Gradient
CORPORATION

September 29, 1999

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Mr. Bruce Fidler
TAMS Consultants, Inc.
300 Broadacres Drive
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Re: Hudson River PCBs Reassessment RI/FS
USACE KC District Contract#: DACW41-D-98-9002 -- Task Order #7
Task 2-A.1 Development of Preliminary Target Contaminant Concentration Ranges

Dear Bruce:

Enclosed is a revised draft evaluation of preliminary human health risk-based target concentrations of PCBs in fish for the Upper Hudson River. This revised draft includes a calculation of RBCs for the dioxin-like PCB congeners in fish as Alison Hess requested.

As you will see, the RBCs for dioxin-like PCB congeners are comparable to the RBCs for Total PCBs. This is consistent with the results of the risk assessment where the RME risks due to the dioxin-like congeners in fish were of the same order of magnitude as the RME risks for Total PCBs.

I have sent a copy of this letter to Alison. If you have any questions, please give me or Tracey Slayton a call.

Yours truly,

GRADIENT CORPORATION

David E. Merrill

David E. Merrill
Program Manager

enclosure

cc: Alison Hess
Tracey Slayton

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DRAFT

Hudson River PCBs Reassessment RI/FS
Development of Preliminary Human Health Based Target Contaminant Concentration Ranges in Fish
(Task Order #7 Task 2-A.1)

Per our letter dated September 7, 1999, Gradient calculated a risk-based concentration in fish (RBC_F) corresponding to a range of target risk (ranging from 10^{-6} to 10^{-4}), and a non-cancer Hazard Index of 1.0.

Calculating the RBCs is a straightforward exercise of solving the intake and risk equations in the Risk Assessment for the concentration that equates to a specified target cancer risk (TR) in the case of carcinogenic risk, or a specified target Hazard Index (HI) for non-carcinogenic health impacts. The equations for these calculations are given below.

Risk-Based Concentration -- Cancer

$$RBC_{F\_C} = TR \times \left\{ CSF \times \frac{IR \times (1 - LOSS) \times FS \times EF \times ED \times CF}{BW \times AT} \right\}^{-1}$$

Risk-Based Concentration -- Non-Cancer

$$RBC_{F\_NC} = HI \times RfD \times \left\{ \frac{IR \times (1 - LOSS) \times FS \times EF \times ED \times CF}{BW \times AT} \right\}^{-1}$$

where:

RBC_{F_C}	=	Cancer risk-based concentration of PCBs in fish (mg/kg)
RBC_{F_NC}	=	Non-cancer risk-based concentration of PCBs in fish (mg/kg)
TR	=	Target risk, *e.g.*, 10^{-6} (unitless)
HI	=	Target non-cancer hazard index (unitless)
CSF	=	Cancer slope factor $(mg/kg\text{-}day)^{-1}$
RfD	=	Non-cancer reference dose (mg/kg-day)
IR	=	Annualized fish ingestion rate (g/day)
LOSS	=	Cooking loss (g/g)
FS	=	Fraction from source (unitless fraction)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
CF	=	Conversion Factor (10^{-3} kg/g)
BW	=	Body weight (kg)

AT = Averaging time (days)

The RBC calculation adopted the exposure factors that were used in our Phase 2 Risk Assessment, using both the central tendency and reasonable maximum exposure (RME) factors. Table 1 summarizes the exposure factors and corresponding RBC_F values for PCBs in fish.

Overall, the RBC values for PCB risk levels range from 0.044 to 0.44 mg/kg for non-cancer effects, and 0.002 to 13 mg/kg for cancer effects as summarized below.

Target Risk or Non-Cancer Hazard Index	Central Tendency	Reasonable Maximum Exposure (RME)
$TR = 10^{-4}$	$RBC_{F\_C} = 13$	$RBC_{F\_C} = 0.2$
$TR = 10^{-5}$	$RBC_{F\_C} = 1.3$	$RBC_{F\_C} = 0.02$
$TR = 10^{-6}$	$RBC_{F\_C} = 0.13$	$RBC_{F\_C} = 0.002$
HI = 1.0	$RBC_{F\_NC} = 0.44$	$RBC_{F\_NC} = 0.044$

RBCs for Dioxin-Like PCB Congeners

As discussed in the Phase 2 Baseline Human Heath Risk Assessment for the Upper Hudson River (HHRA), certain PCB congeners exhibit dioxin-like toxicity. As was the case in the HHRA, only a plausible upper bound cancer slope factor is available for dioxins, therefore, RBC values for high-end exposure cancer effects from dioxin-like PCB congeners were calculated. In order to account for the toxicity of dioxin-like PCB congeners, a congener-weighted CSF was calculated. The congener weighted slope factor ($CSF_{weighted}$) is equal to the upper bound CSF for 2,3,7,8-TCDD (150,000 per mg/kg-d) and multiplied that by the sum of the product of each congener TEF and the ratio of each congener over total PCBs:

$$CSF_{weighted} = \sum_i TEF_i \times \frac{C_i}{Total\ PCB}$$

where

TEF_i = dioxin toxicity equivalency factor for the i^{th} congener

C_i = average concentration of i^{th} congener in fish

The congener TEF values, and the average congener PCB concentration values are those tabulated in Table 5-36 of the HHRA. The congener weighted CSF is 2.7 $(mg/kg\text{-}d)^{-1}$. Table 2 (attached) summarizes the exposure factors and corresponding RBC_F values for PCBs in fish for dioxin-like PCB risk levels.

Overall, the RBC values for PCBs for dioxin-like PCB risk levels range from 0.14 to 0.0014 mg/kg for cancer effects as summarized below. The RBCs below represent the concentration of Total PCBs at the associated target cancer risk levels, where the cancer risk is attributable to the dioxin-like component of the Total PCBs. These RBCs are calculated with the presumption that the relative concentrations of dioxin-like PCB congeners remain at the average relative concentrations summarized in Table 5-36 of the HHRA.

Target Dioxin-Like Cancer Risk	Central Tendency	Reasonable Maximum Exposure (RME)
$TR = 10^{-4}$	NA	$RBC_{F\_C} = 0.14$
$TR = 10^{-5}$	NA	$RBC_{F\_C} = 0.014$
$TR = 10^{-6}$	NA	$RBC_{F\_C} = 0.0014$

TABLE 1

CALCULATION OF RISK-BASED CONCENTRATIONS OF PCBS IN FISH -- UPPER HUDSON RIVER

HUDSON RIVER PCBs REASSESSMENT RI/FS

Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference
RfD	Reference Dose	mg/kg-d	2.00E-05	Oral RfD for Aroclor 1254, see text.	2.00E-05	Oral RfD for Aroclor 1254, see text.
CSF	Cancer Slope Factor	$(mg/kg-d)^{-1}$	2	Upper-bound CSF for exposures to PCBs via fish ingestion, see text.	1	Central estimate CSF for exposures to PCBs via fish ingestion, see text.
IR_{fish}	Ingestion Rate of Fish	grams/day	31.9	90th percentile value, based on 1991 NY Angler survey.	4.0	50th percentile value, based on 1991 NY Angler survey.
Loss	Cooking Loss	g/g	0	Assumes 100% PCBs remains in fish.	0.2	Assumes 20% PCBs in fish is lost through cooking.
FS	Fraction from Source	unitless	1	Assumes 100% fish ingested is from Upper Hudson.	1	Assumes 100% fish ingested is from Upper Hudson.
EF	Exposure Frequency	days/year	365	Fish ingestion rate already averaged over one year.	365	Fish ingestion rate already averaged over one year.
ED-C	Exposure Duration (Cancer)	years	40	95th percentile value, based on 1991 NY Angler and 1990 US Census data.	12	50th percentile value, based on 1991 NY Angler and 1990 US Census data.
ED-NC	Exposure Duration (Non-cancer)	years	7	see text	12	50th percentile value, based on 1991 NY Angler and 1990 US Census data.
CF	Conversion Factor	kg/g	1.00E-03	--	1.00E-03	--
BW	Body Weight	kg	70	Mean adult body weight, males and females (USEPA, 1989b).	70	Mean adult body weight, males and females (USEPA, 1989b).
AT-C	Averaging Time (Cancer)	days	25,550	70-year lifetime exposure x 365 d/yr (USEPA, 1989b).	25,550	70-year lifetime exposure x 365 d/yr (USEPA, 1989b).
AT-NC	Averaging Time (Noncancer)	days	2,555	ED (years) x 365 days/year.	4,380	ED (years) x 365 days/year.
RBC_f-NC	Risk-based Concentration of PCBs in Fish (Non-cancer), HI=1	mg/kg wet weight	0.044	RBC_f-NC = (HI x RfD x BW x AT-NC)/(IR x (1 - Loss) X FS x EF x ED-NC x CF)	0.44	RBC_f-NC = (HI x RfD x BW x AT-NC)/(IR x (1 - Loss) X FS x EF x ED-NC x CF)
RBC_f-C-10^{-4}	Risk-based Concentration of PCBs in Fish (Cancer), Risk = 10^{-4}	mg/kg wet weight	0.2	RBC_f-C = (Risk x BW x AT-C)/(CSF x IR x (1 - Loss) X FS x EF x ED-C x CF)	12.8	RBC_f-C = (Risk x BW x AT-C)/(CSF x IR x (1 - Loss) X FS x EF x ED-C x CF)
RBC_f-C-10^{-5}	Risk-based Concentration of PCBs in Fish (Cancer), Risk = 10^{-5}	mg/kg wet weight	0.02	RBC_f-C = (Risk x BW x AT-C)/(CSF x IR x (1 - Loss) X FS x EF x ED-C x CF)	1.28	RBC_f-C = (Risk x BW x AT-C)/(CSF x IR x (1 - Loss) X FS x EF x ED-C x CF)
RBC_f-C-10^{-6}	Risk-based Concentration of PCBs in Fish (Cancer), Risk = 10^{-6}	mg/kg wet weight	0.002	RBC_f-C = (Risk x BW x AT-C)/(CSF x IR x (1 - Loss) X FS x EF x ED-C x CF)	0.128	RBC_f-C = (Risk x BW x AT-C)/(CSF x IR x (1 - Loss) X FS x EF x ED-C x CF)

TABLE 2

CALCULATION OF RISK-BASED CONCENTRATIONS OF DIOXIN-LIKE PCBS IN FISH -- UPPER HUDSON RIVER

HUDSON RIVER PCBs REASSESSMENT RI/FS

Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference
CSF	Cancer Slope Factor	$(mg/kg\text{-}d)^{-1}$	2.7	Congener-weighted CSF**.
IR_{fish}	Ingestion Rate of Fish	grams/day	31.9	90th percentile value, based on 1991 NY Angler survey.
Loss	Cooking Loss	g/g	0	Assumes 100% PCBs remains in fish.
FS	Fraction from Source	unitless	1	Assumes 100% fish ingested is from Upper Hudson.
EF	Exposure Frequency	days/year	365	Fish ingestion rate already averaged over one year.
ED	Exposure Duration	years	40	95th percentile value, based on 1991 NY Angler and 1990 US Census data.
CF	Conversion Factor	kg/g	1.00E-03	--
BW	Body Weight	kg	70	Mean adult body weight, males and females (USEPA, 1989b).
AT	Averaging Time	days	25,550	70-year lifetime exposure x 365 d/yr (USEPA, 1989b).
$RBC_f\text{-}10^{-4}$	Risk-based Concentration of Dioxin-like PCBs in Fish, Risk = 10^{-4}	mg/kg wet weight	0.14	RBC_f = (Risk x BW x AT)/(CSF x IR x (1 - Loss) X FS x EF x ED x CF)
$RBC_f\text{-}10^{-5}$	Risk-based Concentration of Dioxin-like PCBs in Fish, Risk = 10^{-5}	mg/kg wet weight	0.014	RBC_f = (Risk x BW x AT)/(CSF x IR x (1 - Loss) X FS x EF x ED x CF)
$RBC_f\text{-}10^{-6}$	Risk-based Concentration of Dioxin-like PCBs in Fish, Risk = 10^{-6}	mg/kg wet weight	0.0014	RBC_f = (Risk x BW x AT)/(CSF x IR x (1 - Loss) X FS x EF x ED x CF)

Note:

For dioxin, only a plausible upper bound slope factor is available; therefore, a central tendency estimate was not calculated.

** Congener-weighted CSF is the product of the Dioxin CSF (150,000 kg-d/mg) and the sum of the product of each congener TEF and the congener over total PCB Ratio. See Table 5-36 in HHRA report.