Supplement to Baseline Human Health Risk Assessment
Grand Calumet River Feasibility Study

Utilizing

Uniform Protocol for Great Lakes Sport Fish Consumption Advisory

September 2007

Prepared by:

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Office of Legal Counsel
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Introduction

To supplement information on background conditions for the Grand Calumet Feasibility Study (GCFS), Indiana Department of Environmental Management contracted Ecology & Environment, Inc. to conduct a Baseline Human Health Risk Assessment (BHHRA) in four reaches of the Grand Calumet River/Indiana Harbor Canal Area of Concern (AOC) (Ecology & Environment, Inc. 2007). The contract included a Reasonable Maximum Exposure analysis of risk estimation based on current/future exposure that could occur based on remediation of contaminated sediments and delisting of impaired beneficial uses in the AOC. Extent of the BHHRA was limited to Indiana Harbor Canal (Indiana Harbor Canal south of FNC and west branch GCR east of Indianapolis Boulevard and east branch GCR west of Kennedy Avenue), the Lake George Branch Canal (located west of the Indiana Harbor Federal Navigation Channel (FNC)), East Branch GCR (east of Kennedy Avenue to the first railroad bridge upstream (east) of Industrial Highway), and the Grand Calumet River Lagoons (GCRL) (see Figure 1.2 in BHHRA). These areas correspond to Reaches 2, 3, 4, and 5, respectively, of the Feasibility Study. Lake Mary (part of the Lake George Wetlands) has been included in this supplement. The BHHRA did not include the West Branch GCR (Reach 1) as a Baseline Human Health Risk Assessment was completed for this reach (Tetra Tech EC, 2005). The Federal Navigation Channel was excluded as US ACE had completed an Environmental Impact Statement and had an approved dredging plan for this section of the Harbor and Canal. The eastern five miles of the Grand Calumet River (east or upstream of Reach 4) and the western portion of the west lagoon were excluded from the Feasibility Study and the BHHRA as these portions of the River were being remediated by US Steel.

To accommodate suggestions received during review of the BBHHRA, IDEM included exposure scenarios based on the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory (Anderson, et al. 1993) to more fully examine baseline risks associated with eating fish from the GCR/IHC and to supplement the RME scenario included in the BHHRA. West Branch GCR (Reach 1) and Federal Navigation Channel (Reach 6 – added as part of the GCFS to address Lake Michigan impacts from sediments at edges of the FNC) risks of fish exposure are included in this supplement.

Great Lakes Sports Fish Consumption Advisory Protocols

The Great Lakes Sports Fish Consumption Advisory Task Force (Anderson et al. 1993) included the following advisory procedures:

1. A general statement about contaminants, benefits and hazards.

"Fish are good for you and good to eat. But some fish may take in contaminants from the water they live in and the food they eat. Some of these contaminants build up in the fish - and you - over time. These contaminants could harm the people who eat them, so it is important to keep your exposure to these contaminants as low as possible. This advisory helps you plan what fish to keep as well as how often and how much sport fish to eat. This advisory is not

intended to discourage you from eating fish, but should be used as a guide to eating fish low in contaminants."

2. A statement on cancer risk.

"Although this advisory is primarily based on effects other than cancer, some contaminants cause cancer in animals. Your risk of cancer from eating contaminated fish cannot be predicted with certainty. Cancer currently affects about one in every four people by the age of 70; primarily due to smoking, diet and hereditary risk factors. Exposure to contaminants in the fish you eat may not increase your cancer risk at all. If you follow this advisory over your lifetime, you will minimize your exposure and reduce whatever cancer risk is associated with those contaminants. At worst, using Environmental Protection Agency (EPA) methods, it is estimated that approximately one additional cancer case may develop in 10,000 people eating contaminated fish over their lifetime."

3. A statement on benefits of fish consumption.

"When properly prepared, fish provide a diet high in protein and low in saturated fats. Many doctors suggest that eating a half-pound of fish each week is helpful in preventing heart disease. Almost any kind of fish may have real health benefits when it replaces a high-fat source of protein in the diet. You can get the health benefits of fish and reduce unwanted contaminants by following this advisory."

4. Preparation and cooking advice.

"Many contaminants are found at higher levels in the fat of fish. You can reduce the amount of these contaminants in a fish meal by properly trimming, skinning, and cooking your catch. Remove the skin and trim all the fat from the areas shown on the diagram below: the belly flap, the line along the sides of the fish, fat along the back, and under the skin".

5. Determine whether a meal unit dose reduction is appropriate to convert the raw Fish residue data to a delivered dose.

"The states agreed to the use of a 50% reduction factor [due to preparation and cooking losses of contaminants] for most species. The Task Force realizes that there may be inter-species variances in contaminant reduction by following the suggested guidelines, but feel the 50% reduction factor provides adequate representation of the various species encountered by consumers of sport fish. A 30% (0.3) reduction factor will apply to species that are analyzed as skin-off fillets or skin-off steak."

6. Utilize a uniform meal size.

The Task Force agreed to the use of a 1/2 pound of raw fish per 70 kg body weight as the uniform meal size. It will be assumed that the meal size will change proportionally with body weight. The meal size ratio for fish is commonly given as 227 gm/70 kg [adult] body weight.

7. Utilize easily understood meal frequencies as Advisory Groups.

Five advisory categories used and commonly understood by anglers include: unrestricted consumption, one meal a week (52 meals/year), one meal a month (12 meals/year), one meal every 2 months (6 meals/year), and no consumption (do not eat).

8. Select a fish flesh sample collection protocol for laboratory residue analysis.

"Raw, skin-on, fillet will be the primary sample to be analyzed for contaminants. The fish should be scaled, then filleted so as to include all flesh from the back of the head to the tail and from the top of the back down to and including the belly flap area of the fish. Remove all fins, the tail, head, viscera, and major bones (backbone and ribs). The only exceptions to this sample type would be as follows: the skin will be removed from black bullhead, brown bullhead, yellow bullhead, channel catfish, flathead catfish and burbot, but fillets would still remain untrimmed. Sturgeon would be analyzed as a skin-off cross section (steak). Smelt should be gutted and the head removed."

9. Select uniform limits of detection for residues in tissues.

Laboratories participating in the state monitoring programs should be encouraged to achieve a PCB detection limit of at least 0.05 ppm.

10. Establish whole fish size and species contaminant residue concentrations for use in placing fish into consumption categories.

"Regression analysis will be the primary method used to determine placement of fish sizes into advisory groups."

11. Select a risk assessment procedure for assigning fish to consumption frequency groups.

"Instead of the usual single effect reference endpoint [reference dose for chemical's affect to an organ, organ system or function of them], a "weight-of-evidence" approach was chosen which would represent a composite of possible endpoints. A health protection value of 0.05 ug/kg/day PCB residue in sport fish was selected."

12. Address issue of multiple contaminants.

"The Task Force agreed that the health protection value developed for the PCBs would in most instances account for the majority of the potential health risk from the mixture of chemicals present in the fish". "To establish priorities for developing new health protection values in addition to PCB, the Task Force will compare the existing fish monitoring results with the RfDs [RfDo – reference dose] developed by USEPA (IRIS)."

13. Develop a uniform method for deciding when to shift a size/species class into a higher or lower advisory category.

“The Task Force agreed there should be a documented method for shifting species and/or size classes of fish as the monitoring data warrants.”

14. Coordinate the release of each state/province's annual advisory update.

“The standing committee for the Fish Advisory Task Force will meet annually in October to discuss new data, possible changes in advisory categories, and to coordinate advisories for the following year.”

Advisory Calculations

Utilizing the above outlined protocols the Great Lakes Sport Fish Consumption Advisory Task Force developed the following calculations for PCB for the five advisory groups:

Group 1
For unrestricted consumption or up to 225 meals/year (140 g sport fish/day)
3.5 ug/day PCB / 140 g/day fish / .5 (cleaning reduction)
0.05 ppm PCB in raw fish filet

Group 2
For consumption up to one meal a week (32 g sport fish/day)
3.5 ug/day PCB / 32 g/day fish / .5 (cleaning reduction)
0.22 ppm PCB in raw fish filet

Group 3
For consumption up to 1 meal per month (7.4 g sport fish/day)
3.5 ug/day PCB / 7.4 g/day fish / .5 (cleaning reduction)
0.95 ppm PCB in raw fish filet

Group 4
For vacationer consumption up to 6 meals/yr (3.7 g sport fish/day)
3.5 ug/day PCB / 3.7 g/day fish / .5 (cleaning reduction)
1.89 ppm PCB in raw fish filet

Group 5
Do not eat
Greater than 1.89 ppm PCB in raw fish filet

States have developed advisory groups for other contaminants (e.g., Mercury, DDE, *et al*.) for fish consumption advisories.

Calculation of Risk Estimates using Great Lakes Sport Fish Consumption Protocols

IDEM used standard risk estimate procedures and guidelines (see BHHRA, Ecology and Environment 2007, for details) to calculate the risk estimates for exposure via consumption of fish from the GCR/IHC for each of the GLSFCP advisory groups consumption scenarios. Variations in GLSFCP factors from the RME scenario presented in the BHHRA are outlined in the following brief discussion.

Fish – Fish tissue samples collected in the GCR/IHC by IDEM since 1994 and prepared as skin-on or skin-off fillets following GLSFCP were utilized in the following analyses (see Table 4-3 in BHHRA).

Exposure Point Concentrations - Fish tissue exposure point concentrations for Reaches 2 (IHC) 3 (LGB), 4 (EBGCR I) and 5 (GCRL) are presented in Appendix D of the BHHRA (Ecology & Environment 2007) – see Series 3 Tables. Copies of these tables are included in Attachment A for easy reference. Exposure point concentrations for Reach 1 (see Table WBGCR 3.3), Lake Mary (part of LGB Wetlands) (see Table Lake Mary 3.3), and Reach 6 are also included in Attachment A (see Table FNC (6A) 3.3). Exposure point concentrations (EPC) for Lake Mary, Reach 1 and Reach 6 were calculated using STATISTICA-Version 6 ((Statistica System Reference 2001) for potential contaminants of concern (see BHHRA for screening tables).

Age-Specific Exposure Factors - Age-specific exposure factors were utilized to adjust contaminant and meal size for various age groups (see Series 4 Tables in Attachment B).

Reduction of Contaminants by Preparation and Cooking – It was assumed that a 50% reduction (30% in skin-off fillets) of organic contaminants of potential concern concentrations occurred during preparation and cooking of fish consumed from the GCR/IHC area. Inorganic or non-lipophilic contaminant concentrations were not reduced based on preparation and cooking. The Fish EPC values included in Series 3Tables in Attachment A do not reflect the reduction due to preparation and cooking, but the Fish EPC values included in the Series 7 Tables in Attachment C do reflect the reduction. The RME scenario, based on total PCBs, was calculated following methods utilized in the BHHRA, i.e. there was no reduction in contaminant concentration based on preparation and cooking.

Fraction of Consumed Fish Coming from GCR/IHC - For this risk estimate analysis it was assumed that 100% of fish consumed came from the GCR/IHC. The GLSFC Protocols are based on the assumption that fish consumed are from a specific area and the resulting advisory is valid only for that area (Anderson 1993, Stahl personal communication).

Health Protection Value - As outlined above, the Great Lakes Sport Fish Consumption Advisory Task Force established a reference dose (RfDo) for PCBs of 0.00005 mg/kg-day. USEPA IRIS does not list a RfDo for total PCBs; IRIS has a RfDo for Aroclors 1016 and 1254 of 0.00002 mg/kg-day. The noncancer hazards calculated in the BHHRA (Ecology & Environment 2007) were based on Aroclors and the established RfDo in IRIS. The

noncancer hazards calculations for this supplement utilized GLSFC protocol health protection value (0.00005 mg/kg-day) for PCB RfDo for Groups 1 – 4 analyses. USEPA IRIS protocols were followed for the RME calculation, resulting in no RfDo for the total PCBs and thus no contribution to calculated noncancer hazard indices.

Exposure Scenarios – Fifteen different exposure scenarios were used to calculate an estimated risk of consuming fish from the GCR/IHC feasibility study area. They include Child, Adult and combination of Child and Adult angler groups' risk estimates for: Reasonable Maximum Exposure – based on Total PCBs as opposed to Aroclors and consumption of 37.8 grams fish per day (Williams 2000); GLSFCP Group 1 (125 meals per year); GLSFCP Group 2 (52 meals per year); Group 3 (12 meals per year) and Group 4 (6 meals per year). Fish consumed under each exposure scenario are converted to ingestion rate expressed as grams of fish consumed per day (Anderson, et al. 1993, EPA 1989).

Overview of Risk Estimates

A summary of risk and hazard estimates for each angler group (Child, Adult and Child/Adult) and each exposure scenario is presented in Table 1. The Series 7 Tables (Attachment C) provide detailed results of risk estimate calculations for the five different exposure scenarios examined in this exercise. The following text provides brief summaries of cancer risks and noncancer hazards from eating fish from specific areas within the Grand Calumet River/Indiana Harbor Canal Area of Concern follow.

WBGCR

West Branch Grand Calumet River extends from Indianapolis Boulevard west to the State line and is designated as Reach 1 of the GCFS. Fish fillets analyzed in 2002 indicated PCB concentrations of 11.9 (maximum of 19 ppm) which support a fish advisory of Group 5 (do not eat). Mercury concentrations of 0.07 ppm (maximum of 0.39 ppm) are sufficient to support a Group 2 consumption advisory.

Cancer risks for anglers range from 1.0E-02 to 2.8E-04 for Group 1 to Group 4 using the GLSFC protocols. Noncancer hazards vary from 284 to 6.4 for these protocols. Risk based on RME (using Total PCBs) was 5.7E-03, while noncancer hazard was 1.

Polychlorinated Biphenyls (PCBs) were the primary risk drivers in the West Branch, making up 97% of total risk from fish consumption. Polycyclic Aromatic Hydrocarbons (PAHs) and Pesticides were secondary risk drivers (Table 2). Noncancer hazard index drivers included several metals (mercury and selenium contributed most) and pesticides under the RME scenarios while PCBs and Selenium drove noncancer hazards under GLSFC protocols (Table 2).

IHC

Using GLSFC protocols resulted in cancer risks for Reach 2 (IHC) varying from 5.8E-03 (Group 1) to 6.8E-05 (Group 4). Noncancer hazards ranged from 249 to 7 for the same Groups. Cancer risk based on RME was 5.8E-03 while noncancer hazard index was 1 (Table 1).

Risks were primarily driven by PCBs (98%) with minor contributions by Pesticides and Arsenic. Noncancer hazards were driven arsenic, mercury and pesticides in the RME while PCBs (98%) drove hazards under GLSFC.

Lake Mary

Lake Mary is a 20+ acre lake immediately south but isolated from the Lake George Canal in Hammond, Indiana. Fish samples collected in 2002 from this lake indicate that a Group 2 (1 meal per week) fish consumption advisory would be supported by PCB concentration (0.68 ppm) in raw fish fillets. Mercury concentration (0.15 ppm) in raw fish would support a Group 1 (unlimited consumption) advisory.

Cancer risks for anglers (child/adult receptor group) range from 6.3E-04 to 1.6E-05 for unlimited consumption (Group 1) to visitor (Group 4) using GLSFC protocols. Risk based on RME for this lake falls between Group 1 and Group 2 at 3.2E-04 while noncancer hazard index was 0.8.

LGB Canal

The 18-acre portion of Lake George Branch Canal had RMS risk of 7.5E-03 and hazard index of 1.2 based on fish consumption. Risks under GLSFC protocols ranged from 1.4E-02 to 3.7E-04 for Groups 1 to 4. Hazard indices ranged from 318 to 8 for the same Groups (Table 1).

PCBs (97%), Pesticides (2% and Arsenic 1%) drove cancer risks in this area. Noncancer hazards were driven by Mercury (7%), Pesticides (53%) and Arsenic (27%) under the RME scenario and by PCBs (98%) (Table 2) under the GLSFC scenarios.

EBGCR l

RME cancer risks were estimated to be 6.7E-03 and noncancer hazard index was 1.2 for the East Branch Grand Calumet River Reach of the study area. Using GLSFC protocols, cancer risk varied from 1.4E-02 to 3.7E-04 and noncancer hazards ranged from 283 to 7.5 (Table 1).

PCBs drove cancer risks under both RME and GLSFC scenarios with minor contribution by Arsenic and Pesticides. Noncancer Hazards were driven by PAHs, Pesticides and Arsenic under the RME scenario while PCBs were the primary driver under the GLSFC scenario (Table 2).

GCRL West Lagoon

RME cancer risk for the West Lagoon (Reach 5A) was 5.5E-04 and ranged from 1.8E-03 to 4.6E-05 for GLSFC scenarios. Noncancer hazards were1.9 for the RME and ranged from 23.7 to 0.6 for the GLSFC scenarios (Table 1).

Less than one-half of the cancer risk resulted from PCBs in fish tissues in this lagoon (Table 2). Metals including Arsenic and Beryllium result in 50% to 60% of cancer risk for RME and GLSFC scenarios, respectively (Table 2). Noncancer risks under the RME scenario was driven by metals including Arsenic, Beryllium, Antimony, Cadmium and Mercury while a combination of PCBs (71%) and metals drove hazards using GLSFC scenarios (Table 2).

GCRL Middle + East Lagoon

Fish consumption results in estimated excess cancer risk in the Middle and East Lagoons of 5.9E-04 for RME scenario and from 6.1E-04 to 3.4E-05 using GLSFC protocols (Table 1). Noncancer hazards were 1.4 for RME and ranged from 33.7 to 0.6 for GLSFC protocols.

PCBs composed approximately 76% and 28% of cancer risk under RME and GLSFC scenarios, respectively (Table 2). Arsenic was the primary driver of cancer risk under GLSFC protocols (Table 2). PAHs (13%), Pesticides (19%), Arsenic (21%) and Antimony (41%) drove noncancer hazards under the RME scenario while PCBs (80%) was the primary driver of hazards under the GLSFC scenarios (Table 2).

FNC (6A)

The Federal Navigation Channel in the Indiana Harbor was excluded from the BHHRA as this area was being addressed by US ACE under a separate project. The portions of the FNC outside navigation channel boundaries was added to the Feasibility Study as Reach 6 after the original scoping activities as a mechanism to address concerns about contaminants entering Lake Michigan. This addition was too late to be incorporated into the BHHRA but is included in this supplement for completeness of examining risks and hazards associated with fish consumption calculated from GLSFC protocols.

Cancer risks under the RME scenario was 6.5E-03 and ranged from 1.2E-02 to 3.2E-04 using GLSFC protocols. Noncancer hazards were calculated as 3.1 for RME and 267 to 7 for GLSFC (Table 1).

Cancer risk was driven by PCBs (92%), Arsenic and Pesticides under both RME and GLSFC protocols (Table 2). Arsenic, PAHs and Pesticides drove noncancer hazards under RME while PCBs (97%) was the primary driver of hazards under GLSFC protocols (Table 2).

Summary

This supplement presents the results of estimated cancer risks and noncancer hazards associated with fish consumption from eight sub-areas of the GCFS. Analyses based on Total PCBs as opposed to Aroclors (as in BHHRA) results in differences in hazard calculations and also on perceived contaminant contribution to estimated hazards; RME is calculated without a RfDo for PCBs while GLSFC uses a health protection value for RfDo. Persons following the GLSFC protocols for fish consumption could anticipate risks and hazards as outlined in Table 1 below. Persons strictly following Indiana State Department of Health (ISDH) 2007 Fish Consumption Advisory would realize that the Grand Calumet River and Indiana Harbor have a Group 5 (Do Not Eat) advisory posted and would have no excess risk associated with fish consumption. Following the SDOH 2007 advisory for the GCRLs (see Marquette Lagoon, Lake County) persons could expect estimated risks and hazards as outlined under GLSFC Group 3 in Table 1 (see GCRL M + E Lagoons).

The ISDH 2007 Fish Consumption Advisory can be found at the following web site: http://www.ai.org/isdh/fca/2005/index.htm.

References

Anderson, H.A., J.F. Amhreim, P. Shubat, and J. Hesse. 1993. Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory. Great Lakes Fish Advisory Task Force Protocol Drafting Committee.

Ecology & Environment, Inc. 2007. Grand Calumet Feasibility Study Baseline Human Health Risk Assessment. September 2007. Prepared for Indiana Department of Environmental Management., Indianapolis.

Indiana State Department of Health. 2007. Fish Consumption Advisory. Available only at the website: http://www.ai.org/isdh/fca/2005/index.htm.

U. S. Environmental Protection Agency (USEPA). 2006. Integrated Risk Information System (IRIS) [Online] http://www.epa.gov/iris/.

Table 1. Comparison of Overall Summary of Risk and Hazard Estimates based on Reasonable Maximum Exposure and Great Lakes Sports Fish Consumption Protocol Groups 1 - 4.

	Active Anglers			Active Anglers		
	Child	Adult	Child/Adult	Child	Adult	Child/Adult
	Cancer Risk Estimates			Noncancer HI Estimates		
WBGCR						
RME	1.17E-03	4.49E-03	5.66E-03	1.04	1.01	1.02
GLSFCP Gp 1	2.19E-03	8.31E-03	1.05E-02	249.63	282.64	284.87
GLSFCP Gp 2	5.06E-04	1.92E-03	2.42E-03	67.84	55.41	65.73
GLSFCP Gp 3	1.17E-04	4.39E-04	5.56E-04	15.70	14.94	15.09
GLSFCP Gp 4	5.85E-05	2.20E-04	2.78E-04	6.67	6.35	6.41
IHC						
RME	1.19E-03	4.64E-03	5.83E-03	1.02	0.99	1.00
GLSFCP Gp 1	2.25E-03	8.66E-03	1.09E-02	257.18	247.42	249.37
GLSFCP Gp 2	5.20E-04	5.67E-04	5.84E-04	59.39	59.36	59.36
GLSFCP Gp 3	1.20E-04	1.31E-04	1.35E-04	13.74	13.73	13.74
GLSFCP Gp 4	6.01E-05	6.55E-05	6.75E-05	6.87	6.87	6.87
LAKE MARY						
RME (1)	6.65E-05	2.58E-04	3.25E-04	0.83	0.80	0.81
GLSFCP Gp 1	1.24E-04	4.79E-04	6.03E-04	16.39	15.77	15.89
GLSFCP Gp 2	2.87E-05	1.10E-04	1.39E-04	3.78	3.64	3.67
GLSFCP Gp 3	6.65E-06	2.53E-05	3.19E-05	0.88	0.83	0.84
GLSFCP Gp 4	3.32E-06	1.27E-05	1.60E-05	0.44	0.42	0.42
LGB Canal						
RME	1.53E-03	5.94E-03	7.47E-03	1.20	1.17	1.18
GLSFCP Gp 1	2.88E-03	1.11E-02	1.40E-02	327.63	315.20	317.68
GLSFCP Gp 2	6.66E-04	2.56E-03	3.22E-03	75.65	72.72	73.31
GLSFCP Gp 3	1.54E-04	5.86E-04	7.40E-04	17.51	16.66	16.83
GLSFCP Gp 4	7.70E-05	2.93E-04	3.70E-04	8.75	8.33	8.41
EBGCR 1						
RME	1.37E-03	5.34E-03	6.72E-03	1.64	1.59	1.60
GLSFCP Gp 1	2.60E-03	1.00E-02	1.26E-02	292.19	281.11	283.32
GLSFCP Gp 2	6.01E-04	2.31E-03	2.91E-03	67.47	64.85	65.38
GLSFCP Gp 3	1.39E-04	5.29E-04	6.68E-04	15.61	14.86	15.01
GLSFCP Gp 4	6.95E-05	2.65E-04	3.34E-04	7.81	7.43	7.50

Table 1. (Continued)

GCRL West Lagoon						
RME	1.14E-04	4.42E-04	5.55E-04	1.91	1.86	1.87
GLSFCP Gp 1	3.62E-04	1.39E-03	1.75E-03	24.47	23.54	23.72
GLSFCP Gp 2	8.35E-05	3.21E-04	4.05E-04	5.65	5.43	5.47
GLSFCP Gp 3	1.93E-05	7.35E-05	9.29E-05	1.31	1.24	1.26
GLSFCP Gp 4	9.66E-06	3.68E-05	4.64E-05	0.65	0.62	0.63
GCRL M + E Lagoon						
RME	1.21E-04	4.71E-04	5.92E-04	1.44	1.40	1.41
GLSFCP Gp 1	2.62E-04	1.01E-03	6.12E-04	34.83	33.51	33.77
GLSFCP Gp 2	6.06E-05	2.33E-04	2.94E-04	5.78	5.55	5.60
GLSFCP Gp 3	1.40E-05	5.34E-05	6.74E-05	1.34	1.27	0.26
GLSFCP Gp 4	7.01E-06	2.67E-05	3.37E-05	0.67	0.64	0.64
FNC (6A)						
RME	1.33E-03	5.16E-03	6.49E-03	3.21	3.12	3.14
GLSFCP Gp 1	2.51E-03	9.64E-03	1.21E-02	275.76	265.30	267.39
GLSFCP Gp 2	5.79E-04	2.22E-03	2.80E-03	63.68	61.21	61.70
GLSFCP Gp 3	1.34E-04	5.10E-04	6.43E-04	14.74	14.02	14.17
GLSFCP Gp 4	6.70E-05	2.55E-04	3.22E-04	7.37	7.01	7.08

(1) - Noncancer risk estimates based on total PCBs (high risk) instead of Aroclors - IRIS does not list RfDo.

Table 2. Cancer Risk and Noncancer Hazard Drivers for Fish Consumption Using Great Lakes Sport Fish Consumption Protocols for Child/Adult Angler Receptor Group.

Assessment Area	WBGCR	IHC	Lake Mary	LGB Canal	EBGCR I	GCRL - West	GCRL M+E	FNC (6A)
CANCER RISKS								
RME Total PCBs	PCB - 97.7% PAHs - 1.0% Pesticides - 1.3%	PCB - 97.6% PAH - 0.02% Pesticides -1.6% Arsenic - 0.8%	PCB - 97.4% Pesticides - 2.6%	PCB - 97.3% Pesticides - 1.9% Arsenic - 0.8%	PCB - 95.8% Pesticides - 3.0% Arsenic - 1.2%	PCB - 49.7% Arsenic - 20.9% Beryllium – 29.2%	PCB - 76.2% Pesticides - 8.7% Arsenic - 9.6%	PCB - 92.5% Pesticides - 0.8% Arsenic - 1.2%
GLSFCP	PCB - 97.7% PAHs - 1.0% Pesticides - 1.2%	PCB - 97.6% PAH - 0.02% Pesticides -1.5% Arsenic - 1.7%	PCB - 97.4% Pesticides - 2.6%	PCB - 96.5% Pesticides - 1.9% Arsenic - 1.6%	PCB - 94.7% Pesticides - 2.9% Arsenic - 2.3%	PCB - 41.5% Arsenic - 24.6% Metals - 34.3%	PCB - 28.0% Pesticides - 8.7% Arsenic - 34.3%	PCB - 91.8% Pesticides - 6.6% Arsenic - 1.6%
NONCANCER HAZARDs								
RME - Total PCBs	Selenium -11.4% Mercury -20.1% Pesticides - 40.3% Zinc – 8.0% Chromium – 6.9%	Arsenic - 25.3% Mercury - 24.5% Pesticides - 35.4%	Metals - 66.4% Mercury - 32.6% Pesticides - 0.9%	Mercury - 7.2% Pesticides - 52.6% Arsenic - 27.0%	PAH - 11.7% Pesticides - 47.0% Arsenic - 25.4%	Mercury - 16.6% Metals - 73.5% Arsenic - 32.3%	PAHs - 13.5% Pesticides - 18.7% Arsenic - 20.8% Antimony - 41.1%	PAHs - 3.3% Pesticides - 8.9% Arsenic - 25.4%
GLSFCP	PCB -84.0% Selenium – 15.2% Mercury – 0.3% Pesticides - 0.2%	PCB - 98.5% Arsenic - 0.4% Mercury - 0.4% Pesticides - 0.3%	PCB - 86.3% Metals - 7.5% Mercury - 6.2% Pesticides - 0.9%	PCB - 98.9% Arsenic - 0.4% Mercury - 0.1% Pesticides - 0.4%	PCB - 98.4% Arsenic - 0.5% Mercury - 0.2% Pesticides - 0.5%	PCB - 70.8% Arsenic - 9.4% Mercury - 4.8% Metals - 15.0%	PCB - 80.0% Arsenic - 4.5% PAHs -2.9% Pesticides - 2.4%	PCB - 97.3% Arsenic - 0.4% PAHs - 0.1% Pesticides - 1.5%