Memorandum

Date: August 8, 2012

From: Chau Vu, Human Health Risk Assessor, Technical & Enforcement Support Section

To: Centredale Site File

Subj: Updated calculation of site-specific cancer and non-cancer dioxin soil PRGs for recreational scenario at the Oxbow General Area

On February 17, 2012, EPA finalized its non-cancer science assessment for dioxins, including development of the non-cancer toxicity value reference dose of 0.7 pg/kg-day. EPA now requires using this toxicity value for evaluations of dioxin non-cancer health effects in a range of agency activities, including establishing cleanup levels at Superfund sites. With science available from the non-cancer dioxin assessment, the purpose of this memorandum is to revise site-specific non-cancer dioxin soil preliminary remediation goals (PRGs) for passive recreational visitor at the Oxbow General Area.

Since there is no change to dioxin cancer toxicity values, there is no change to the cancer risk-based dioxin PRGs and cancer dioxin PRGs calculated in the September 2011 Addendum to the Interim Final Preliminary Remediation Goals Report: Oxbow Area, Part I Human Health (2011 Oxbow PRGs Report). The cancer dioxin soil PRGs for recreational scenario are again documented in the attached Table 1, which provides exposure assumptions used, cancer and non-cancer PRG equations, and the PRG results for various target risk levels.

From the 2012 final dioxin non-cancer assessment, the new non-cancer toxicity value is a reference dose value of 0.7 pg/kg-day. Applying this value to the equation for non-cancer PRGs from the 2011 Oxbow PRGs Report and using the same standard default and site-specific exposure parameters, the non-cancer soil PRGs for 2,3,7,8-TCDD are presented in the attached Table 1.

The non-cancer PRG value of 680 parts per trillion (ppt) based on target non-cancer hazard index of 1 was selected to delineate the area to be excavated to immediately reduce human health risks due to exposure in this area. This value of 680 ppt would result in cancer risk within EPA's acceptable risk range for recreational visitor. For long-term protection, enhanced natural recovery would be used to reduce risk to the cancer PRG value of 53 ppt based on 10E-6 target cancer risk level.

Attachment
Table 1

Table 1
Derivation of Surface Soil Human Health Preliminary Remediation Goals - Direct Contact - Passive Recreational Visitor Oxbow General Area

Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

SCENARIO TIMEFRAME: CURRENT/FUTURE
MEDIUM: SOIL
EXPOSURE MEDIUM: SURFACE SOIL

EXPOSURE ROUTE	RECEPTOR POPULATION	RECEPTOR AGE	EXPOSURE POINT	PARAMETER CODE	PARAMETER DEFINITION	VALUE	UNITS	RATIONALE/ REFERENCE
INGESTION	PASSIVE RECREATIONAL VISITOR	ADULT (ages 19 and above)	OXBOW	IR-S	INGESTION RATE OF SOIL	100	mg/day	USEPA, 1994
				FI	FRACTION INGESTED	1	unitless	Professional Judgement
				EF	EXPOSURE FREQUENCY	26	day/yr	Professional Judgement[1]
				ED	EXPOSURE DURATION	12	yr	USEPA, 1994[2]
				BW	BODY WEIGHT	70	kg	USEPA, 1994
				AT-C	AVERAGING TIME (CANCER)	25550	day	USEPA, 1989
				AT-N	AVERAGING TIME (NONCANCER)	4380	day	USEPA, 1989
				ADAF	AGE DEPENDENT ADJUSTMENT FACTOR	1	unitless	USEPA, 2005[3]
				CF	CONVERSION FACTOR	0.000001	kg/mg	
		ADOLESCENT (ages 7 - 18)	OXBOW	IR-S	INGESTION RATE OF SOIL	100	mg/day	USEPA, 1994
				FI	FRACTION INGESTED	1	unitless	Professional Judgement
				EF	EXPOSURE FREQUENCY	26	day/yr	Professional Judgement[1]
				ED	EXPOSURE DURATION	12	yr	USEPA, 1994[2]
				BW	BODY WEIGHT	45	kg	USEPA, 1997[4]
				AT-C	AVERAGING TIME (CANCER)	25550	day	USEPA, 1989
				AT-N	AVERAGING TIME (NONCANCER)	4380	day	USEPA, 1989
				ADAF	AGE DEPENDENT ADJUSTMENT FACTOR	2.5	unitless	USEPA, 2005[3]
				CF	CONVERSION FACTOR	0.000001	kg/mg	
		CHILD (ages 1 - 6)	OXBOW	IR-S	INGESTION RATE OF SOIL	200	mg/day	USEPA, 1994
				FI	FRACTION INGESTED	1	unitless	Professional Judgement
				EF	EXPOSURE FREQUENCY	26	day/yr	Professional Judgement[1]
				ED	EXPOSURE DURATION	6	yr	USEPA, 1994[2]
				BW	BODY WEIGHT	15	kg	USEPA, 1994
				AT-C	AVERAGING TIME (CANCER)	25550	day	USEPA, 1989
				AT-N	AVERAGING TIME (NONCANCER)	2190	day	USEPA, 1989
				ADAF	AGE DEPENDENT ADJUSTMENT FACTOR	4.2	unitless	USEPA, 2005[3]
				CF	CONVERSION FACTOR	0.000001	kg/mg	
DERMAL	PASSIVE RECREATIONAL VISITOR	ADULT (ages 19 and above)	OXBOW	AF	ADHERENCE FACTOR	0.07	mg/cm2	USEPA, 2001[5]
				AbF	ABSORPTION FACTOR	chemical-specific	unitless	USEPA, 2001[6]
				SA	SKIN SURFACE AREA AVAILABLE FOR CONTACT	5700	cm2/day	USEPA, 2001[7]
				EV	EVENT DAY	1	unitless	Professional Judgement
				EF	EXPOSURE FREQUENCY	26	day/yr	Professional Judgement[1]
				ED	EXPOSURE DURATION	12	yr	USEPA, 1994[2]
				BW	BODY WEIGHT	70	kg	USEPA, 1994
				AT-C	AVERAGING TIME (CANCER)	25550	day	USEPA, 1989
				AT-N	AVERAGING TIME (NONCANCER)	4380	day	USEPA, 1989
				ADAF	AGE DEPENDENT ADJUSTMENT FACTOR	1	unitless	USEPA, 2005[3]
				CF	CONVERSION FACTOR	0.000001	kg/mg	
		ADOLESCENT (ages 7 - 18)	OXBOW	AF	ADHERENCE FACTOR	0.2	mg/cm2	USEPA, 2001[5]
				AbF	ABSORPTION FACTOR	chemical-specific	unitless	USEPA, 2001[6]
				SA	SKIN SURFACE AREA AVAILABLE FOR CONTACT	4800	cm2/day	USEPA, 1997[8]
				EV	EVENT DAY	1	unitless	Professional Judgement
				EF	EXPOSURE FREQUENCY	26	day/yr	Professional Judgement[1]
				ED	EXPOSURE DURATION	12	yr	USEPA, 1994[2]
				BW	BODY WEIGHT	45	kg	USEPA, 1997[4]
				AT-C	AVERAGING TIME (CANCER)	25550	day	USEPA, 1989
				AT-N	AVERAGING TIME (NONCANCER)	4380	day	USEPA, 1989
				ADAF	AGE DEPENDENT ADJUSTMENT FACTOR	2.5	unitless	USEPA, 2005[3]
				CF	CONVERSION FACTOR	0.000001	kg/mg	
		CHILD (ages 1 - 6)	OXBOW	AF	ADHERENCE FACTOR	0.2	mg/cm2	USEPA, 2001[5]
				AbF	ABSORPTION FACTOR	chemical-specific	unitless	USEPA, 2001[6]
				SA	SKIN SURFACE AREA AVAILABLE FOR CONTACT	2800	cm2/day	USEPA, 2001[7]
				EV	EVENT DAY	1	unitless	Professional Judgement
				EF	EXPOSURE FREQUENCY	26	day/yr	Professional Judgement[1]
				ED	EXPOSURE DURATION	6	yr	USEPA, 1994[2]
				BW	BODY WEIGHT	15	kg	USEPA, 1994
				AT-C	AVERAGING TIME (CANCER)	25550	day	USEPA, 1989
				AT-N	AVERAGING TIME (NONCANCER)	2190	day	USEPA, 1989
				ADAF	AGE DEPENDENT ADJUSTMENT FACTOR	4.2	unitless	USEPA, 2005[3]
				CF	CONVERSION FACTOR	0.000001	kg/mg	

Table 1
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Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

SCENARIO TIMEFRAME: CURRENT/FUTURE
MEDIUM: SOIL
EXPOSURE MEDIUM: SURFACE SOIL

EXPOSURE ROUTE	RECEPTOR POPULATION	RECEPTOR AGE	EXPOSURE POINT	PARAMETER CODE	PARAMETER DEFINITION	VALUE	UNITS	RATIONALE/ REFERENCE

USEPA, 1989. "Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)"; Office of Emergency and Remedial Response; EPA-540/1-89/002 (interim final); Washington, D.C., December.
USEPA, 1994. "Risk Updates No. 2"; USEPA Region I, Waste Management Division; August. Values from "Attachment 2" to Risk Updates No. 2.
USEPA, 1997. "Exposure Factors Handbook, Volume 1"; Office of Research and Development; EPA-600/P-95/002Fa; Washington, D.C.; August.
USEPA, 2001. "Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
USEPA, 2005. "Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens, Risk Assessment Forum; EPA/630/R-03/003F; Washington, D.C. March.
1 - Value based on exposure during wading, swimming, and walking/exploring banks (1 day per week May - October).
2 - The total RME exposure duration is 30 years, consistent with USEPA, 1994. The allocation of exposure duration for the three age groups is based on professional judgement.
3 - ADAF is only used for carcinogenic chemicals that operate with a mutagenic mode of action (only benzo(a)pyrene for these COPCs).
4 - Values are the average of 50th percentile body weights for males and females ages 7 through 18.
5 - Values for residential exposure to soil used as conservative estimate of potential soil adherence associated with recreational walking/exploring.
6 - Values are provided (Table 3-4 of USEPA, 2001) for arsenic, cadmium, chlordane, 2,4-D, DDT (used for DDD, DDE), TCDD, lindane (used for other BHC isomers), PAHs, PCBs, and pentachlorophenol. A single value is listed for all other SVOCs. No values are listed for VOCs, other pesticides, or other inorganics and, subsequently, no value will be assigned to the AbF term for COPCs falling into those categories.
7 - Values for residential exposure to soil used as conservative estimate of potential surface area exposed to soil during recreational walking/exploring.
9 - Values are the average of 50th percentile body surface areas (sum of areas for face, hands, forearms, lower legs, and feet) for males in the various age groups indicated.
mg - milligrams
cm2 - square centimeters
kg - kilograms

Based on cancer risk,

$$PRG_{soil,c} = \frac{TR_{soil}}{\left[\left(\frac{CSF_o \times ADAF \times IR_{child} \times FI \times EF_{child} \times ED_{child} \times CF}{BW_{child} \times AT}\right) + \left(\frac{CSF_o \times ADAF \times IR_{olderchild} \times FI \times EF_{olderchild} \times ED_{olderchild} \times CF}{BW_{olderchild} \times AT}\right) + \left(\frac{CSF_o \times ADAF \times IR_{adult} \times FI \times EF_{adult} \times ED_{adult} \times CF}{BW_{adult} \times AT}\right)\right] + \left[\left(\frac{CSF_d \times ADAF \times AF \times AbF \times CF \times EV_{child} \times ED_{child} \times EF_{child} \times SA_{child}}{BW_{child} \times AT}\right) + \left(\frac{CSF_d \times ADAF \times AF \times AbF \times CF \times EV_{olderchild} \times ED_{olderchild} \times EF_{olderchild} \times SA_{olderchild}}{BW_{olderchild} \times AT}\right) + \left(\frac{CSF_d \times ADAF \times AF \times AbF \times CF \times EV_{adult} \times ED_{adult} \times EF_{adult} \times SA_{adult}}{BW_{adult} \times AT}\right)\right]}$$

COMPOUND OF POTENTIAL CONCERN	ORAL SLOPE FACTOR (mg/kg/dsy)-1	DERMAL SLOPE FACTOR (mg/kg/day)-1	DERMAL ABSORPTION FACTOR [AbF]	PRG ELCR = 10^{-4} (mg/Kg)	PRG ELCR = 10^{-5} (mg/Kg)	PRG ELCR = 10^{-6} (mg/Kg)
Arsenic	1.5	1.5	0.03	467	47	4.7
Benzo(a)pyrene	7.3	7.3	0.13	21.2	2.1	0.21
Dioxin-TEQ	150000	150000	0.001	0.0053	0.00053	0.000053

TRsoil - Target Risk
ELCR - Excess Lifetime Cancer Risk

Based on non-cancer risk,

$$PRG_{soil,nc} = \frac{THI_{soil}}{\left[\left(\frac{CF \times IR_{agegroup} \times FI \times EF_{agegroup} \times ED_{agegroup}}{RfD_o \times BW_{agegroup} \times AT}\right) + \left(\frac{AF \times AbF \times CF \times EV_{agegroup} \times ED_{agegroup} \times EF_{agegroup} \times SA_{agegroup}}{RfD_d \times BW_{agegroup} \times AT}\right)\right]}$$

COMPOUND OF POTENTIAL CONCERN	ORAL CHRONIC REFERENCE DOSE (mg/kg/day)	DERMAL CHRONIC REFERENCE DOSE (mg/kg/day)	DERMAL ABSORPTION FACTOR [AbF]	PRG ADULT HI = 0.1 (mg/Kg)	PRG ADULT HI = 1 (mg/Kg)	PRG ADULT HI = 10 (mg/Kg)	PRG ADOLESCENT HI = 0.1 (mg/Kg)	PRG ADOLESCENT HI = 1 (mg/Kg)	PRG ADOLESCENT HI = 10 (mg/Kg)	PRG CHILD HI = 0.1 (mg/Kg)	PRG CHILD HI = 1 (mg/Kg)	PRG CHILD HI = 10 (mg/Kg)
Arsenic	0.0003	0.0003	0.03	263	2633	26329	147	1471	14714	29	291	2914
Benzo(a)pyrene	0.03	0.03	0.13	19412	194118	1941185	8431	84306	843057	2316	23157	231573
Dioxin-TEQ	7.00E-10	7.00E-10	0.03	0.000614	0.006143	0.061435	0.000343	0.003433	0.034333	0.000068	0.000680	0.006799

THI - Target Hazard Index
HI - Hazard Index
NA - not available

TCDD AbF 0.03 or 0.001 if soil organic content is >10%