and the adverse effects that may be associated with exposure, the State has adopted an action level of 0.215 mg/kg for mercury (NDEQ, 2014). Currently there are no known methods by which one can effectively reduce mercury levels in fish tissue.

Polychlorinated Biphenyls (PCBs) − PCBs are a class of aromatic organic compounds that were produced and marketed in the United States beginning in 1929. PCBs are represented by a group of 209 individual chemical compounds referred to as congeners. Prior to 1971, PCBs were used as plasticizers, heat transfer fluids, hydraulic fluids, lubricants, and wax extenders. Since 1971, PCBs have been limited to use in closed electrical systems such as capacitors and transformers because of their insulating properties. Although PCB production was discontinued in the U.S. in 1977, PCBs are still present in old transformers and capacitors. Virtually insoluble in water, PCB compounds are readily soluble in lipids and are stored in areas such as the liver, fat, breast milk, and skin. Bioconcentration factors for fish have been documented to occur from 3,000 to 247,000 times ambient levels (EPA, 1980).

Commercially, PCBs were sold as mixtures of individual congeners; most of these mixtures were sold under the trade name Aroclor. Aroclors are named based on the amount of chlorine in the total

mixture. As the chlorine content increases, the compound becomes more stable and becomes increasingly difficult to break down. It is the highly-chlorinated PCB congeners which are more readily detected in fish tissue samples due to their persistence in the environment. Nebraska has EPA analyze PCBs for three congeners - PCB-1248, -1254, and -1260. PCB-1260 is the most highly chlorinated congener and PCB-1248 is the least chlorinated. PCB-1254 and -1260 are the most frequently detected in Nebraska fish.

Since PCBs are stored in a fish's fatty tissue and organs, there are effective means by which consumers can reduce their PCB intake. The best approach is to trim away all visible fat from the fillet, and grill, broil or bake the fillets in such a way that any remaining fat is allowed to drain or drip away.

Risk Assessment Results

Table 5 summarizes the findings of the 2013-2014 Regional Ambient Fish Tissue analysis. This includes the 2013-2014 screening and previous advisory site locations. Table 5 also highlights the sample locations, the fish species collected, and shows where Nebraska Risk Criteria were exceeded (bold text).

Table 5. Fish Tissue Risk Assessment Results for Nebraska Streams and Lakes Monitored in 2013-2014.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	CANCER RISK (≥0.0001)	HAZARD INDEX (≥1.0)	MERCURY CONC. (≥0.215 mg/kg)
PREVIOUS ADVISORY LOCATIONS						
Ravenna Lake	LO4-L0010	Buffalo	Largemouth Bass[1,2]	–	–	**0.310**
			Bluegill[2]	–	–	0.113
Bassway Strip Lake No. 5	MP2-L0190	Buffalo	Largemouth Bass[1,2]	–	–	**0.275**
Kea Lake - WMA	MP2-L0320	Buffalo	Largemouth Bass[1,2]	–	–	**0.401**
Cottonmill Lake	MP2-L0360	Buffalo	Largemouth Bass[1,2]	–	–	**0.477**
Yanney Park Lake	MP2-LXXXX	Buffalo	Largemouth Bass[1,2]	–	–	**0.342**
			Channel Catfish[2]	–	–	0.037
Valentine Mill Pond	NI3-L0170	Cherry	Largemouth Bass[1,2]	–	–	**0.460**
			Channel Catfish[2]	–	–	0.109
			Bluegill[2]	–	–	**0.254**
Merritt Reservoir	NI3-L0330	Cherry	Walleye[1,2]	–	–	**0.610**
			Largemouth Bass[2]	–	–	**0.507**
			Largemouth Bass[2]	–	–	**0.261**
			Bluegill[2]	–	–	0.168
			Channel Catfish[2]	–	–	0.053
Cottonwood Lake	NI4-L0010	Cherry	Largemouth Bass[1,2]	–	–	**0.365**
			Bluegill[2]	–	–	0.153
Shell Lake	NI4-L0020	Cherry	Northern Pike[1,3]	–	–	–
			Largemouth Bass[2]	–	–	**0.454**
			Bluegill[2]	–	–	0.186
Box Butte Reservoir	NI4-L0080	Dawes	Northern Pike[1,2]	–	–	**0.439**
			Largemouth Bass[2]	–	–	**0.841**
Phillips Canyon Reservoir	MP2-L0500	Gosper	Carp[1]	<0.0001	0.00	–
Eagle Scout Lake	MP1-L0120	Hall	Largemouth Bass[1,2]	–	–	0.201
			Carp[2]	–	–	0.079
North Loup Lake - SRA	LO2-L0010	Howard	Largemouth Bass[1,2]	–	–	0.142
Farwell South Reservoir	LO3-L0010	Howard	Largemouth Bass[1,2]	–	–	**0.493**
			Carp[2]	–	–	**0.347**
Cub Creek Lake	NI3-L0070	Keya Paha	Largemouth Bass[1,2]	–	–	**0.389**

1 – Advisory Species, 2 – Only Mercury Analyzed, 3 – Species Not Sampled

NOTE: Boldface type indicates risk criteria were exceeded. Values appearing in the Cancer Risk and Hazard Index columns were derived by summing the Hazard Quotients and cancer risk estimates for each contaminant found in the fish samples analyzed. Cancer risk estimates expressed as <0.0001 were below State criteria. Waterbodies where two trophic level species (i.e., bottom feeder and predator) were collected, the "predator" sample was only assessed for mercury per EPA procedures.

NOTE: The NDEQ's Policy for Issuing Fish Consumption Advisories uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 30 years for calculating health risks (NDEQ, 2011). Carcinogenic effects are still averaged over a lifetime of 70 years because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

Table 5. Continued.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	CANCER RISK (≥0.0001)	HAZARD INDEX (≥1.0)	MERCURY CONC. (≥0.215 mg/kg)
PREVIOUS ADVISORY LOCATIONS- CON'T						
Niobrara River	NI2-10000	Knox	Carp[1,3]	–	–	–
			Channel Catfish[2]	–	–	0.072
Walgren Lake	NI4-L0050	Sheridan	Largemouth Bass[1,2]	–	–	**0.414**
			Northern Pike[2]	–	–	0.194
			Bluegill[2]	–	–	0.118
Sherman Reservoir	LO3-L0020	Sherman	Walleye[1,2]	–	–	0.210
			White Bass[2]	–	–	**0.274**
			Channel Catfish[2]	–	–	0.192
Pibel Lake	LO1-L0130	Wheeler	Largemouth Bass[1,2]	–	–	**0.573**
SCREENING LOCATIONS						
Grove Lake	NI2-L0060	Antelope	Largemouth Bass[2]	–	–	0.126
			Bluegill[2]	–	–	0.020
			Black Crappie[2]	–	–	0.031
East Branch Verdigre Creek – Grove Trout Rearing Station	NI2-10320	Antelope	Rainbow Trout[2]	–	–	0.017
Beaver Creek	LO1-10700	Boone	Channel Catfish[2]	–	–	0.092
Keya Paha River	NI3-10100	Boyd	Channel Catfish[2]	–	–	0.087
Hull Lake	NI1-L0010	Boyd	Largemouth Bass[2]	–	–	0.157
Niobrara River	NI2-10000	Boyd	Channel Catfish[2]	–	–	0.094
Willow Lake - WMA	LO2-L0055	Brown	Carp[2]	–	–	0.023
Cozad Lake - South Pine WMA	LO2-LXXXX	Brown	Black Bullhead[2]	–	–	0.016
			Largemouth Bass[2]	–	–	0.096
Long Pine Creek	NI3-12400	Brown	Rainbow Trout[2]	–	–	0.016
Plum Creek	NI3-13000	Brown	Brown Trout[2]	–	–	0.118
Keller Park No. 1	NI3-L0020	Brown	Largemouth Bass[2]	–	–	0.131
			Bluegill[2]	–	–	0.037
Keller Park No. 2	NI3-L0030	Brown	Largemouth Bass[2]	–	–	0.035
			Bluegill[2]	–	–	0.063
Bone Creek	NI3-12220	Brown	Brown Trout[2]	–	–	0.071
			White Sucker[2]	–	–	0.148

1 – Advisory Species, 2 – Only Mercury Analyzed, 3 – Species Not Sampled

NOTE: Boldface type indicates risk criteria were exceeded. Values appearing in the Cancer Risk and Hazard Index columns were derived by summing the Hazard Quotients and cancer risk estimates for each contaminant found in the fish samples analyzed. Cancer risk estimates expressed as <0.0001 were below State criteria. Waterbodies where two trophic level species (i.e., bottom feeder and predator) were collected, the "predator" sample was only assessed for mercury per EPA procedures.

NOTE: The NDEQ's Policy for Issuing Fish Consumption Advisories uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 30 years for calculating health risks (NDEQ, 2011). Carcinogenic effects are still averaged over a lifetime of 70 years because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

Table 5. Continued.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	CANCER RISK (≥0.0001)	HAZARD INDEX (≥1.0)	MERCURY CONC. (≥0.215 mg/kg)
SCREENING LOCATIONS - CON'T						
Tower Lake	NI3-LXXXX	Brown	Largemouth Bass[2]	–	–	0.204
			Bluegill[2]	–	–	0.037
			Bluegill[2]	–	–	0.064
			Yellow Perch[2]	–	–	0.030
Wax Axe Lake - SRA	MP2-L0120	Buffalo	Smallmouth Bass[2]	–	–	**0.321**
Windmill State Park Lake No. 1 - SRA	MP2-L0170	Buffalo	Largemouth Bass[2]	–	–	0.152
Kea West Lake - WMA	MP2-L0340	Buffalo	Largemouth Bass[2]	–	–	**0.240**
Bufflehead Lake - WMA	MP2-L0341	Buffalo	Largemouth Bass[2]	–	–	0.194
Union Pacific Lake - SRA	MP2-L0390	Buffalo	Largemouth Bass[2]	–	–	**0.307**
Coot Shallows Lake - WMA	MP2-L0400	Buffalo	Largemouth Bass[2]	–	–	**0.229**
Sandy Channel Lake - SRA	MP2-L0420	Buffalo	Largemouth Bass[2]	–	–	**0.327**
			Walleye[2]	–	–	**0.458**
Blue Hole Lake - WMA	MP2-L0430	Buffalo	Carp[2]	–	–	0.072
			Largemouth Bass[2]	–	–	**0.391**
South Loup River	LO4-10000	Buffalo	Channel Catfish[2]	–	–	**0.267**
Rat and Beaver Lake - WMA	LO2-L0260	Cherry	Carp[2]	–	–	0.041
Big Alkali Lake	NI3-L0220	Cherry	Northern Pike[2]	–	–	0.125
			Black Crappie[2]	–	–	0.075
			Channel Catfish[2]	–	–	0.108
Hackberry Lake	NI3-L0200	Cherry	Northern Pike[2]	–	–	0.063
			Largemouth Bass[2]	–	–	0.102
			Bluegill[2]	–	–	0.036
Pelican Lake	NI3-L0270	Cherry	Largemouth Bass[2]	–	–	0.090
			Bluegill[2]	–	–	0.023
Watts Lake	NI3-L0290	Cherry	Northern Pike[2]	–	–	0.100
			Largemouth Bass[2]	–	–	0.068
			Bluegill[2]	–	–	0.023

1 – Advisory Species, 2 – Only Mercury Analyzed, 3 – Species Not Sampled

NOTE: Boldface type indicates risk criteria were exceeded. Values appearing in the Cancer Risk and Hazard Index columns were derived by summing the Hazard Quotients and cancer risk estimates for each contaminant found in the fish samples analyzed. Cancer risk estimates expressed as <0.0001 were below State criteria. Waterbodies where two trophic level species (i.e., bottom feeder and predator) were collected, the "predator" sample was only assessed for mercury per EPA procedures.

NOTE: The NDEQ's Policy for Issuing Fish Consumption Advisories uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 30 years for calculating health risks (NDEQ, 2011). Carcinogenic effects are still averaged over a lifetime of 70 years because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

Table 5. Continued.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	CANCER RISK (≥0.0001)	HAZARD INDEX (≥1.0)	MERCURY CONC. (≥0.215 mg/kg)
SCREENING LOCATIONS - CON'T						
Clear Lake	NI3-L0260	Cherry	Northern Pike[2]	–	–	0.163
			Black Crappie[2]	–	–	0.010
			Carp[2]	–	–	0.028
Dewey Lake	NI3-L0240	Cherry	Northern Pike[2]	–	–	0.119
			Northern Pike[2]	–	–	0.071
			Yellow Perch[2]	–	–	0.030
			Largemouth Bass[2]	–	–	0.114
			Bluegill[2]	–	–	0.049
Duck Lake	NI3-L0320	Cherry	Largemouth Bass[2]	–	–	**0.215**
Lord Lake	NI3-LXXXX	Cherry	Largemouth Bass[2]	–	–	0.156
			Bluegill[2]	–	–	0.067
Schoolhouse Lake	NI3-LXXXX	Cherry	Northern Pike[2]	–	–	**0.236**
			Largemouth Bass[2]	–	–	**0.373**
			Black Crappie[2]	–	–	**0.232**
Cottonwood-Steverson Lake	NI3-LXXXX	Cherry	Carp[2]	–	–	0.047
			Black Crappie[2]	–	–	0.038
Pressey Pond - WMA	LO4-LXXXX	Custer	Largemouth Bass[2]	–	–	**0.385**
Ansley City Lake	LO4-L0030	Custer	Largemouth Bass[2]	–	–	**0.457**
			Largemouth Bass[2]	–	–	**0.370**
Melham Park Lake	LO4-L0040	Custer	Largemouth Bass[2]	–	–	**0.223**
			Bluegill[2]	–	–	0.038
South Loup River- Pressey WMA	LO4-20000	Custer	Channel Catfish[2]	–	–	0.173
Dogwood Lake - WMA	MP2-L0460	Dawson	Largemouth Bass[2]	–	–	**0.328**
			Carp[2]	–	–	0.022
Darr Lake - WMA	MP2-L0550	Dawson	Largemouth Bass[2]	–	–	**0.234**
Plum Creek Canyon Reservoir	MP2-L0560	Dawson	Carp	**0.0002**	**1.06**	–
			Channel Catfish[2]	–	–	0.121
Gallager Canyon Reservoir - SRA	MP2-L0570	Dawson	Carp	<0.0001	0.00	–
			Largemouth Bass[2]	–	–	0.202
			Channel Catfish[2]	–	–	0.102

1 – Advisory Species, 2 – Only Mercury Analyzed, 3 – Species Not Sampled

NOTE: Boldface type indicates risk criteria were exceeded. Values appearing in the Cancer Risk and Hazard Index columns were derived by summing the Hazard Quotients and cancer risk estimates for each contaminant found in the fish samples analyzed. Cancer risk estimates expressed as <0.0001 were below State criteria. Waterbodies where two trophic level species (i.e., bottom feeder and predator) were collected, the "predator" sample was only assessed for mercury per EPA procedures.

NOTE: The NDEQ's Policy for Issuing Fish Consumption Advisories uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 30 years for calculating health risks (NDEQ, 2011). Carcinogenic effects are still averaged over a lifetime of 70 years because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

Table 5. Continued.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	CANCER RISK (≥0.0001)	HAZARD INDEX (≥1.0)	MERCURY CONC. (≥0.215 mg/kg)
SCREENING LOCATIONS - CON'T						
West Cozad Lake - WMA	MP2-L0580	Dawson	Largemouth Bass[2]	–	–	**0.271**
			Carp[2]	–	–	0.012
Cozad Lake - WMA	MP2-L0590	Dawson	Channel Catfish[2]	–	–	0.046
			Largemouth Bass[2]	–	–	**0.333**
Midway Canyon Reservoir	MP2-L0620	Dawson	Carp	<0.0001	0.00	–
			Channel Catfish[2]	–	–	0.073
East Gothenburg Lake - WMA	MP2-L0681	Dawson	Carp[2]	–	–	0.009
			Largemouth Bass[2]	–	–	**0.333**
Johnson Lake	MP2-L0520	Gosper	Walleye[2]	–	–	0.106
			White Bass[2]	–	–	0.174
Elwood Reservoir	MP2-L0540	Gosper	Largemouth Bass[2]	–	–	**0.538**
			Northern Pike[2]	–	–	**0.541**
Tri-County Supply Canal - below J1 hydro	MP2-20500	Gosper	Carp	<0.0001	**1.58**	–
Frye Lake - WMA	LO3-L0070	Grant	Largemouth Bass[2]	–	–	**0.341**
			Yellow Perch[2]	–	–	0.085
Mormon Island Middle Lake - SRA	MP2-L0060	Hall	Largemouth Bass[2]	–	–	**0.423**
L.E. Ray Lake	MP2-L0061	Hall	Largemouth Bass[2]	–	–	**0.318**
Mormon Island West Lake - SRA	MP2-L0070	Hall	Channel Catfish[2]	–	–	0.031
			Largemouth Bass[2]	–	–	0.184
Alda Rest Area Lake	MP2-L0090	Hall	Largemouth Bass[2]	–	–	0.186
Cheyenne Lake - SRA	MP2-L0100	Hall	Largemouth Bass[2]	–	–	**0.359**
Niobrara River	NI2-10000	Holt	Channel Catfish[2]	–	–	0.115
Middle Loup River	LO3-10000	Howard	Channel Catfish[2]	–	–	0.154
Missouri River	NI1-10000	Knox	Smallmouth Bass[2]	–	–	0.116
			Carp[2]	–	–	0.143
			Rock Bass[2]	–	–	0.102
			Channel Catfish[2]	–	–	0.058
			Flathead Catfishs[2]	–	–	**0.220**
Verdigre Creek	NI2-10100	Knox	Channel Catfish[2]	–	–	0.050

1 – Advisory Species, 2 – Only Mercury Analyzed, 3 – Species Not Sampled

NOTE: Boldface type indicates risk criteria were exceeded. Values appearing in the Cancer Risk and Hazard Index columns were derived by summing the Hazard Quotients and cancer risk estimates for each contaminant found in the fish samples analyzed. Cancer risk estimates expressed as <0.0001 were below State criteria. Waterbodies where two trophic level species (i.e., bottom feeder and predator) were collected, the "predator" sample was only assessed for mercury per EPA procedures.

NOTE: The NDEQ's Policy for Issuing Fish Consumption Advisories uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 30 years for calculating health risks (NDEQ, 2011). Carcinogenic effects are still averaged over a lifetime of 70 years because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

Table 5. Continued.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	CANCER RISK (≥0.0001)	HAZARD INDEX (≥1.0)	MERCURY CONC. (≥0.215 mg/kg)
SCREENING LOCATIONS - CON'T						
West Gothenburg Lake - WMA	MP2-L0680	Lincoln	Largemouth Bass[2]	–	–	0.181
Brady Interchange Lake - WMA	MP2-L0690	Lincoln	Largemouth Bass[2]	–	–	0.094
Jeffery Reservoir	MP2-L0710	Lincoln	Carp[1]	<0.0001	0.00	–
West Brady Lake - WMA	MP2-L0720	Lincoln	Channel Catfish[2]	–	–	0.037
Fort McPherson Lake	MP2-L0770	Lincoln	Largemouth Bass[2]	–	–	**0.425**
West Maxwell Lake - WMA	MP2-L0800	Lincoln	Channel Catfish[2]	–	–	0.078
Fremont Slough - WMA	MP2-L0840	Lincoln	Largemouth Bass[2]	–	–	**0.258**
Pawnee Slough Lake	MP2-LXXXX	Lincoln	Largemouth Bass[2]	–	–	**0.686**
			Channel Catfish[2]	–	–	0.100
Calamus Reservoir	LO2-L0050	Loup	Carp[2]	–	–	**0.280**
			Walleye[2]	–	–	0.064
			White Bass[2]	–	–	0.207
Smith Lake	NI4-L0040	Sheridan	Largemouth Bass[2]	–	–	**0.574**
			Bluegill[2]	–	–	0.088
			Yellow Perch[2]	–	–	0.074
Bessey Pond	LO3-LXXXX	Thomas	Largemouth Bass[2]	–	–	0.190
Davis Creek Lake	LO2-L0015	Valley	Carp[2]	–	–	**0.297**
			Walleye[2]	–	–	0.156
			White Bass[2]	–	–	**0.336**
Auble Pond	LO2-L0020	Valley	Channel Catfish[2]	–	–	0.117
			Largemouth Bass[2]	–	–	**0.296**
Lake Ericson	LO1-L0140	Wheeler	Carp[2]	–	–	0.189

1 – Advisory Species, 2 – Only Mercury Analyzed, 3 – Species Not Sampled

NOTE: Boldface type indicates risk criteria were exceeded. Values appearing in the Cancer Risk and Hazard Index columns were derived by summing the Hazard Quotients and cancer risk estimates for each contaminant found in the fish samples analyzed. Cancer risk estimates expressed as <0.0001 were below State criteria. Waterbodies where two trophic level species (i.e., bottom feeder and predator) were collected, the "predator" sample was only assessed for mercury per EPA procedures.

NOTE: The NDEQ's Policy for Issuing Fish Consumption Advisories uses an 8-oz weekly meal portion combined with a consumer body weight of 70 kg (154 lbs.), an absorption factor of 1.0 and an exposure period of 30 years for calculating health risks (NDEQ, 2011). Carcinogenic effects are still averaged over a lifetime of 70 years because it is assumed cancer can develop at any time during one's lifetime, even after the exposure to the carcinogen has ended.

VII. SUMMARY

A list of Nebraska streams and lakes monitored in 2013-2014 along with their advisory status is presented in Table 6. A summary of the risk assessment results are as follows:

1. Fish tissue samples were collected and analyzed from 73 screening sites. Tissue samples collected from 41 sites did not exceed any of the State's risk criteria and will not come under advisory.
2. Samples collected at 30 screening sites exceeded the risk criteria for mercury.
3. The bottom feeder sample at a two sites exceeded risk criteria having a Hazard Index ≥1.0, with one of two having an excess Cancer Risk ≥ 1 in 10,000. The primary contaminants being PCBs.
4. Nineteen advisory sites were also monitored in 2013-2014. Advisories will be maintained at 16 of the 19 sites based on contaminant levels still exceeding risk criteria.
5. Eight sites exceeded the risk criteria for mercury in two or more species.
6. In all, 32 new waterbodies monitored in 2013-2014 came under advisory, 16 sites that were already under an advisory remained listed, and three sites were removed.
7. Combined with previous year's assessments, 127 Nebraska waterbodies (14 stream segments and 113 lakes) are now under fish consumption advisories (see *Appendix A* for site list and map).

.

Table 6. List of Waterbodies with an Advisory Status Change for 2013-2014.

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	ADVISORY ACTION	LISTING REASON[1]
ADVISORY LOCATIONS					
Ravenna Lake	LO4-L0010	Buffalo	Largemouth Bass	Maintain	Mercury
Bassway Strip Lake No. 5	MP2-L0190	Buffalo	Largemouth Bass	Maintain	Mercury
Kea Lake -WMA	MP2-L0320	Buffalo	Largemouth Bass	Maintain	Mercury
Cottonmill Lake	MP2-L0360	Buffalo	Largemouth Bass	Maintain	Mercury
Yanney Park Lake	MP2-LXXXX	Buffalo	Largemouth Bass	Maintain	Mercury
Valentine Mill Pond	NI3-L0170	Cherry	Largemouth Bass / Bluegill[3]	Maintain	Mercury
Merritt Reservoir	NI3-L0330	Cherry	Walleye / Largemouth Bass[3]	Maintain	Mercury
Cottonwood Lake	NI4-L0010	Cherry	Largemouth Bass	Maintain	Mercury
Shell Lake	NI4-L0020	Cherry	Northern Pike[2] / Largemouth Bass[3]	Maintain	Mercury
Box Butte Reservoir	NI4-L0080	Dawes	Northern Pike / Largemouth Bass[3]	Maintain	Mercury
Phillips Canyon Lake	MP2-L0500	Gosper	Carp	Maintain	Mercury
Eagle Scout Lake	MP1-L0120	Hall	Largemouth Bass	Remove	<Risk Criteria
North Loup Lake - SRA	LO2-L0010	Howard	Largemouth Bass	Remove	<Risk Criteria
Farwell South Reservoir	LO3-L0010	Howard	Largemouth Bass / Carp[3]	Maintain	Mercury
Cub Creek Lake	NI3-L0070	Keya Paha	Largemouth Bass	Maintain	Mercury
Niobrara River	NI2-10000	Knox	Carp[2] / Channel Catfish[3]	Remove	<Risk Criteria
Walgren Lake	NI4-L0050	Sheridan	Largemouth Bass	Maintain	Mercury
Sherman Reservoir	LO3-L0020	Sherman	Walleye[2] / WhiteBass[3]	Maintain	Mercury
Pibel Lake	LO1-L0130	Wheeler	Largemouth Bass	Maintain	Mercury
SCREENING LOCATIONS					
Wax Axe Lake - SRA	MP2-L0120	Buffalo	Smallmouth Bass	New Advisory	Mercury
Kea West Lake - WMA	MP2-L0340	Buffalo	Largemouth Bass	New Advisory	Mercury
Union Pacific Lake - SRA	MP2-L0390	Buffalo	Largemouth Bass	New Advisory	Mercury
Coot Shallows Lake - WMA	MP2-L0400	Buffalo	Largemouth Bass	New Advisory	Mercury
Sandy Channel Lake - SRA	MP2-L0420	Buffalo	Largemouth Bass / Walleye	New Advisory	Mercury
Blue Hole Lake - WMA	MP2-L0430	Buffalo	Largemouth Bass	New Advisory	Mercury
South Loup River	LO4-10000	Buffalo	Channel Catfish	New Advisory	Mercury
Duck Lake	NI3-L0320	Cherry	Largemouth Bass	New Advisory	Mercury

[1] Sites listed with H.I. (Hazard Index), C.R. (Cancer Risk), or Mercury had contaminant levels above human health risk criteria.

[2] Listed fish species had contaminant levels below human health risk criteria, is no longer present, wasn't collected, and/or in-take is considered insignificant for waterbody.

[3] Additional indicator specie(s) collected and analyzed.

Table 6. Continued

WATERBODY	WATER-BODY ID	COUNTY	FISH SPECIES	ADVISORY ACTION	LISTING REASON[1]
SCREENING LOCATIONS					
Schoolhouse Lake	NI3-LXXXX	Cherry	Northern Pike / Largemouth Bass / Black Crappie	New Advisory	Mercury
Pressey Pond - WMA	LO4-LXXXX	Custer	Largemouth Bass	New Advisory	Mercury
Ansley City Lake	LO4-L0030	Custer	Largemouth Bass	New Advisory	Mercury
Melham Park Lake	LO4-L0040	Custer	Largemouth Bass	New Advisory	Mercury
Dogwood Lake - WMA	MP2-L0460	Dawson	Largemouth Bass	New Advisory	Mercury
Darr Lake - WMA	MP2-L0550	Dawson	Largemouth Bass	New Advisory	Mercury
Plum Creek Canyon Reservoir	MP2-L0560	Dawson	Carp	New Advisory	C.R / H.I.
West Cozad Lake - WMA	MP2-L0580	Dawson	Largemouth Bass	New Advisory	Mercury
Cozad Lake - WMA	MP2-L0590	Dawson	Largemouth Bass	New Advisory	Mercury
East Gothenburg Lake - WMA	MP2-L0681	Dawson	Largemouth Bass	New Advisory	Mercury
Elwood Reservoir	MP2-L0540	Gosper	Northern Pike / Largemouth Bass	New Advisory	Mercury
Tri-County Supply Canal - below J1 hydro	MP2-20500	Gosper	Carp	New Advisory	H.I.
Frye Lake - WMA	LO3-L0070	Grant	Largemouth Bass	New Advisory	Mercury
Mormon Island Middle Lake - SRA	MP2-L0060	Hall	Largemouth Bass	New Advisory	Mercury
L.E. Ray Lake	MP2-L0061	Hall	Largemouth Bass	New Advisory	Mercury
Cheyenne Lake - SRA	MP2-L0100	Hall	Largemouth Bass	New Advisory	Mercury
Missouri River	NI1-10000	Knox	Flathead Catfish	New Advisory	Mercury
Fort McPherson Lake	MP2-L0770	Lincoln	Largemouth Bass	New Advisory	Mercury
Fremont Slough - WMA	MP2-L0840	Lincoln	Largemouth Bass	New Advisory	Mercury
Pawnee Slough Lake	MP2-LXXXX	Lincoln	Largemouth Bass	New Advisory	Mercury
Calamus Reservoir	LO2-L0050	Loup	Carp	New Advisory	Mercury
Smith Lake	NI4-L0040	Sheridan	Largemouth Bass	New Advisory	Mercury
Davis Creek Lake	LO2-L0015	Valley	White Bass / Carp	New Advisory	Mercury
Auble Pond	LO2-L0020	Valley	Largemouth Bass	New Advisory	Mercury

[1] Sites listed with H.I. (Hazard Index), C.R. (Cancer Risk), or Mercury had contaminant levels above human health risk criteria.

[2] Listed fish species had contaminant levels below human health risk criteria, is no longer present, wasn't collected, and/or in-take is considered insignificant for waterbody.

[3] Additional indicator specie(s) collected and analyzed.

VIII. LITERATURE CITED

ACS. 2010. Cancer Facts and Figures 2010. American Cancer Society.

Barnes, D.G., et al. 1989. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-Dioxins and Dibenzofurans (CDDs and CDFs) and 1989 Update. Risk Assessment Forum. U.S. Environmental Protection Agency. Washington, D.C. 20460.

EPA. 1980. Ambient Water Quality Criteria for Polychlorinated Biphenyls. Office of Water Regulations and Standards. U.S. Environmental Protection Agency. Washington, D.C. 20460. EPA Document Number 440/5-80-068.

EPA. 1989. Assessing Human Health Risks from Chemically Contaminated Fish and Shellfish: A Guidance Manual. Office of Water Regulations and Standards. U.S. Environmental Protection Agency. Washington, D.C. 20460.

EPA. 1991. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance, Standard default Exposure Factors. U.S. Environmental Protection Agency. Washington, D.C. 20460.

EPA. 1995. *Proceedings* of the National Forum on Mercury in Fish. Office of Water. Washington, D.C. 20460. EPA Document Number 823-R-95-002.

EPA. 1999. Proceedings of the 1999 American Fisheries Society Forum on Contaminants in Fish.

EPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Office of Water. U.S. Environmental Protection Agency. Washington, D.C. 20460. EPA Document Number 823-B-00-008.

EPA. 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. Office of Water. U.S. Environmental Protection Agency. Washington, D.C. 20460. EPA Document Number 823-R-01-001.

EPA. 2009. Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion. Office of Water. U.S. Environmental Protection Agency. Washington, D.C. 20460. EPA Document Number 823-R-09-002.

EPA. 2015. Integrated Risk Information System (IRIS) database. Online. (http://www.epa.gov/IRIS/).

EPA. 2015. Regional Screening Levels for Chemical Contaminants. U.S. Environmental Protection Agency – Pacific Southwest, Region 9. Online. (http://www.epa.gov/region9/superfund/prg/).

Goyer, Robert A. 1986. Toxic effects of metals In: Casarett and Doull's Toxicology - The Basic Science of Poisons, 3rd edition, C.D. Vlaassen, M.O. Amdur, and J. Doull, Eds., pp. 605-609.

Harada, H. 1978. Congenital minamata disease: Intrauterine methylmercury poisoning. Teratology 18: 285-288.

LITERATURE CITED – Con't

NDEQ. 1992. Nebraska Stream Inventory. Nebraska Department of Environmental Quality. Lincoln, NE 68509

NDEQ. 2011. Policy for Issuing Nebraska Fish Consumption Advisories. Nebraska Department of Environmental Quality. Lincoln, NE 68509.

NDEQ. 2014. Title 117 – Nebraska Surface Water Quality Standards. Nebraska Department of Environmental Quality. Lincoln, NE 68509.

APPENDIX A

NEBRASKA FISH CONSUMPTION ADVISORIES THROUGH 2014

Important Note: Fish consumption advisories are not bans on eating fish, rather they provide information on the potential risks associated with the consumption of specified fish from certain waterbodies. Nebraska's *Risk Criteria* for issuing fish consumption advisories are based on an 8-oz weekly fillet meal portion combined with a consumer body weight of 70 kg (154 lbs), assuming 100% contaminant absorption, and an exposure period of 30 years.

WATERBODY	ID	FISH TYPE	HEALTH RISK CRITERIA VIOLATED[1]	POLLUTANT OF CONCERN
BIG BLUE RIVER BASIN				
Big Blue River	BB1-10000	Carp	Cancer Risk, Hazard Index	PCBs, Dieldrin
Lake Hastings	BB3-L0050	Carp	Cancer Risk, Hazard Index	PCBs
Recharge Lake	BB3-L0080	Largemouth Bass	Hazard Index, Mercury	Mercury
Rockford Lake	BB1-L0060	Largemouth Bass	Hazard Index, Mercury	Mercury
Walnut Creek #2	BB1-L0100	Largemouth Bass	Hazard Index, Mercury	Mercury
Swanton Lake (Swan Lake 67)	BB2-L0005	Largemouth Bass	Mercury	Mercury
Willard L. Meyer / Swan Creek Lake 5A	BB2-L0020	Largemouth Bass	Hazard Index, Mercury	Mercury
Wolf-Wildcat Lake	BB1-L0050	Largemouth Bass	Hazard Index, Mercury	Mercury
ELKHORN RIVER BASIN				
Johnson Lake	EL1-L0030	Largemouth Bass	Hazard Index, Mercury	Mercury
West Point City Lake	EL1-L0060	Largemouth Bass	Mercury	Mercury
Maskenthine Lake	EL1-L0080	Largemouth Bass	Hazard Index, Mercury	Mercury
Dead Timber Lake	EL1-L0140	Largemouth Bass	Hazard Index, Mercury	Mercury
O'Neill City Lake	EL4-L0060	Largemouth Bass	Hazard Index, Mercury	Mercury
LITTLE BLUE RIVER BASIN				
Crystal Springs NW Lake	LB1-L0020	Channel Catfish	Hazard Index	PCBs, Mercury
Lone Star Reservoir	LB1-L0050	Largemouth Bass	Hazard Index, Mercury	Mercury
Big Sandy Creek	LB2-10200	Channel Catfish	Hazard Index, Mercury	Mercury
Liberty Cove	LB2-L0050	Largemouth Bass	Hazard Index, Mercury	Mercury
LOUP RIVER BASIN				
Columbus City Park Pond	LO1-L0010	Largemouth Bass	Hazard Index, Mercury	Mercury
Farwell South Reservoir	LO3-L0010	Largemouth Bass / Carp	Mercury	Mercury
Davis Creek Lake	LO2-L0015	Carp / White Bass	Mercury	Mercury
Auble Pond	LO2-L0020	Largemouth Bass	Mercury	Mercury
Calamus Reservoir	LO2-L0050	Carp	Mercury	Mercury
Frye Lake - WMA	LO3-L0070	Largemouth Bass	Mercury	Mercury
South Loup River	LO4-10000	Channel Catfish	Mercury	Mercury
Ansley City Lake	LO4-L0030	Largemouth Bass	Mercury	Mercury
Melham Park Lake	LO4-L0040	Largemouth Bass	Mercury	Mercury
Pressey Pond - WMA	LO4-LXXXX	Largemouth Bass	Mercury	Mercury
Pibel Lake	LO1-L0130	Largemouth Bass	Mercury	Mercury
Ravenna Lake	LO4-L0010	Largemouth Bass	Mercury	Mercury
Sherman Reservoir	LO3-L0020	White Bass	Mercury	Mercury

[1] The Risk Criteria established by the Nebraska Fish Tissue Advisory Committee include fish tissue that: (1) are found to have mercury concentrations > 0.215 mg/kg, (2) have contaminant concentrations that may be associated with adverse health effects (Hazard Index > 1.0) or (3) may be associated with an excess Cancer Risk > 1 in 10,000 when ingested.

WATERBODY	ID	FISH TYPE	HEALTH RISK CRITERIA VIOLATED[1]	POLLUTANT OF CONCERN
LOWER PLATTE RIVER BASIN				
Bluestem Lake	LP2-L0110	Channel Cat	Hazard Index, Mercury	Mercury
Czechland Lake	LP2-L0270	Largemouth Bass	Hazard Index, Mercury	Mercury
Fremont Lake No. 1	LP1-L0290	Largemouth Bass	Hazard Index, Mercury	Mercury
Holmes Lake	LP2-L0040	Largemouth Bass	Hazard Index, Mercury	Mercury
Memphis Lake	LP2-L0010	Largemouth Bass	Mercury	Mercury
Merganser Lake	LP2-L0170	Largemouth Bass	Hazard Index, Mercury	Mercury
Oak Creek	LP2-20500	Channel Cat	Hazard Index	PCBs, Mercury
Platte River	LP1-10000	Channel Cat	Hazard Index	PCBs, Mercury
Salt Creek	LP2-20000	Carp	Hazard Index	PCBs, Mercury
Stagecoach Lake	LP2-L0050	Largemouth Bass	Hazard Index, Mercury	Mercury
Wagon Train Lake	LP2-L0030	Largemouth Bass	Hazard Index, Mercury	Mercury
Wildwood Reservoir	LP2-L0120	Largemouth Bass	Hazard Index, Mercury	Mercury
MIDDLE PLATTE RIVER BASIN				
Tri-County Supply Canal - below J1 hydro	MP2-20500	Carp	Hazard Index	PCBs
Mormon Island Middle Lake - SRA	MP2-L0060	Largemouth Bass	Mercury	Mercury
L.E. Ray Lake	MP2-L0061	Largemouth Bass	Mercury	Mercury
Cheyenne Lake - SRA	MP2-L0100	Largemouth Bass	Mercury	Mercury
Wax Axe Lake - SRA	MP2-L0120	Smallmouth Bass	Mercury	Mercury
Bassway Strip Lake No. 5	MP2-L0190	Largemouth Bass	Mercury	Mercury
Kea Lake - WMA	MP2-L0320	Largemouth Bass	Mercury	Mercury
Kea West Lake - WMA	MP2-L0340	Largemouth Bass	Mercury	Mercury
Cottonmill Lake	MP2-L0360	Largemouth Bass	Mercury	Mercury
Union Pacific Lake - SRA	MP2-L0390	Largemouth Bass	Mercury	Mercury
Coot Shallows Lake - WMA	MP2-L0400	Largemouth Bass	Mercury	Mercury
Sandy Channel Lake - SRA	MP2-L0420	Largemouth Bass	Mercury	Mercury
Blue Hole Lake - WMA	MP2-L0430	Largemouth Bass	Mercury	Mercury
Dogwood Lake - WMA	MP2-L0460	Largemouth Bass	Mercury	Mercury
Phillips Lake	MP2-L0500	Carp	Hazard Index, Mercury	Mercury
Elwood Reservoir	MP2-L0540	Northern Pike / Largemouth Bass	Mercury	Mercury
Darr Lake - WMA	MP2-L0550	Largemouth Bass	Mercury	Mercury
Plum Creek Canyon Reservoir	MP2-L0560	Carp	Cancer Risk , Hazard Index	PCBs
West Cozad Lake - WMA	MP2-L0580	Largemouth Bass	Mercury	Mercury
Cozad Lake - WMA	MP2-L0590	Largemouth Bass	Mercury	Mercury
East Gothenburg Lake - WMA	MP2-L0681	Largemouth Bass	Mercury	Mercury
Fort McPherson Lake	MP2-L0770	Largemouth Bass	Mercury	Mercury
Fremont Slough - WMA	MP2-L0840	Largemouth Bass	Mercury	Mercury

[1] The Risk Criteria established by the Nebraska Fish Tissue Advisory Committee include fish tissue that: (1) are found to have mercury concentrations > 0.215 mg/kg, (2) have contaminant concentrations that may be associated with adverse health effects (Hazard Index > 1.0) or (3) may be associated with an excess Cancer Risk > 1 in 10,000 when ingested.

WATERBODY	ID	FISH TYPE	HEALTH RISK CRITERIA VIOLATED[1]	POLLUTANT OF CONCERN
MIDDLE PLATTE RIVER BASIN- CON'T				
Pawnee Slough Lake	MP2-LXXXX	Largemouth Bass	Mercury	Mercury
Yanney Park Lake	MP2-LXXXX	Largemouth Bass	Mercury	Mercury
MISSOURI TRIBUTARIES RIVER BASIN				
Carter Lake	MT1-L0090	Largemouth Bass	Hazard Index	PCBs
Chalkrock Reservoir	MT2-L0020	Largemouth Bass	Hazard Index	Mercury, Selenium
Crystal Cove Lake	MT1-L0020	Largemouth Bass	Hazard Index, Mercury	Mercury
Offutt Lake	MT1-L0010	Channel Cat	Cancer Risk	PCBs
Halleck Park Lake	MT1-L0023	Largemouth Bass	Hazard Index	Mercury, Selenium
Prairie View Lake	MT1-LXXXX	Largemouth Bass	Hazard Index, Mercury	Mercury
Standing Bear Lake	MT1-L0100	Largemouth Bass	Hazard Index, Mercury	Mercury
Walnut Creek Lake	MT1-L0025	Largemouth Bass	Hazard Index, Mercury	Mercury
Wehrspann Lake	MT1-L0030	Largemouth Bass	Hazard Index, Mercury	Mercury
West Papillion Creek	MT1-10250	Carp	Hazard Index	PCBs, Mercury
Zorinsky Lake	MT1-L0050	Largemouth Bass	Hazard Index, Mercury	Mercury
NEMAHA RIVER BASIN				
Burchard Lake	NE2-L0120	Largemouth Bass	Hazard Index, Mercury	Mercury
Iron Horse Trail Lake	NE2-L0090	Largemouth Bass	Hazard Index, Mercury	Mercury
Kirkman's Cove Lake	NE2-L0040	Carp, Largemouth Bass	Hazard Index, Mercury / Mercury	Mercury
Mayberry Lake -WMA	NE2-LXXXX	Largemouth Bass	Hazard Index, Mercury	Mercury
Prairie Knoll Lake	NE2-L0080	Largemouth Bass	Hazard Index, Mercury	Mercury
Steinart Park Lake	NE1-L0010	Largemouth Bass	Hazard Index, Mercury	Mercury
Verdon Lake	NE2-L0020	Largemouth Bass	Hazard Index, Mercury	Mercury
Weeping Water City Lake	NE1-L0020	Largemouth Bass	Hazard Index, Mercury	Mercury, Selenium
NIOBRARA RIVER BASIN				
Missouri River	NI1-10000	Flathead Catfish	Mercury	Mercury
Duck Lake	NI3-L0320	Largemouth Bass	Mercury	Mercury
Schoolhouse Lake	NI3-LXXXX	Northern Pike / Largemouth Bass / Black Crappie	Mercury	Mercury
Box Butte Reservoir	NI4-L0080	Northern Pike / Largemouth Bass	Mercury	Mercury
Cottonwood Lake	NI4-L0010	Largemouth Bass	Mercury	Mercury
Cub Creek Lake	NI3-L0070	Largemouth Bass	Mercury	Mercury
Merritt Reservoir	NI3-L0330	Walleye / Largemouth Bass	Mercury	Mercury
Shell Lake	NI4-L0020	Largemouth Bass	Mercury	Mercury
Smith Lake	NI4-L0040	Largemouth Bass	Mercury	Mercury
Valentine Mill Pond	NI3-L0170	Largemouth Bass / Bluegill	Mercury	Mercury
Walgren Lake	NI4-L0050	Largemouth Bass	Mercury	Mercury
NORTH PLATTE RIVER BASIN				
Bridgeport Middle Lake	NP3-L0030	Largemouth Bass	Mercury	Mercury

[1] The *Risk Criteria* established by the Nebraska Fish Tissue Advisory Committee include fish tissue that: (1) are found to have mercury concentrations $\geq$ 0.215 mg/kg, (2) have contaminant concentrations that may be associated with adverse health effects (Hazard Index $\geq$ 1.0) or (3) may be associated with an excess Cancer Risk $\geq$ 1 in 10,000 when ingested.

WATERBODY	ID	FISH TYPE	HEALTH RISK CRITERIA VIOLATED[1]	POLLUTANT OF CONCERN
NORTH PLATTE RIVER BASIN – CON'T				
Crescent Lake	NP2-LXXXX	Largemouth Bass	Mercury	Mercury
Island Lake	NP2-L0110	Largemouth Bass	Mercury	Mercury
Lake McConaughy	NP2-L0010	Walleye	Hazard Index, Mercury	Mercury, Selenium
Morrill Sandpit - Southwest	NP2-LXXXX	Largemouth Bass	Mercury	Mercury
Morrill Sandpit - North	NP2-LXXXX	Largemouth Bass	Hazard Index, Mercury	Mercury, Selenium
North Platte River	NP1-10000	Largemouth Bass	Hazard Index, Mercury	Mercury
North Platte River	NP3-10000	Carp	Hazard Index	Mercury, Selenium
Smith Lake	NP2-L0290	Largemouth Bass	Hazard Index, Mercury	Mercury
REPUBLICAN RIVER BASIN				
Frenchman WMA Lake	RE3-LXXXX	Largemouth Bass	Hazard Index, Mercury	Mercury
Holdrege Park Lake	RE1-L0040	Largemouth Bass	Hazard Index	Mercury, Selenium
Medicine Creek Reservoir	RE3-L0010	Largemouth Bass	Mercury	Mercury
Hayes Center WMA Lake	RE3-L0080	Largemouth Bass	Mercury	Mercury
Rock Creek Lake	RE3-L0120	Largemouth Bass	Hazard Index, Mercury	Mercury
SOUTH PLATTE RIVER BASIN				
Birdwood Lake	SP1-L0030	Largemouth Bass	Mercury	Mercury
Chappell Interstate Lake	SP2-L0010	Largemouth Bass	Hazard Index	Mercury, Selenium
East Hershey Lake	SP1-L0040	Largemouth Bass	Mercury	Mercury
East Sutherland Lake	SP1-L0070	Largemouth Bass	Mercury	Mercury
Hershey Lake	SP1-L0050	Largemouth Bass	Mercury	Mercury
Maloney Res. Outlet Canal - above hydro	SP1-10500	Carp	Hazard Index	PCBs, Mercury
Maloney Res. Outlet Canal - below hydro	SP1-10500	Channel Cat / Smallmouth Bass	Cancer Risk, Hazard Index / Mercury	PCBs / Mercury
North Platte Interstate Lake	SP1-L0010	Largemouth Bass	Mercury	Mercury
Ogallala City Park Lake	SP1-L0090	Channel Catfish	Cancer Risk	PCBs, Chlordane
Sutherland Reservoir	SP1-L0080	Carp	Hazard Index	PCBs, Mercury
Sutherland Cooling Pond	SP1-LXXXX	Carp / Largemouth Bass	Hazard Index / Mercury	Mercury, Selenium / Mercury
Sutherland Outlet Canal	SP1-10600	Channel Catfish	Hazard Index	PCBs, Mercury
WHITE-HAT CREEK RIVER BASIN				
Carter P. Johnson Lake	WH1-L0200	Largemouth Bass	Hazard Index, Mercury	Mercury
Grabel Pond #5	WH1-L0170	Largemouth Bass	Hazard Index, Mercury	Mercury, Selenium
Isham Dam Lake	WH1-L0010	Largemouth Bass	Hazard Index, Mercury	Mercury
Whitney Reservoir	WH1-L0060	White Bass	Mercury	Mercury

[1] The *Risk Criteria* established by the Nebraska Fish Tissue Advisory Committee include fish tissue that: (1) are found to have mercury concentrations $\geq$ 0.215 mg/kg, (2) have contaminant concentrations that may be associated with adverse health effects (Hazard Index $\geq$ 1.0) or (3) may be associated with an excess Cancer Risk $\geq$ 1 in 10,000 when ingested.

APPENDIX B

FISH CONSUMPTION ADVISORY SITES IN NEBRASKA THROUGH 2014