

## ATTACHMENT 1

### Virginia Rail: Risk Calculations for Selected Analytes and Areas

Food Ingestion Rate (FIR)	0.00817 kg/day (dry wt)
Proportion Sediment in Diet	0.18 Based on data for western sandpiper (USEPA 1993, as cited in the BERA)
Sediment Ingestion Rate (SIR)	0.00147 kg/day (dry wt)
Dietary Composition	100% Benthic Invertebrates
Body Weight (BW)	0.049 kg (wet wt) from Cornell Lab of Ornithology, www.allaboutbirds.org, accessed October 7, 2011
Area Use Factor	1

Analyte	Sediment EPC <sup>1</sup> (mg/kg)	BSAF <sup>2</sup>	Benthic Invertebrate Prey Concentration (mg/kg dw)	Sediment Dose (mg/kg-d)	Prey Dose (mg/kg-d)	Total Dose (mg/kg-d)	Toxicity Reference Value <sup>3</sup> (mg/kg-d)	Hazard Quotient <sup>4</sup>
<u>Central Blag Slough</u>								
Cadmium	24.59	3.073	75.6	0.738	12.6	13.3	1.47	9.1
Chromium	19.42	0.468	9.09	0.583	1.52	2.10	2.66	0.79
Molybdenum	42.59	NA	NA	1.28	NA	NA	3.5	0.37
<u>Eastern Wetland</u>								
Arsenic	47.14	0.675	31.8	1.41	5.31	6.72	2.24	3.0
Boron	28.65	NA	NA	0.860	NA	NA	28.8	0.03
Chromium	20.98	0.468	9.82	0.630	1.64	2.27	2.66	0.85
Molybdenum	139.4	NA	NA	4.18	NA	NA	3.5	1.2
Selenium	4.304	2.5	10.76	0.129	1.79	1.923	0.29	6.6
<u>Northwest Blag Slough</u>								
Chromium	31.75	0.468	14.86	0.953	2.48	3.43	2.66	1.3
Mercury (using MeHg TRV)	0.658	2.868	1.89	0.0197	0.315	0.334	0.0064	52
Mercury (using inorganic Hg TRV)	0.658	2.868	1.89	0.0197	0.315	0.334	0.45	0.74
Molybdenum	73.64	NA	NA	2.21	NA	NA	3.5	0.63

<sup>1</sup> Sediment EPCs are from Table 6-2 of the BERA.

<sup>2</sup> Biota-to-Sediment Accumulation Factors (BSAFs) for cadmium, arsenic, chromium, and mercury are 90th percentile values from Bechtel Jacobs (1998). The BSAF for selenium is from Lemly (2002). All BSAF units are mg/kg dw tissue / mg/kg sediment. BSAFs for boron and molybdenum were not available from standard sources and prey doses were not calculated.

<sup>3</sup> TRVs are from Table 6-6 of the BERA. The methylmercury (MeHg) TRV is from Sample et al. (1996, as cited in the BERA) and is included to bracket the range of mercury risk.

<sup>4</sup> HQs for boron and molybdenum are based on incidental sediment ingestion only. HQs for these metals in the revised BERA should incorporate prey doses, which should be calculated based on measured, site-specific benthic invertebrate tissue residue concentrations (preferably) or BSAFs developed from a comprehensive literature review.

#### Equations:

$$\text{FIR (kg/day dw)} = 0.0582 * (\text{BW})^{0.651} \text{ (from EPA 1993, as cited in the BERA)}$$

## **ATTACHMENT 1**

### **Virginia Rail: Risk Calculations for Selected Analytes and Areas**

$SIR \text{ (kg/d dw)} = FIR \text{ (kg/d dw)} * \text{Proportion soil in diet}$

$\text{Benthic Invertebrate Prey Concentration (mg/kg dw)} = \text{Sediment EPC (mg/kg)} * BSAF$

$\text{Sediment Dose (mg/kg-d)} = [\text{Sediment EPC (mg/kg)} * SIR \text{ (kg-d dw)} * AUF] / BW \text{ (kg ww)}$

$\text{Prey Dose} = [\text{Prey Concentration (mg/kg dw)} * FIR \text{ (kg/d dw)} * AUF] / BW \text{ (kg ww)}$

$\text{Total Dose} = \text{Sediment Dose} + \text{Prey Dose}$

$HQ = \text{Total Dose} / TRV$

## ATTACHMENT 2

### American Robin: Risk Calculations for Selected Analytes and Areas

#### Food Ingestion

Rate (FIR)<sup>1</sup> 0.01668 kg dw/day [FIR (g dw/day) = 0.398\*(BW)<sup>0.850</sup> (from USEPA 1993 as cited in the BERA), converted to kg/day by dividing by 1,000]

Proportion Soil in Diet 0.104 From BERA Table 6-4

Dietary Composition 49% Plants  
51% Invertebrates

Soil Ingestion Rate (SIR) 0.00173 kg dw/day [SIR (kg/d dw) = FIR (kg/d dw) \* Proportion soil in diet]

Plant Ingestion Rate (IR<sub>p</sub>) 0.00817 kg dw/day [IR<sub>p</sub> = FIR \* 0.49]

#### Invertebrate

Ingestion Rate (IR<sub>i</sub>) 0.00850 kg dw/day [IR<sub>i</sub> = FIR \* 0.51]

Body Weight (BW) 0.081 kg (ww) from BERA Table 6-4

Area Use Factor 1

	C <sub>soil</sub> (mg/kg)	Soil-to-Plant BCF (dry wt basis)	C <sub>plant</sub> (mg/kg dw) <sup>2</sup>	Soil-to-Earthworm BCF or Equation (dry wt basis) <sup>3</sup>	C <sub>earthworm</sub> (mg/kg dw)	Soil Dose (mg/kg-d)	Plant Dose (mg/kg-d)	Earthworm Dose (mg/kg-d)	Total Dose (mg/kg-d)	TRV (mg/kg-d)	HQ
Analyte	From Table 6-2	Site-Specific BCFs from Table 6-3	= C <sub>soil</sub> * Soil-to- Plant BCF	From Eco-SSLs and Table 6-3	Based on equations in Soil-to- Earthworm BCF column	=(SIR*Soil EPC*AUF) /BW	=(IR <sub>p</sub> *C <sub>soil</sub> *AUF)/BW	=(IR <sub>e</sub> *C <sub>soil</sub> *AUF)/BW	=Soil Dose + Plant Dose + Earthworm Dose	From Table 6-6	=Total Dose /TRV
<u>Eastern Wetland</u>											
Arsenic	34.11	0.056	1.9	ln(Ce) = 0.706*ln(Cs)-1.421	2.92	0.730	0.193	0.306	1.23	2.24	0.5
Boron	47.4	34	1612	Ce = Cs * 0.144	6.83	1.01	163	0.717	164	28.8	5.7
Cadmium	1.055	6.0	6.33	ln(Ce) = 0.795*ln(Cs)+2.114	8.64	0.0226	0.639	0.907	1.57	0.290	5.4
Chromium	26.16	0.048	1.26	Ce = Cs * 0.306	8.00	0.560	0.127	0.841	1.53	2.66	0.6
Manganese	3078	0.96	2955	ln(Ce) = 0.682*ln(Cs)-0.809	106.6	65.9	298	11.2	375	179	2.1
Molybdenum	75.69	0.094	7.11	Ce = Cs * 0.144	10.9	1.62	0.718	1.14	3.48	3.50	1.0
Selenium	2.334	0.67	1.56	ln(Ce) = 0.733*ln(Cs)-0.075	1.73	0.0500	0.158	0.181	0.389	0.290	1.3
<u>SWMU 14/15</u>											
Arsenic	97.87	0.056	5.48	ln(Ce) = 0.706*ln(Cs)-1.421	6.14	2.10	0.553	0.645	3.29	2.24	1.5
Boron	87.67	34	2981	Ce = Cs * 0.144	12.6	1.88	301	1.33	304	28.8	11
Cadmium	2.985	6.0	17.9	ln(Ce) = 0.795*ln(Cs)+2.114	19.8	0.0639	1.81	2.07	3.94	0.290	14

<sup>1</sup> Note that this value was derived differently from, and is considerably greater than, the Total Dietary Intake of 0.138 kg diet dw/kg bw-d that was used in the BERA. The FIR given here, when divided by the robin's body weight, gives a dietary intake of 0.206 kg diet dw/kg bw-d).

<sup>2</sup> Literature-derived soil-to-plant BCFs were used for SWMU 14/15 in the BERA, but we used site-specific BCFs here to determine the impacts of this possible change on hazard quotients.

<sup>3</sup> BCFs from EPA's Eco-SSL guidance (Attachment 4-1) were used in preference to other literature-derived BCFs. For chemicals lacking Eco-SSL BCFs (i.e., boron, molybdenum), the values from BERA Table 6-3 were used, adjusted to dry weight basis (i.e., dry wt BCF = wet wt BCF / proportion solids = 0.023/0.16). In the revised BERA, site-specific measured earthworm concentrations should be used for molybdenum and boron, or a literature search should be conducted for earthworm BCFs for these metals.

### ATTACHMENT 3

#### Central Blag Slough: Comparison of Soil-to-Plant Bioconcentration Factors (BCFs) and Plant Concentrations Determined Via Varying Methods

Table 1. Comparison of Soil-to-Plant BCFs (all units in [mg/kg plant dw] / [mg/kg soil])

Analyte	Eco-SSL BCF Equations <sup>1</sup>	Calculated Eco-SSL BCFs <sup>2</sup>	Literature-Derived BCFs Used by NIPSCO (from BERA Table 6-3)	Site-Specific BCFs (from BERA Table 6-3)
Aluminum	NA	NA	0.0040	0.036
Arsenic	$C_p = 0.03752 * C_s$	0.03752	0.038	0.056
Barium	$C_p = 0.156 * C_s$	0.156	0.16	0.79
Boron	NA	NA	4.0	34
Cadmium	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	0.286	0.59	6.0
Chromium	$C_p = 0.041 * C_s$	0.041	0.041	0.048
Copper	$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	0.274	0.12	0.36
Lead	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	0.0411	0.039	0.018
Manganese	$C_p = 0.079 * C_s$	0.079	0.079	0.96
Mercury	NA	NA	0.90	0.43
Molybdenum	NA	NA	0.25	0.094
Selenium	$\ln(C_p) = 1.104 * \ln(C_s) - 0.677$	0.532	0.67	NA

<sup>1</sup> From USEPA. 2007. Guidance for Developing Ecological Soil Screening Levels. Attachment 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. OSWER Directive 9285.7-55. Office of Solid Waste and Emergency Response, Washington, D.C. Revised April 2007.

<sup>2</sup> For BCF values that are dependent on soil concentrations, plant concentrations (C<sub>p</sub>) were calculated first as described in the footnotes to Table 2 below. The BCFs were then calculated as  $BCF = C_p/C_s$  based on the soil concentrations (C<sub>s</sub>) and plant concentrations (C<sub>p</sub>) listed in Table 2 below.

**ATTACHMENT 3**

**Central Blag Slough: Comparison of Soil-to-Plant Bioconcentration Factors (BCFs) and Plant Concentrations Determined Via Varying Methods**

**Table 2. Comparison of Plant Concentrations<sup>1</sup> (all units in mg/kg dw)**

Analyte	Soil Concentration <sup>2</sup>	Estimated Plant Concentrations Using Site-Specific BCFs	Estimated Plant Concentrations Using Eco-SSL BCFs <sup>3</sup>	Estimated Plant Concentrations Using NIPSCO's Literature-Derived BCFs	Estimated Plant Concentrations <sup>4</sup> (from BERA Table L-32)
Aluminum	3652	131	NA	14.6	18.42
Arsenic	9.897	0.554	0.371	0.376	0.097
Barium	NA	NA	NA	NA	NA
Boron	4.333	147	NA	17.3	9.85
Cadmium	5.534	33.2	1.58	3.27	2.34
Chromium	24.89	1.19	1.02	1.02	0.25
Copper	25.44	9.16	6.98	3.05	1.26
Lead	69.62	1.25	2.86	2.72	0.23
Manganese	286.4	275	22.6	22.6	54.13
Mercury	0.0659	0.0283	NA	0.05931	0.0043
Molybdenum	145.2	13.6	NA	36.3	1.70
Selenium	1.551	NA	0.825	1.04	0.11

<sup>1</sup> Except where otherwise noted, plant concentrations are calculated as  $C_p = C_s * BCF$  (using the applicable BCF from Table 1 above), where  $C_s$  = soil concentrations listed in this table.

<sup>2</sup> Soil concentrations listed here are the exposure point concentrations for Central Blag Slough, from Table 6-2 of the BERA.

<sup>3</sup> For cadmium, copper, lead and selenium, plant concentrations ( $C_p$ ) were calculated according to the logarithmic equations given in Table 1 and using the soil concentrations ( $C_s$ ) listed in Table 2.

<sup>4</sup> These concentrations were copied directly from Table L-32 of the BERA; it is unclear how these concentrations were calculated.