

**State Of Ohio
Cooperative Fish Tissue Monitoring Program
Sport Fish Tissue Consumption Advisory Program**

Final

Last Revised October 2010

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Acronyms

BPJ	Best Professional Judgment
DES	Division of Environmental Services
DSW	Division of Surface Water
EPA	Environmental Protection Agency
FDA	Food and Drug Administration
GLSFATF	Great Lakes Sport Fish Advisory Task Force
HPV	Human Protection Value
HUC	Hydrologic Unit Code
IRIS	Integrated Risk Information System
ND	Not Detected
ODH	Ohio Department of Health
ODNR	Ohio Department of Natural Resources
ORSANCO	Ohio River Valley Water Sanitation Commission
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
RfD	Reference Dose
RL	Reporting Limit
RM	River Mile
SOP	Standard Operating Procedure
TOC	Total Organic Carbon
USGS	United States Geological Survey

1.0 Introduction to Fish Tissue Data Advisory Calculations

A standardized fish tissue risk assessment procedure is used to calculate fish consumption risk, and to determine if and to what level a fish consumption advisory issuance is necessary. A best professional judgment (BPJ) procedure may be used in certain circumstances. The following text describes the sport fish consumption advisory procedures currently used by the State of Ohio.

2.0 History

The State of Ohio adopted the “Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory” (September 1993) on January 10, 1994, developed by the Great Lakes Sport Fish Advisory Task Force (GLSFATF) for the Great Lakes’ Governors (Ohio Department of Health 1994). The “Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory” procedure uses a Total Polychlorinated Biphenyl (PCB) Health Protection Value (HPV) to protect sensitive populations, defined as women of childbearing age and children fifteen years old and younger, against reproductive health effects.

The State of Ohio deviated slightly from the Agreement’s Total PCB HPV concentration for the “eat no more than one meal per week” upper limit. The State of Ohio used 0.30 mg Total PCBs (analyzed and reported as the sum of Aroclors 1061, 1221, 1232, 1242, 1248, 1254 and 1260) in raw fish as the “eat no more than one meal per week upper limit” (i.e., 52 meals per year) for fish caught in Lake Erie from 1994 to 2003 in place of the Agreement’s 0.22 mg Total PCBs in raw fish “eat no more than one meal per week upper limit.” A Total PCB HPV concentration of 0.22 mg “eat no more than one meal per week upper limit” Total PCBs in raw fish was used in Ohio from 1994 for all fish consumption risk assessment calculations for all other Ohio jurisdictional water bodies.

The Ohio Department of Health (ODH) was responsible for calculating fish consumption advisory limits until July 2002. ODH’s Sport Fish Monitoring Program participation was discontinued due to budget constraints.

Beginning in January 2003, all fish consumption advisory calculations for all Ohio jurisdictional waters use the Agreement’s 0.22 mg Total PCBs in raw fish for “eat no more than one meal per week upper limit.” Beginning in July 2003, the Ohio EPA, Division of Surface Water (DSW), was responsible for calculating fish consumption risk assessments. ODH is responsible for releasing fish consumption advice to the public.

In February 2007, two modifications were made to the fish consumption advisory calculations. Until that time, if any calculated contaminant concentration using the GLSFATF’s Procedure exceeded a U.S. Food and Drug Administration’s (FDA) Action Level (Table 2), the FDA’s Action Level superseded the GLSFATF’s calculated value,

except where the FDA Action Level could be shown to be outdated and newer information was available. Fish fillet chemical concentrations and calculated consumption rates using the GLSFATF's Model, and FDA's Action Levels that supersede the GLSFATF's calculated values, were used to issue fish consumption advisories in Ohio.

Beginning in February 2007, FDA Action Levels were no longer used to issue fish consumption advisories. The FDA has reiterated numerous times at fish advisory conferences and meetings that the Action Levels are not intended to be used as cutoffs for issuing fish advisories.

Also in February 2007, Ohio officially adopted the April 2006 Mercury Addendum to the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory. The main change to the fish advisory program as a result of adopting this protocol is the addition of a "Two Meals Per Week" category based upon mercury fillet concentrations only. All other contaminants will continue to be monitored using the advisory levels set forth in the original 1993 Protocol.

In May 2008, Ohio modified its fish tissue collection program such that all fish collected from inland waters to be used in the advisory calculations are to be collected as skin-off fillets. Lake Erie and Ohio River samples will continue to be collected as skin-on fillets for all scaled fishes except carp. All PCB calculations will be adjusted to skin-on concentrations based on database-determined species-specific lipid levels to remain consistent with exposure assumptions.

A detailed description of the historical Fish Tissue Consumption Advisory Monitoring Program can be found in Ohio EPA's 1992, 1994 and 1996 305(b) Biennial Reports to Congress.

3.0 Current Procedure

The State of Ohio adopted the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (September 1993) on January 10, 1994, developed by the Great Lakes Sport Fish Advisory Task Force for the Great Lakes' Governors. Five advisory levels are used in Ohio's risk assessment procedure for fish consumption advice for each chemical evaluated. The five consumption advisory categories are: unrestricted (225 meals/year); 1 meal/week (52 meals /year); 1 meal/month (12 meals/year); 6 meals/year; and no consumption.

In February 2007, the State of Ohio adopted the Mercury Addendum to the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (September 1993). This addendum includes a 2 meals/week category (104 meals/year), and eliminates the 6 meals/year category for mercury only.

Table 1 "Ohio Fish Consumption Advisory Chemicals: Fillet Chemical Concentrations

and Meal Consumption Rates” identifies all the chemicals for which consumption rates for fish caught in Ohio waters have been calculated.

4.0 Chemical Parameters

4.1 PCBs

For PCBs, the Great Lakes’ Governors Sport Fish Advisory Procedure’s weight of evidence HPV concentration of 0.05 µg Total PCBs/kg/day is used. An ingestion rate of 0.22 mg per week of Total PCBs in raw fish is the upper risk limit for a reduction in fish consumption to “eat no more than once per week.” A Total PCB ingestion rate of from 0.22 to 1.0 mg per week is the raw fish PCB concentration range for reducing fish consumption to “eat no more than one meal per month” or 12 meals per year. Refer to Table 1 for additional information.

4.2 Mercury

For mercury, the Great Lakes’ Governors Sport Fish Advisory Procedure’s use of U.S. EPA’s Reference Dose (RfD) of 0.1 µg Methylmercury/kg/day is used. An ingestion rate of 0.11 mg per week of mercury in raw fish is the upper risk limit for a reduction in fish consumption to “eat no more than twice per week.” A mercury ingestion rate of 0.11 to 0.22 mg per week is the raw fish mercury concentrations range for reducing fish consumption to “eat no more than once per week” or 52 meals per year. Refer to Table 1 for additional information.

4.3 Other Chemicals

For all other chemicals except lead, Toxaphene and the alkylated biphenyl mixtures SAS 305 and SAS 310, Ohio fish consumption risk assessment calculations use a U.S. EPA Reference Dose (RfD) to determine if and at what level a fish consumption advisory issuance is necessary. U.S. EPA’s RfD concentrations can be found in U.S. EPA’s Integrated Risk Information System (IRIS) Database. The Ohio sport fish consumption advisory RfDs are updated as U.S. EPA’s IRIS data are updated. The RfD values identified in this document were verified during September 2003.

4.4 Lead

For lead, U.S. FDA’s lead protection Total Tolerable Daily Intake concentration of 6.0 µg/day is used in fish consumption risk assessment calculations.

4.5 Alkylated Biphenyl Mixtures SAS 305 and SAS 310

For alkylated biphenyl SAS 305 and SAS 310 mixtures, RfDs of 50.0 µg/kg/day and 28.6 µg/kg/day are used, respectively (Woltering 2001).

4.6 Toxaphene

For Toxaphene, U.S. EPA's Office of Pesticide Program's RfD of 0.25 µg/kg/day is used in fish consumption risk assessment calculations.

5.0 Great Lakes' Governors Sport Fish Advisory Procedure's Model Assumptions

The Great Lakes Governors' Sport Fish Advisory Procedure's Model Assumptions are used in all Ohio fish consumption risk assessment calculations. They include: an average meal of 227 g (one-half pound) of uncooked fish; a 70 kg (154 pound) adult; and a 70 year exposure.

6.0 Assessment Procedures

6.1 Lake Erie and Ohio River Assessments

The Ohio Department of Natural Resources (ODNR) is responsible for collecting Lake Erie and Ohio River fish samples for Ohio's Fish Tissue Monitoring Program. The Ohio River Valley Water Sanitation Commission (ORSANCO) also collects fish samples from the Ohio River and Ohio River tributary mouths. Ohio EPA's standard operating procedures (SOPs) for sample collection, identification, preparation, preservation and transport are followed (Ohio EPA 2008).

For Lake Erie, station locations are identified by Lake Erie grid number (Smith *et al.* 1961). The latitude and longitude of the Lake Erie grid number's center where the fish are caught is used to identify the Lake Erie fish collection station location. A station where the grid's center latitude and longitude are located on land along the Lake Erie shore is moved within the grid so that the station latitude and longitude are located over the Lake.

Geographic collecting areas described by numbered, north-south boundaries should not be used to identify fish tissue sample collection locations. Historically, ODNR identified project collection geographic areas by describing numbered, north-south boundaries. Two historically defined boundary area examples are: Area 1 - Maumee Bay; Area 3 - Toussaint River to Catawba Point (ODNR 1989). Area boundaries were changed over the years for different projects (ODNR 1989; ODNR 1990; ODNR 1991; and ODNR 1992). There was no consistency for ODNR boundary locations and area descriptions.

ODNR follows the same fish sampling and sample preparation procedures that are used by Ohio EPA in large Ohio rivers when collecting Ohio River samples. The ODNR/Ohio EPA collection and analyses of Ohio River fish samples are done independent of the Ohio River Valley Water Sanitation Commission's (ORSANCO's) Ohio River Fish Tissue Monitoring Program. ORSANCO and Ohio EPA exchange and share Ohio River

fish tissue data; ORSANCO's data, along with Ohio EPA's data, are used in issuing Ohio River fish consumption advisories. Ohio EPA is responsible for assessing all Ohio River data collected in Ohio jurisdictional waters and issuing fish consumption advisories as needed.

6.2 River and Stream Assessments

Ohio EPA is responsible for collecting Ohio river and stream fish samples for Ohio's Fish Tissue Monitoring Program. The number of fish tissue sampling stations in a river or stream is dependent upon river/stream size. In large rivers like the Scioto River or Muskingum River, sampling stations are located every 9 or 10 miles. In smaller rivers/streams like the Olentangy River or Darby Creek, sampling stations are located every 5 to 7 miles. In small streams like Scippo Creek, located in Circleville, 3 sampling locations, one at an upstream control location or upstream from an entity/location of concern, a near downstream location and a far downstream location are needed. The final number of stations may be adjusted based upon data requirements.

Human health assessments may require four stations, the fourth location being a second far downstream location. When the area of concern is located close to a river confluence, the confluence is bracketed with sampling locations upstream and downstream from the confluence. Heavily fished streams like the Mad River and the Stillwater River have fish tissue sampling stations every 5 miles. A stream location that is visually impacted, or that is known to be receiving chemicals of concern, may be bracketed by additional station locations to evaluate fish tissue chemical uptake.

Fish sampling zone distance varies. If all the priority fish species, numbers and sizes are collected in a small area, the crew processes the samples and then proceeds to the next station. Within a reach, crews generally move from spot to spot sampling the proper habitat for the larger species. In larger rivers, the sampling zone distance is approximately 300 to 500 meters. At wading sites, crews generally sample approximately 100 to 200 meters. A fish tissue sampling station location is defined as the midpoint latitude and longitude of the sampling zone. Longer distances may be sampled if there is very good habitat, but the priority fish can not be found within the standard distances. Usually, standard distance zone sampling requires 45 minutes to one hour to either collect the required specimens, or to make the decision to move to the next sampling location. Samples are collected by moving from downstream locations to upstream locations in wading sized streams. Rivers and streams that are sampled with boat electro-fishing equipment are sampled from upstream to downstream going with the current.

6.3 Inland Lake and Reservoir Assessments

ODNR is responsible for collecting inland lake and reservoir fish samples for Ohio's Fish Tissue Monitoring Program. The number of fish sample locations in inland lakes and reservoirs varies. A small lake/reservoir will have one fish sampling location, most

lakes/reservoirs will have two sampling locations and large lakes/reservoirs will have three or more sampling locations. At least three priority species specific composite samples are collected at each sampling location in a screening evaluation. Additional samples are collected at each location in follow-up lake evaluations. Specific species collected and analyzed at a lake/reservoir may be selected based upon ODNR creel data and/or stocking and management activities. This evaluation procedure is considered a screening to determine if there are any fish tissue contaminant problems. If a possible problem is identified, follow-up sample collections and analyses are scheduled. Usually, follow-up sampling and data are required prior to issuing lake/reservoir fish consumption advisory advice.

7.0 Fish Tissue and Sediment Sampling for Environmental Assessment

For environmental assessment studies, a human health fish consumption assessment must also include the analysis of at least one sediment sample per fish tissue sampling location. Sediment samples are collected, identified, processed and transported on ice to the laboratory for analyses according to Ohio EPA described methods and standard operating procedures (SOPs) (Ohio EPA 2001). A composite surficial sediment sample of from 0 to 3 inches, and no deeper than 6 inches, must be collected according to Ohio EPA's sediment collecting procedures (Ohio EPA 2001). The sediment samples should be analyzed for the parameters of concern that were identified for the fish tissue sample. Sediment samples must also include analytical results for Total Organic Carbon (TOC) and sediment particle composition (see Table 4 for analyte reporting limits -RLs).

7.1 Sample Collection, Preparation and Transport

Fish fillet composite samples are collected, identified, processed and transported on ice to a storage area where they are kept frozen at minus twenty-one degrees Celsius until they are transported to the laboratory for analyses according to the Ohio EPA described methods and standard operating procedures (SOPs) (Ohio EPA 2004; Ohio EPA, DES). Sample collection, storage and transport to the DES Laboratory must be documented with Chain of Custody per Ohio EPA requirements.

Fillet composite samples of most sport caught fish are analyzed as skin-off samples. Fat is not trimmed from the fillets. The percent lipid is analyzed and reported for all fish tissue samples.

Fillet composite samples consist of both fillets of from two to five fish of the same species (Ohio EPA 2008). The minimum sample wet weight prepared for analyses is 150 grams. The minimum number of fish for a composite sample is two fish. More than a five fish composite may be used to meet the minimum 150 gram sample weight requirement if the fish being collected from the site are small and are an important or priority species for monitoring. Under certain conditions, a large, single fish fillet composite can be analyzed if no other fish for that species are available. A three to five

fish composite sample is usually collected for analyses. Fish are measured (in millimeters), weighed (in kilograms), rinsed, scaled or skinned and filleted in the field. The smallest fish in the sample must be within ten percent of the total length of the largest fish in the sample.

7.2 Fillet Preparation

A skin-on "Standard Fillet" is prepared using the following procedure. The fish is rinsed with water taken from the stream from which the fish is collected to remove any sediment and/or organic matter present on the fish. All scales are then removed. A shallow cut is made through the skin on either side of the dorsal fin from the base of the head to the tail. A second cut is made along the entire length of the gill cover cutting through skin and flesh to the bone. A third cut is made along the belly (includes the belly flap) from the base of the pectoral fin to the tail and along the side of the anus and the fin directly behind. The skin-on fillet is removed and major bones are removed. Both fillets are prepared as described and Ohio EPA SOPs are followed for the remainder of the sample preparation, transport, storage and analyses. Skin-off fillets are prepared using the same procedure as skin-on fillets, except that the skin is removed from the fillet.

7.3 Sample Analyses

The Ohio EPA, Division of Environmental Services (DES) usually analyzes Ohio EPA's fish tissue samples (Ohio EPA, DES). DES' Fish Tissue Monitoring Program's analytes and their reporting limits (RLs) are listed in Table 4. Additional parameters may be analyzed by DES on an as-needed basis. Occasionally, Ohio EPA uses consultant laboratories for fish tissue analyses for special studies/parameters, e.g., dioxin analysis.

8.0 Data Related Issues

8.1 Best Professional Judgment (BPJ) Advisory Assessment Procedures

8.1.1 Sample Criteria not Met

A best professional judgment (BPJ) decision outside of the defined GLSFATF's Model Fish Advisory Issuance Procedure can be made if there are less than five samples, and at least three sample results at a specific location all have "very high" tissue contaminant concentrations (i.e., exceed the do not eat concentration for the parameter of concern). The GLSFATF's Model calculations, procedures and requirements are not used in this scenario.

8.1.2 Advisory Issuance for Special Situations

Historically, ODH issued fish consumption advisories when fish were found in areas where there were high concentrations of Polycyclic Aromatic Hydrocarbons

(PAHs) (in excess of 100 mg/kg dry weight Total PAHs) in sediment and a high incidence of external fish tumors.

Advisories have also been issued without fish tissue data in cases where the Agency representatives believed that, based on water column concentrations of algal toxins, there may be a risk to human health from fish consumption.

8.2 Sample Data Requirements for a Fish Consumption Advisory Risk Assessment

8.2.1 Minimum Data Requirements Using the GLSFATF Model

The minimum number of sample results per species per river or stream reach for a fish consumption advisory risk assessment using the GLSFATF's Model is five sample results (no fewer). The minimum number of sample results per species for Lake Erie for a fish consumption advisory risk assessment using the GLSFATF's Model is 40 sample results.

Inland lakes and reservoirs are initially screened to identify possible fish tissue chemical problems. If a problem(s) is/are identified, follow-up sampling and analyses are scheduled. All data are reviewed prior to issuing any lake/reservoir advisory recommendation. The BPJ procedure previously described may be used to issue an advisory if the BPJ criteria are met.

8.2.2 Number of Years of Data Used in a Fish Consumption Advisory Assessment

All data from the last five years are included in fish consumption risk assessment calculations. If the data for the last five years are very limited, previous data going back further than five years, but not more than ten years, may be used.

The exception to this is algal toxin fish tissue data. Because of the transitory nature of algal toxins in both the water column and in fish, best professional judgment should be used in determining time frames for inclusion of data in a risk assessment. For example, 3 month, 6 month, or 1 year windows of time, depending on fluctuating blooms and toxin concentrations, as well as data availability, could be used in determining appropriate exposure concentrations. The time frame selected for a particular water body and algal toxin should be written up and justified on a case-by-case basis as part of the supporting documentation for the advisory.

8.2.3 Not-detected Concentrations

One-half of the laboratory's reporting limit (RL) (Table 4) for the chemical is used in fish consumption advisory calculations to determine average contaminant concentration. The laboratory's reported not-detected (ND) concentration is not

used in fish consumption risk assessment calculations.

8.2.4 Laboratory Qualified Data

The Ohio EPA's Laboratory definition of laboratory data qualifiers:

B = The analytical result is estimated. The organic compound is found in the method blank as well as in the sample;

J = The analyte was positively identified, and the associated numerical value is estimated;

PS = The reported result is estimated because the sample was not submitted to the laboratory within the required shipping time;

R = The analyte result is unusable because quality control criteria were not met;

U = the analyte is reported with a value between its reported quantification detection limit and its lowest calibration standard.

Laboratory data qualified with the qualifiers B, J, PS and U, or a combination of the qualifiers, are used when calculating data and issuing fish consumption advisories. Laboratory data qualified with R are not used.

8.2.5 Tissue Chemical Concentration Reductions

PCB tissue concentrations in raw fillets are reduced by one-half to account for contaminant loss through proper trimming and cooking. Mercury tissue concentrations are not reduced. Tissue contaminant concentrations for other chemicals are reduced to account for contaminant loss through cooking if the chemical undergoing consumption risk evaluation has chemical characteristics similar to PCBs, i.e., has a high (> 3.0) octanol/water partition coefficient (Kow), and is concentrated in fatty tissue rather than muscle. Tissue contaminant concentrations for chemicals that do not have chemical characteristics similar to PCBs are not reduced by one-half prior to fish consumption risk assessment calculations, e.g., mercury.

Fish tissue concentrations are not normalized for percent lipid prior to performing fish consumption advisory calculations. This was done in order to calculate the per meal consumption exposure.

8.2.6 Methodology for Lipid-Normalizing Fillet Data

Lipid levels were calculated using Ohio fish tissue data from 1998 to 2006. The median lipid level of skin-on fillets was calculated for each species with available data. Median lipid levels for each species are shown in Table 3.

Lipid levels of skin-off fillets for scaled fish should be adjusted to skin-on levels

for PCB and pesticide evaluations using the following equation:

Equation 1

$$PCB_{SOF_{adj}} = \frac{PCB_{SFF} \times \%Lipid_{med}}{\%Lipid_{SFF}}$$

Where:

Abbreviation	Definition	Units
PCB _{SOFadj}	Skin-off fillet PCB concentration adjusted to reflect skin-on fillet lipid concentration	µg/kg or mg/kg
PCB _{SFF}	Skin-off fillet PCB concentration	µg/kg or mg/kg
%Lipid _{med}	Median percent lipid level for species	unitless
%Lipid _{SFF}	Percent lipid in skin-off fillet	unitless

In cases where, for a given sample, lipid levels exceed the median, PCB or pesticide levels should not be adjusted. Since the purpose of adjusting contaminant levels based on the median lipid level is not to ensure accuracy as much as to prevent underestimation of contaminant levels, downward contaminant level adjustment is not appropriate.

9.0 Fish Consumption Advisory Data Decision Making Details

9.1 Inland Lakes and Reservoirs

9.1.1 Inland Lake And Reservoir Fish Consumption Advisories for “Consume No More Than One Meal Per Month” or More Restrictive Consumption Advisories

Advisories issued for “consume no more than one meal per month” or more restrictive consumption advisories require at least two species specific samples with an average contaminant concentration exceeding the advisory lower limit threshold for issuance (see Table 3). When there is only one species specific sample result above the advisory lower limit threshold and relevant historical data does not exist, additional sampling is required. For inland lake and reservoir locations, historical data back to ten years old can be combined and used with more recent data for advisory issuance.

9.1.2 Inland Lake And Reservoir Fish Consumption Advisories for “Consume No

More Than Two Meals Per Week”

A fish consumption advisory is issued for “consume no more than two meals per week” when at least three sample results for the same species are below the one meal per week lower threshold contaminant concentration (see Table 1). A fish consumption advisory is not issued for “consume no more than two meals per week” when a multiple sample species specific average result is greater than the one meal per week lower threshold contaminant concentration.

Inland lake and reservoir information identifying the fish consumption advisory category and location is disseminated to the public and presented on Ohio EPA’s Web site (www.epa.state.oh.us/dsw/fishadvisory/index.aspx).

9.2 *Rivers and Streams*

9.2.1 River And Stream Fish Consumption Advisories for “Consume No More Than One Meal Per Month” or More Restrictive Consumption Advisories, With Three Sample Results Available

Situations When Additional Sampling Is Required.

Advisories issued at the “do not consume more than one meal per month,” or more restrictive consumption advisories, require at least three species specific samples with each sample result exceeding the advisory lower limit threshold for issuance (see Table 3). For river and stream locations, historical data generated within the last five years is combined and used with more recent data for advisory issuance. Under certain circumstances, when data are very limited, historical data generated within the last ten years may be combined and used with recent data for advisory issuance.

When there are three species specific sample results, and two results exceed the “do not consume more than once per two months” and the third result exceeds the “do not consume more than once per month” advisory lower limit threshold, or two sample results exceed the “do not consume more than once per month” and one result exceeds the “do not consume more than once per two months” lower limit threshold, with no additional, relevant existing historical data, a “do not consume more that once per month” consumption advisory is issued and additional sampling is required.

Threshold Exceeded

Sample 1	Once per two months
Sample 2	Once per two months
Sample 3	Once per month

Threshold Exceeded

Sample 1	Once per month
Sample 2	Once per month
Sample 3	Once per two months

Action	Additional sampling	Action	Additional sampling
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When there are three species specific sample results, and two results exceed the “do not consume more than once per week” and the third result exceeds the “do not consume more than once per month” advisory lower limit threshold, or two sample results exceed the “do not consume more than once per month” and one result exceeds the “do not consume more than once per week” lower limit threshold, with no additional, relevant historical data, additional sampling is required.

Threshold Exceeded		Threshold Exceeded	
Sample 1	Once per week	Sample 1	Once per month
Sample 2	Once per week	Sample 2	Once per month
Sample 3	Once per month	Sample 3	Once per week
Action	Additional sampling	Action	Additional sampling

9.2.2 River And Stream Fish Consumption Advisories for “Consume One Meal Per Month” or More Restrictive Consumption Advisories, With More Than Three Sample Results Available

And

Delineating River And Stream Reach, Graphical Presentation of Data, Use of HUC Watershed Codes And Consumption Advisory Information Related to Fish Size

A logarithmic regression analysis of data must be used when adequate data are available. The r squared correlation value must be 0.5 or above.

All data outliers are included in the data population distribution. A river contaminant profile should also be generated when the data are available with a histogram that indicates contaminant concentration (y axis) as one proceeds from the highest river mile sampled to the lowest river mile sampled (x axis) in an evaluated reach.

Results are ranked by contaminant concentration in rivers and streams with four or more species specific sample results. When some sample concentrations are below and others are above the advisory threshold concentration indicated by the average contaminant concentration for all samples, the sample concentrations are graphed as concentration versus river mile and concentration versus average length of fish sampled. A logarithmic regression is plotted and a correlation coefficient calculated. If the correlation coefficient is greater than 0.5, the advisory takes into account the regression line in determining river reach or fish

size delineation. The advisory is issued across the entire sampled river reach and for all sizes of a fish species sampled when the correlation coefficient is less than 0.5 and the average of the data is greater than the advisory limit.

Once a river or stream reach has been delineated by an upstream and downstream river mile (RM), either by using sampling locations described in the fish sample collection field log by the collecting team or by using regression curves, U.S. Geological Survey (USGS) 7.5 minute topographic maps are used to identify appropriate landmarks associated with the RM location, e.g., roads, dams, wastewater treatment plants, etc.

River and stream information identifying the fish consumption advisory category and location, which includes geographic and/or physical delineated reach boundaries, is disseminated to the public and presented on Ohio EPA's Web site (www.epa.state.oh.us/dsw/fishadvisory/index.aspx).

9.2.3 Transforming Fish Consumption Advisory Location Information to Hydrologic Unit Codes (HUC)

Fish consumption advisory locations, once described and delineated, must be transformed to USGS Hydrologic Unit Code (HUC) 12 watershed notation. USGS's HUC notation is a subdivision of hydrologic units which are classified into various levels of geographic detail (Adapted from Seaber *et al.* 1987). The HUC 12 watershed notation is used when reporting fish consumption advisory information in Ohio's Integrated Report on the condition of the State's surface waters.

9.2.4 River And Stream Fish Consumption Advisories for "Consume No More Than One Meal Per Week"

A fish consumption advisory issued for "consume no more than one meal per week" is issued when the average of three or more species specific sample results exceed the one meal per week lower threshold contaminant concentration (see Table 1).

9.2.5 Procedure for Rescinding Fish Consumption Advisories

Two consecutive fish tissue data generating cycles are required before a fish consumption advisory is rescinded (i.e., removed) from the State's Fish Consumption Advisory Listing. The data generating cycles can be separated by one or more years between sample collections and analyses.

In cases where only one year of data has been collected, but the number of data points is large (i.e., 30 or more), the species collected are representative of the different fish guilds, and all data are below the concentration threshold that

would cause the issuance of a fish consumption advisory, best professional judgment can be used to rescind an advisory.

10.0 Fish Tissue Monitoring Program Databases

Fish tissue data are kept in a FoxPro database. The database includes data from 1969 through the present. Data are either uploaded directly from the Ohio EPA laboratory database, or are hand entered, as is the case with data from other entities such as ORSANCO or historical data for unusual contaminants. Data are pulled from the FoxPro database using queries and imported into Excel to perform advisory calculations.

The Fish Tissue Monitoring Program database is in the process of being updated as a database component of DSW's EA3 database, a database which will include all of the Division's environmental data.

11.0 New Analyte Risk Assessment Advisory Consumption Limits

11.1 Technical Justification Package for New Chemical Risk Assessment Consumption Limits

A technical information package is generated for all new chemical risk assessments. The information is used to justify fish advisory consumption limits. Each justification package must include the following information when available: a tabular summary (comparison) of other states' fish consumption advisory limits for the parameter based upon risk assessment procedures; a spreadsheet showing the Great Lakes Protocol calculations identifying each concentration range for each consumption group; a graph showing the Great Lakes States' upper bounds for the chemical for each consumption group; the RfD for the chemical used in the calculations and the source and citation for the RfD value; and a copy of IRIS's chemical risk information, or the RfD's reference document if IRIS can not be used. The justification package should also include any additional information and/or data that are used in the calculations that would justify the numerical consumption group limits.

Advisory information provided to the public through ODH gives advice about the number of sport fish meals it is safe to eat. The advice categories, or consumption groups, are: no restrictions (225 meals/year); two meals/week (104 weeks/year, mercury only); one meal/week (52 meals/year); one meal/month (12 meals/year); 6 meals/year; and do not eat.

12.0 Lipid-Normalizing Skin-on and Skin-off Fillet Data Sets

12.1 Rationale for Lipid-Normalizing Fillet Data

The concept of normalizing fish tissue results to account for differing lipid concentrations has been the subject of numerous studies in published literature. Most often, the concept is used to convert whole body data to fillet data or vice versa.

Studies have found that in many cases there is not strong statistical correlation between lipid content and PCB levels. In environmental samples such as those used by the Division of Surface Water, there are many variables that contribute to differing fish PCB levels, including time of year of sample collection, fish gender, and location. However, PCBs are lipophilic, and therefore, for lack of a better predictive mechanism, a correlation between PCB levels and lipid levels in fish is assumed in normalizing calculations.

Division of Surface Water implemented lipid normalization processes in its fish advisory procedure in 2008 to account for a change in sample collection methodology from collecting scaled fish as skin-on fillets to skin-off fillets. That change is detailed in section 8.2.6 in this document, as well as in the Fish Collection Procedure manual.

The purpose of lipid normalization is to equate skin-on and skin-off fillet organic sample results in calculating the fish consumption advisories.

The “Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory”, created to assess PCB contamination in fish, recommends skin-on fillet samples for all scaled fishes. The intent of the Protocol in recommending skin-on fillets is to estimate the highest probable levels of PCBs consumed from fish, because the skin has a lipid-rich underlying fat layer that contains PCBs. By continuing to collect samples skin-on from Lake Erie, and by adjusting inland samples to reflect higher lipid levels in skin-on fillets, Division of Surface Water remains true to the intent of the Protocol in both ensuring uniform Great Lakes advisories and in estimating higher-risk exposures to PCBs from fish consumption.

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**Table 1: Ohio Fish Consumption Advisory Chemicals: (ODH 10/25/99)
 Fillet Chemical Upper Bound Limit Concentrations (ppm) and Advisory
 Meal Consumption Rate Using the Great Lakes' Governors Procedure ***

Chemical (RfD µg/kg/day)	Unrestricted	1/week	1/month	6/year	Do Not Eat
Aldrin (0.03)	<0.030	0.131	0.568	1.135	>1.135
Total Arsenic (0.3)	<0.150	0.656	2.838	5.676	>5.676
Total Cadmium (1.0)	<0.500	2.188	9.459	18.91	>18.919
Total Chlordane (0.5)	<0.500	2.188	9.459	18.919	>18.919
Total DDT (0.5)	<0.500	2.188	9.459	18.919	>18.919
Dieldrin (0.05)	<0.050	0.220	1.000	1.999	>1.999
Endosulfan (6.0)	<6.000	26.250	131.514	227.027	>227.027
Endrin (0.30)	<0.300	1.313	5.676	11.351	>11.351
Heptachlor (0.5)	<0.500	2.188	9.459	18.919	>18.919
Heptachlor Epoxide (0.013)	<0.013	0.057	0.246	0.492	>0.492
Hexachlorobenzene (0.8) **	<0.800	3.500	15.135	30.270	>30.270
Total Lead (6.0)	<0.086	0.375	1.622	3.243	>3.243
Lindane (6.0)	<0.3	1.313	5.676	11.315	>11.315
Methoxychlor (5.0)	<5.000	21.875	94.545	189.189	>189.189
Microcystin LR (0.003)	<0.003	0.007	0.028	NA	>0.028
Mirex (0.2)	<0.200	0.875	3.784	7.568	>7.568
Methylmercury (0.1)	Unrestricted	2/week	1/week	1/month	Do Not Eat
	<0.050	0.110	0.220	0.999	>1.000
Total PCBs (0.05) HPV **	<0.050	0.220	1.000	1.999	>1.999
Total SAS 305 (50.0) **	<50,000	218,750	945,946	1,891,892	>1,891,892
Total SAS 310 (28.6) **	<28,600	125,125	541,081	1,082,162	>1,082,162
Total Selenium (5.0)	<2.500	10.938	47.927	94.545	>94.545
Toxaphene (0.25)	<0.250	1.094	4.730	9.459	>9.45

* Concentrations are reported in mg/kg (ppm) raw fish fillet wet weight. Meal consumption rates are: No restrictions (225 meals/year); One meal/week (52 meals/year); One meal/month (12 meals/year); 6 meals/year; and Do not eat. All metals results are reported as Total metals, including Mercury. Total PCBs are reported as the sum of Aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260; Total Chlordane is reported as the sum of Alpha-Chlordane, Gamma-Chlordane, Oxychlordane, cis-Nonachlor and trans-Nonachlor; Total DDT is reported as the sum of DDT and Metabolites (DDE and DDD).

** HPV = Health Protection Value; HCB = hexachlorobenzene; Total SAS 305 is a chemical mixture of the following alkylated biphenyls: o-isopropyl-1,1-diphenylethane, m-isopropyl-1,1-diphenylethane, p-

isopropyl-1,1-diphenylethane and p-isopropyl-1,2-diphenylethane; Total SAS 310 is a chemical mixture of the following alkylated biphenyls: o-sec Butyl diphenylmethane, m-sec Butyl diphenylmethane, p-sec Butyl diphenylmethane, o-sec Butyl 1,1-diphenyl-ethane, m-sec Butyl 1,1-diphenylethane, p-sec Butyl 1,1-diphenylethane, o-sec Butyl 1,2-diphenylethane, m-sec Butyl 1,2-diphenylethane, and p-sec Butyl 1,2-diphenylethane.

Table 2: Ohio EPA Division of Environmental Services (2009) Fish Tissue and Sediment Reporting Limits ($\mu\text{g}/\text{kg}$) *

Chemical	Reporting Limits		Chemical	Reporting Limits	
	Fish Tissue	Sediment		Fish Tissue	Sediment
Aldrin	10	2	PCB-1232	50	10
Total Arsenic	50	800	PCB-1242	50	10
Total Cadmium	4	2	PCB-1248	50	10
Alpha-Chlordane	10	2	PCB-1254	50	10
Gamma-Chlordane	10	2	PCB-1260	50	10
Oxychlordane	10	2	Total Selenium	50	800
cis-Nonachlor	10	2	Toxaphene	20	10
trans-Nonachlor	10	2	SAS 305		
4,4'-DDD	10	2	o-isopropyl-1,1-diphenylethane	40	20
4,4'-DDE	10	2	m-isopropyl -1,1-diphenylethane	40	20
4,4'-DDT	10	2	p-isopropyl- 1,1-diphenylethane	40	20
Dieldrin	10	2	p-isopropyl-1,2-diphenylethane	40	20
Endosulfan	10	2	SAS 310		
Endrin	10	2	o-sec Butyl diphenylmethane	40	40
Heptachlor	10	2	m-sec Butyl diphenylmethane	40	40
Heptachlor Epoxide	10	2	p-sec Butyl diphenylmethane	40	40
Hexachlorobenzene	10	2	o-sec Butyl 1,1-diphenylethane	40	40
Total Lead	40	800	m-sec Butyl 1,1-diphenylethane	40	40
Methoxychlor	10	2	p-sec Butyl 1,1-diphenylethane	40	40
Mirex	10	2	o-sec Butyl 1,2-diphenylethane	40	40
Total mercury	24	80	m-sec Butyl 1,2-diphenylethane	40	40
PCB-1016	50	10	p-sec Butyl 1,2-diphenylethane	40	40
PCB-1221	50	10			

* Fish tissue RLs and Total Metals are reported in $\mu\text{g}/\text{kg}$ wet weight. Sediment RLs and Total Metals are

reported in $\mu\text{g}/\text{kg}$ dry weight. Metals are analyzed as Total metals. Fish tissue analytical results include percent lipid for each sample.

Table 3. Median lipid levels by species, 1998-2006

Species	Median Lipid Levels (%)
Black Crappie	0.33
Black Redhorse	3.2
Bluegill Sunfish	0.41
Common Carp	3.86
Freshwater Drum	2.7
Golden Redhorse	1.29
Green Sunfish	0.58
Largemouth Bass	0.37
Longear Sunfish	2.15
Northern Hog Sucker	0.99
Northern Pike	0.44
Pumpkinseed Sunfish	0.33
Quillback Carpsucker	1.78
Rainbow Trout	6.66
Redear Sunfish	0.4
Rock Bass	0.37
Sauger	1.0
Saugeye	0.68
Shorthead Redhorse	10.3
Silver Redhorse	2.1
Smallmouth Bass	0.77
Smallmouth Buffalo	4.3
Spotted Bass	0.43
Spotted Sucker	1.39
Striped Bass Hybrid	1.28
Walleye	1.73
White Crappie	0.31
White Sucker	1.35
Yellow Perch	0.38