Table 3-1
Lead and Mercury Emission Rates Evaluated in the HHRA

Chemical	Modeled Emission Rate	
	(lb/hr)	(g/s)
Lead	6.54E-02	8.24E-03
Mercury	7.35E-03	9.26E-04

Table 3-2
Emission Rates of Mercury Species Evaluated in the HHRA

Mercury Form	Symbol	% of Total Hg Emissions	Mercury Emission Rate (lb/hr)	Modeled Mercury Emission Rate (g/s)
Elemental Vapor	Hg0	50%	3.68E-03	4.63E-04
Divalent Vapor	Hg2	30%	2.21E-03	2.78E-04
Particle Bound	HgP	20%	1.47E-03	1.85E-04
Totals		100%	7.35E-03	9.26E-04

Table 4-1
Representative Plot File Generated Following AERMOD Run

UTMX	UTMY	AVERAGE CONC	TOTAL DEPO	DRY DEPO	WET DEPO	ZELEV	ZHILL	ZFLAG	AVE	GRP	NUM YRS	NET ID
564790.9	4727858	0.00799	6.41006	6.13867	0.27140	176.78	216.71	0	ANNUAL	ALL	1	
565090.9	4727858	0.00812	6.62949	6.30201	0.32747	197.27	216.41	0	ANNUAL	ALL	1	
--	--	--	--	--	--	--	--	--	--	--	--	
565690.9	4727858	0.00950	8.14442	7.59997	0.54448	205.33	224.03	0	ANNUAL	ALL	1	
565990.9	4727858	0.01001	8.88733	8.24375	0.64356	192.02	192.02	0	ANNUAL	ALL	1	

Table 4-2
AERMOD Modeled COPC Impacts on Candidate Residential Locations

Chemical	Air Concentration (µg/m^3)	Dry Deposition (g/m^2-yr)	Wet Deposition (g/m^2-yr)
Candidate Residential Area 1			
Hg2 [Divalent Mercury-Vapor Phase]	6.40E-07	4.25E-07	9.55E-08
HgP [Divalent Mercury-Particle Bound Phase]	4.30E-07	2.27E-08	2.27E-08
Hg0 [Elemental Mercury-Vapor Phase]	1.07E-06		
Lead	1.90E-05	5.85E-06	6.37E-06
Candidate Residential Area 2			
Hg2 [Divalent Mercury-Vapor Phase]	2.40E-07	1.39E-07	2.21E-07
HgP [Divalent Mercury-Particle Bound Phase]	1.60E-07	7.46E-09	5.84E-08
Hg0 [Elemental Mercury-Vapor Phase]	4.00E-07		
Lead	7.20E-06	1.82E-06	1.70E-05

Table 4-3
AERMOD Modeled COPC Impacts on Candidate Surface Water Bodies

Chemical	Water Body		Watershed	
	Air Concentration ($\mu g/m^3$)	Total Deposition (g/m^2-yr)	Air Concentration ($\mu g/m^3$)	Total Deposition (g/m^2-yr)
Kawkawlin River				
Hg2 [Divalent Mercury-Vapor Phase]	1.96E-07	1.25E-07	2.21E-07	1.40E-07
HgP [Divalent Mercury-Particle Bound Phase]	1.34E-07	9.90E-09	1.50E-07	1.05E-08
Lead	6.31E-06	3.07E-06	7.11E-06	3.16E-06
Tobico Marsh				
Hg2 [Divalent Mercury-Vapor Phase]	1.66E-07	1.03E-07	1.60E-07	9.82E-08
HgP [Divalent Mercury-Particle Bound Phase]	1.12E-07	7.26E-09	1.10E-07	7.21E-09
Lead	4.99E-06	1.80E-06	4.89E-06	1.84E-06
Saginaw River				
Hg2 [Divalent Mercury-Vapor Phase]	3.91E-07	3.43E-07	3.98E-07	2.99E-07
HgP [Divalent Mercury-Particle Bound Phase]	2.64E-07	3.91E-08	2.70E-07	2.70E-08
Lead	1.18E-05	1.12E-05	1.32E-05	7.18E-06

Table 5-1

Terrestrial and Atmospheric Fate and Transport Parameters Used in the HHRA

Parameter	Symbol	Units	Value	Source
Ambient Air Temperature	T	K	281.4	30-yr Average for MBS Airport, MI [NOAA, 2007]
Average Annual Evapotranspiration	E	cm/yr	39.4	Surface Water Hydrology Model [Appendix A]
Average Annual Irrigation	I	cm/yr	19.8	Calculated: Geraghty, 1973.
Average Annual Precipitation	P	cm/yr	80.3	30-yr Average for MBS Airport, MI [NOAA, 2007]
Average Annual Runoff	RO	cm/yr	12.7	Calculated: Geraghty, 1973.
Average Annual Wind Speed	W	m/s	4.04	Average for MBS Airport, MI [2004-2006]
Density of Air	ρ_a	g/cm^3	0.0012	Default: HHRA Guidance [USEPA, 2005]
Soil Mixing Depth - Tilled Soil	$Z_{s(tilled)}$	cm	20	Default: HHRA Guidance [USEPA, 2005]
Soil Mixing Depth - Untilled Soil	$Z_{s(untilled)}$	cm	2	Default: HHRA Guidance [USEPA, 2005]
Soil Particle Density	ρ_s	g/cm^3	2.7	Default: HHRA Guidance [USEPA, 2005]
Time Unit Correction Factor	UCF_{yr}	d/yr	365	Default: HHRA Guidance [USEPA, 2005]
Total Deposition Time (i.e., Facility Operating Life)	tD	yr	30	Default: HHRA Guidance [USEPA, 2005]
Universal Gas Constant	R_{Gas}	$atm\text{-}m^3/mol\text{-}K$	8.205E-05	Default: HHRA Guidance [USEPA, 2005]
Viscosity of Air	μ_a	g/cm-s	1.810E-04	Default: HHRA Guidance [USEPA, 2005]

Geraghty, 1973: Water Atlas of the United States

NOAA, 2006: Annual Climatological Survey [http://hurricane.ncdc.noaa.gov/ancsum/ACS]

USEPA, 2005: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Office of Solid Waste.

Table 5-2
Concentration of COPCs in Air
Selected Residence Location

Chemical	Cyv ($\mu g/m^3$)	Cyp_{SA} [1] ($\mu g/m^3$)	Cyp_{M} [2] ($\mu g/m^3$)	Cyp ($\mu g/m^3$)	Ca ($\mu g/m^3$)
Mercury (Hg+2)	6.40E-07	4.30E-07	0.00E+00	4.30E-07	1.1E-06
Mercury (MeHg)					
Mercury (Hg0)	1.07E-06	0.00E+00	0.00E+00	0.00E+00	1.1E-06
Lead	0.00E+00	0.00E+00	1.90E-05	1.90E-05	1.9E-05

[1] Cyp_{SA} is the air concentration of particle-bound COPCs modeled using surface area based particle size distribution.

[2] Cyp_{M} is the air concentration of particle-phase COPCs modeled using mass based particle size distribution.

Table 5-3
Concentration of COPCs in Soil - Deposition Term
Selected Residence Location

Chemical	Dydv (g/m^2-yr)	Dywv (g/m^2-yr)	$Dydp_{SA}$ (g/m^2-yr)	$Dydp_M$ (g/m^2-yr)	Dydp (g/m^2-yr)	$Dywp_{SA}$ (g/m^2-yr)	$Dywp_M$ (g/m^2-yr)	Dywp (g/m^2-yr)	BD (g/cm^3)	$Z_{s(untilled)}$ (cm)	$Z_{s(tilled)}$ (cm)	$Ds_{untilled}$ (mg/kg-yr)	Ds_{tilled} (mg/kg-yr)
Mercury (Hg+2)	4.25E-07	9.55E-08	2.27E-08	0.00E+00	2.27E-08	2.27E-08	0.00E+00	2.27E-08	1.5	2	20	1.8E-05	1.8E-06
Mercury (MeHg)												3.8E-07	3.8E-08
Mercury (Hg0)													
Lead	0.00E+00	0.00E+00	0.00E+00	5.85E-06	5.85E-06	0.00E+00	6.37E-06	6.37E-06	1.5	2	20	4.1E-04	4.1E-05

Table 5-4
Concentration of COPCs in Soil
Selected Residence Location

Chemical	tD (yr)	T_1 (yr)	Adult T_2 (yr)	Child T_1 (yr)	$Ds_{untilled}$ (mg/kg-yr)	$ks_{untilled}$ (yr^{-1})	$Cs_{untilled}$ (mg/kg)	Ds_{tilled} (mg/kg-yr)	ks_{tilled} (y^{r-1})	Cs_{tilled} (mg/kg)
Mercury (Hg+2)	30	0	30	24	1.8E-05	3.5E-04	5.5E-04	1.8E-06	3.5E-05	5.5E-05
Mercury (MeHg)	30	0	30	24	3.8E-07	3.1E-03	1.1E-05	3.8E-08	2.9E-04	1.1E-06
Mercury (Hg0)										
Lead	30	0	30	24	4.1E-04	2.2E-02	8.9E-03	4.1E-05	2.2E-03	1.2E-03

Table 5-5
Combined Soil Loss Constants

Chemical	$ksl_{untilled}$ (yr^{-1})	$kse_{untilled}$ (yr^{-1})	$ksr_{untilled}$ (yr^{-1})	ksg (yr^{-1})	$ksv_{untilled}$ (yr^{-1})	$ks_{untilled}$ (yr^{-1})	ksl_{tilled} (yr^{-1})	kse_{tilled} (yr^{-1})	ksr_{tilled} (yr^{-1})	ksg (yr^{-1})	ksv_{tilled} (yr^{-1})	ks_{tilled} (yr^{-1})
Mercury (Hg+2)	2.8E-04	0.0E+00	7.3E-05	0.0E+00	3.1E-08	3.5E-04	2.8E-05	0.0E+00	7.3E-06	0.0E+00	3.1E-10	3.5E-05
Mercury (MeHg)	2.3E-03	0.0E+00	6.0E-04	0.0E+00	2.0E-04	3.1E-03	2.3E-04	0.0E+00	6.0E-05	0.0E+00	2.0E-06	2.9E-04
Mercury (Hg0)												
Lead	1.8E-02	0.0E+00	4.7E-03	0.0E+00	0.0E+00	2.2E-02	1.8E-03	0.0E+00	4.7E-04	0.0E+00	0.0E+00	2.2E-03

Table 5-6
Soil Loss Constant Due to Leaching

Chemical	P (cm/yr)	I (cm/yr)	RO (cm/yr)	E_v (cm/yr)	θ_{sw} (mL/cm^3)	$Z_{s(untilled)}$ (cm)	$Z_{s(tilled)}$ (cm)	BD (g/cm^3)	Kd_s (cm^3/g)	$ksl_{untilled}$ (yr^{-1})	ksl_{tilled} (yr^{-1})
Mercury (Hg+2)	80.3	19.8	12.7	39.4	0.20	2	20	1.5	5.8E+04	2.8E-04	2.8E-05
Mercury (MeHg)	80.3	19.8	12.7	39.4	0.20	2	20	1.5	7.0E+03	2.3E-03	2.3E-04
Mercury (Hg0)											
Lead	80.3	19.8	12.7	39.4	0.20	2	20	1.5	9.0E+02	1.8E-02	1.8E-03

Table 5-7
Soil Loss Constant Due to Runoff

Chemical	RO (cm/yr)	$Z_{s(untilled)}$ (cm)	$Z_{s(tilled)}$ (cm)	θ_{sw} (mL/cm^3)	Kd_s (cm^3/g)	BD (g/ml)	$ksr_{untilled}$ (yr^{-1})	ksr_{tilled} (yr^{-1})
Mercury (Hg+2)	12.7	2	20	0.20	5.8E+04	1.5	7.3E-05	7.3E-06
Mercury (MeHg)	12.7	2	20	0.20	7.0E+03	1.5	6.0E-04	6.0E-05
Mercury (Hg0)								
Lead	12.7	2	20	0.20	9.0E+02	1.5	4.7E-03	4.7E-04

Table 5-8
Soil Loss Constant Due to Volatilization

Chemical	Kd_s (cm^3/g)	D_a (cm^2/s)	$Z_{untilled}$ (cm)	$Z_{s(tilled)}$ (cm)	H ($atm\text{-}m^3/mol$)	R_{Gas} ($atm\text{-}m^3/mol\text{-}K$)	T (K)	BD (g/cm^3)	θ_{sw} (mL/cm^3)	ρ_s (g/cm^3)	$ksv_{untilled}$ (y^{r-1})	ksv_{tilled} (y^{r-1})
Mercury (Hg+2)	5.8E+04	4.5E-02	2	20	7.1E-10	8.2E-05	281	1.5	0.20	2.7	3.1E-08	3.1E-10
Mercury (MeHg)	7.0E+03	5.3E-02	2	20	4.7E-07	8.2E-05	281	1.5	0.20	2.7	2.0E-04	2.0E-06
Mercury (Hg0)												
Lead	9.0E+02	7.7E-02	2	20	0.0E+00	8.2E-05	281	1.5	0.20	2.7	0.0E+00	0.0E+00

Table 5-9
Concentration of COPCs in Above-Ground Plants Due to Particle Deposition
Selected Residence Location

Chemical	$Dydp_{SA}$ [1] (g/m²-yr)	$Dydp_M$ [2] (g/m²-yr)	Dydp (g/m²-yr)	Fw ( )	$Dywp_{SA}$ [1] (g/m²-yr)	$Dywp_M$ [2] (g/m²-yr)	Dywp (g/m²-yr)	Rp ( )	kp (yr^{-1})	Tp (yr)	Yp (kg/m²)	Pd (mg/kg)
Mercury (Hg+2)	2.27E-08	0.00E+00	2.27E-08	0.6	2.27E-08	0.00E+00	2.27E-08	0.39	18.0	0.16	2.24	2.6E-07
Mercury (MeHg)												7.3E-08
Mercury (Hg0)												
Lead	0.00E+00	5.85E-06	5.85E-06	0.6	0.00E+00	6.37E-06	6.37E-06	0.39	18.0	0.16	2.24	8.8E-05

[1] $Dydp_{SA}$ and $Dywp_{SA}$ are the dry and wet deposition fluxes of particle-bound COPCs modeled using surface area based particle size distribution.
[2] $Dydp_M$ and $Dywp_M$ are the dry and wet deposition fluxes of particle-phase COPCs modeled using mass based particle size distribution.

Table 5-10
Concentration of COPCs in Above-Ground Plants Due to Air-to-Plant Transfer
Selected Residence Location

Chemical	Cyv ($\mu g/m^3$)	Bv_{ag} [1] [(mg/kg)/(μg/g)]	ρ_a (g/m^3)	VG_{ag} ( )	Pv (mg/kg)
Mercury (Hg+2)	6.40E-07	1.80E+03	1.2E+03	1.00	7.5E-07
Mercury (MeHg)					2.1E-07
Mercury (Hg0)					
Lead	0.00E+00	0.0E+00	1.2E+03	1.00	0.0E+00

[1] COPC-specific Bv_{ag} values are from USEPA, 2005.

Table 5-11
Concentration of COPCs in Above-Ground Plants Due to Root Uptake
Selected Residence Location

Chemical	Cs_{tilled} (mg/kg)	Br [1] [(mg/kg)/(mg/kg)]	Pr (mg/kg)
Mercury (Hg+2)	5.5E-05	1.4E-02	7.8E-07
Mercury (MeHg)	1.1E-06	2.9E-02	3.3E-08
Mercury (Hg0)			
Lead	1.2E-03	1.4E-02	1.7E-05

[1] COPC-specific Br values are from USEPA, 2005.

Table 5-12
Concentration of COPCs in Below-Ground Plants Due to Root Uptake
Selected Residence Location

Chemical	Cs_{tilled} (mg/kg)	Kd_s (L/kg)	Br_{rveg} [1] [(mg/kg)/(mg/kg)]	VG_{rveg} ( )	Pr_{root} (mg/kg)
Mercury (Hg+2)	5.5E-05	5.8E+04	3.6E-02	1.00	2.0E-06
Mercury (MeHg)	1.1E-06	7.0E+03	9.9E-02	1.00	1.1E-07
Mercury (Hg0)					
Lead	1.2E-03	9.0E+02	9.0E-03	1.00	1.1E-05

[1] COPC-specific Br_{rveg} values are from USEPA, 2005.

Table 5-13
Aquatic Fate-and-Transport Parameters Used in the HHRA

Parameter	Symbol	Units	Value	Source
Non Water Body Specific Values				
Bed Sediment Concentration	BS	g/cm^3	1	Default: HHRA Guidance [USEPA, 2005]
Bed Sediment Porosity	θ_{bs}	L_{water}/L	0.6	Default: HHRA Guidance [USEPA, 2005]
Density of Water	ρ_w	g/cm^3	1	Default: HHRA Guidance [USEPA, 2005]
Depth of Upper Benthic Layer	d_b	m	0.03	Default: HHRA Guidance [USEPA, 2005]
Drag Coefficient	C_d	( )	0.0011	Default: HHRA Guidance [USEPA, 2005]
Empirical Slope Coefficient	b	( )	0.125	Default: HHRA Guidance [USEPA, 2005]
Fraction Organic Carbon in Bottom Sediment	OC_{sed}	( )	0.04	Default: HHRA Guidance [USEPA, 2005]
Soil Bulk Density	BD	g/cm^3	1.5	Default: HHRA Guidance [USEPA, 2005]
Soil Enrichment Ratio (Organics)	ER	( )	3	Default: HHRA Guidance [USEPA, 2005]
Soil Enrichment Ratio (Metals)	ER	( )	1	Default: HHRA Guidance [USEPA, 2005]
Suspended Solids Deposition Rate	D_{ss}	m/yr	1825	Default: HHRA Guidance [USEPA, 2005]
Temperature Correction Factor - Surface Water	θ	( )	1.026	Default: HHRA Guidance [USEPA, 2005]
Total Suspended Solids	TSS	mg/L	10	Default: HHRA Guidance [USEPA, 2005]
USLE Cover Management Factor	C	( )	0.1	Default: HHRA Guidance [USEPA, 2005]
USLE Erodibility Factor	K	ton/acre	0.27	Calculated: State Average [MDEQ, 2006a]
USLE Length-slope Factor	LS	( )	1.5	Default: HHRA Guidance [USEPA, 2005]
USLE Rainfall Factor	RF	yr^{-1}	85	Default: Bay County [MDEQ, 2006a]
USLE Supporting Practice Factor	P	( )	1	Default: HHRA Guidance [USEPA, 2005]
Viscous Sublayer Thickness-Dimensionless	λ_2	( )	4	Default: HHRA Guidance [USEPA, 2005]
Viscosity of Water	μ_W	g/cm-s	0.0169	Default: HHRA Guidance [USEPA, 2005]
Volumetric Soil Water Content	θ_{SW}	cm^3/cm^3	0.2	Default: HHRA Guidance [USEPA, 2005]
Von Karman's Constant	k	( )	0.4	Default: HHRA Guidance [USEPA, 2005]
Waterbody Temperature	T_k	K	282.4	Estimated: From Air Temperature
Water Body Specific Values [Kawkawlin River]				
Average Volumetric Flow Through Waterbody	Vfx	m^3/yr	6.10E+07	Calculated: Based on Gaging Data
Current Velocity	u	m/s	4.0E-02	Calculated: From Vfx & Channel Cross Sectional Area
Depth of Water Column	d_w	m	1.45	Calculated: ArcGIS from Navigation Chart
Empirical Intercept Coefficient	a	( )	1.4	Calculated: HHRA Guidance [USEPA, 2005] Table B-4-14
Water Body Area	WA_W	m^2	4.19E+05	Calculated: ArcGIS from DOQQ
Watershed Area	WA_L	m^2	6.01E+07	Calculated: ArcGIS from DOQQ
Watershed Area, Impervious	WA_I	m^2	1.50E+07	Calculated: ArcGIS from DOQQ

MDEQ, 2006a: Soil Erosion and Sediment Control Training Manual. MDEQ Water Bureau.

USEPA, 2005: Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Office of Solid Waste.

Table 5-14

Concentration of COPCs in Watershed Soil - Deposition Term

Chemical	Watershed				BD	$Z_{untilled}$	Ds
	Dytwv (g/m^2-yr)	$Dytwp_{SA}$ [1] (g/m^2-yr)	$Dytwp_{M}$ [2] (g/m^2-yr)	Dytwp (g/m^2-yr)	(g/cm^3)	(cm)	(mg/kg-yr)
Mercury (Hg+2)	1.40E-07	1.05E-08	0.00E+00	1.05E-08	1.5	2	4.9E-06
Mercury (MeHg)							1.0E-07
Mercury (Hg0)							
Lead	0.00E+00	0.00E+00	3.16E-06	3.16E-06	1.5	2	1.1E-04

[1] $Dytwp_{SA}$ is the total deposition flux of particle-bound COPCs modeled using surface area based particle size distribution.

[2] $Dytwp_{M}$ is the total deposition flux of particle-phase COPCs modeled using mass based particle size distribution.

Table 5-15
Concentration of COPCs in Watershed Soil

Chemical	Ds (mg/kg-yr)	$ks_{untilled}$ (yr^{-1})	tD (yr)	Cs_{wshed} (mg/kg)
Mercury (Hg+2)	4.9E-06	4.2E-03	30	1.4E-04
Mercury (MeHg)	1.0E-07	1.5E-02	30	2.4E-06
Mercury (Hg0)				
Lead	1.1E-04	2.6E-02	30	2.2E-03

Table 5-16
Watershed Soil Loss Constant Due to Erosion

Chemical	Kd_s (cm^3/g)	X_e (kg/m^2-yr)	SD ( )	ER ( )	$Z_{untilled}$ (cm)	BD (g/cm^3)	θ_{sw} (mL/cm^3)	kse_{wshed} (yr^{-1})
Mercury (Hg+2)	5.8E+04	0.77	0.15	1.0	2	1.5	0.2	3.8E-03
Mercury (MeHg)	7.0E+03	0.77	0.15	3.0	2	1.5	0.2	1.2E-02
Mercury (Hg0)								
Lead	9.0E+02	0.77	0.15	1.0	2	1.5	0.2	3.8E-03

Table 5-17
Combined Watershed Soil Loss Constant

Chemical	ksl_{wshed} (yr^{-1})	kse_{wshed} (yr^{-1})	ksr_{wshed} (yr^{-1})	ksg_{wshed} (yr^{-1})	ksv_{wshed} (yr^{-1})	ks_{wshed} (yr^{-1})
Mercury (Hg+2)	2.8E-04	3.8E-03	7.3E-05	0.0E+00	3.1E-08	4.2E-03
Mercury (MeHg)	2.3E-03	1.2E-02	6.0E-04	0.0E+00	2.0E-04	1.5E-02
Mercury (Hg0)						
Lead	1.8E-02	3.8E-03	4.7E-03	0.0E+00	0.0E+00	2.6E-02

Table 5-18

Deposition Loading of COPCs to the Kawkawlin River

Chemical	Water Body				A_W (m^2)	L_{Dep} (g/yr)
	Dytwv (g/m^2-yr)	$Dytwp_{SA}$ [1] (g/m^2-yr)	$Dytwp_M$ [2] (g/m^2-yr)	Dytwp (g/m^2-yr)		
Mercury (Hg+2)	1.25E-07	9.90E-09	0.00E+00	9.90E-09	4.19E+05	5.6E-02
Mercury (MeHg)						0.0E+00
Mercury (Hg0)						
Lead	0.00E+00	0.00E+00	3.07E-06	3.07E-06	4.19E+05	1.3E+00

[1] $Dytwp_{SA}$ is the total deposition flux of particle-bound COPCs modeled using surface area based particle size distribution.

[2] $Dytwp_M$ is the total deposition flux of particle-phase COPCs modeled using mass based particle size distribution.

Table 5-18
Deposition Loading of COPCs to the Kawkawlin River

Chemical	Water Body				A_W (m^2)	L_{Dep} (g/yr)
	Dytwv (g/m^2-yr)	$Dytwp_{SA}$ (g/m^2-yr)	$Dytwp_M$ (g/m^2-yr)	Dytwp (g/m^2-yr)		
Mercury (Hg+2)	1.25E-07	9.90E-09	0.00E+00	9.90E-09	4.19E+05	5.6E-02
Mercury (MeHg)						0.0E+00
Mercury (Hg0)						
Lead	0.00E+00	0.00E+00	3.07E-06	3.07E-06	4.19E+05	1.3E+00

Table 5-19
Diffusion Loading of COPCs to the Kawkawlin River

Chemical	K_V (m/yr)	Cywv (μg/m^3)	A_W (m^2)	H (atm-m^3/mol)	R (atm-m^3/mol-K)	T_{wk} (K)	L_{Dif} (g/yr)
Mercury (Hg+2)	8.33E-04	1.96E-07	4.19E+05	7.1E-10	8.21E-05	281.4	2.2E-03
Mercury (MeHg)							
Mercury (Hg0)							
Lead	0.00E+00	0.00E+00	4.19E+05	0.0E+00	8.21E-05	281.4	0.0E+00

Table 5-20
Impervious Runoff Loading of COPCs to the Kawkawlin River

Chemical	Watershed				A_I (m^2)	L_{RI} (g/yr)
	Dytwv (g/m^2-yr)	$Dytwp_{SA}$ [1] (g/m^2-yr)	$Dytwp_M$ [2] (g/m^2-yr)	Dytwp (g/m^2-yr)		
Mercury (Hg+2)	1.40E-07	1.05E-08	0.00E+00	1.05E-08	1.50E+07	2.3E+00
Mercury (MeHg)						0.0E+00
Mercury (Hg0)						
Lead	0.00E+00	0.00E+00	3.16E-06	3.16E-06	1.50E+07	4.7E+01

[1] $Dytwp_{SA}$ is the total deposition flux of particle-bound COPCs modeled using surface area based particle size distribution.
[2] $Dytwp_M$ is the total deposition flux of particle-phase COPCs modeled using mass based particle size distribution.

Table 5-21
Pervious Runoff Loading of COPCs to the Kawkawlin River

Chemical	Cs_{wshed} (mg/kg)	RO (cm/yr)	BD (g/cm^3)	Kd_s (L/kg)	A_L (m^2)	A_I (m^2)	θ_{sw} ( )	UCF (cm^2-kg/m^2-mg)	L_R (g/yr)
Mercury (Hg+2)	1.4E-04	12.7	1.5	5.8E+04	6.01E+07	1.50E+07	0.2	0.01	1.4E-02
Mercury (MeHg)	2.4E-06	12.7	1.5	7.0E+03	6.01E+07	1.50E+07	0.2	0.01	2.0E-03
Mercury (Hg0)									
Lead	2.2E-03	12.7	1.5	9.0E+02	6.01E+07	1.50E+07	0.2	0.01	1.4E+01

Table 5-22
Erosion Loading of COPCs to the Kawkawlin River

Chemical	Cs_{wshed} (mg/kg)	X_e (kg/m^2-yr)	A_L (m^2)	A_I (m^2)	SD ( )	ER ( )	Kd_s (L/kg)	θ_{sw} ( )	BD (g/cm^3)	UCF (mg/g)	L_E (g/yr)
Mercury (Hg+2)	1.4E-04	0.77	6.01E+07	1.50E+07	0.15	1.0	5.8E+04	0.2	1.5	0.001	7.2E-01
Mercury (MeHg)	2.4E-06	0.77	6.01E+07	1.50E+07	0.15	3.0	7.0E+03	0.2	1.5	0.001	3.8E-02
Mercury (Hg0)											
Lead	2.2E-03	0.77	6.01E+07	1.50E+07	0.15	1.0	9.0E+02	0.2	1.5	0.001	1.1E+01

Table 5-23
Universal Soil Loss Equation and Sediment Delivery Ratio

RF (yr^{-1})	K (ton/acre)	LS ( )	C ( )	PF ( )	X_e (kg/m^2-yr)	A_L (m^2)	b ( )	a ( )	SD ( )
85.0	0.27	1.5	0.1	1.0	0.77	6.01E+07	0.125	1.4	0.15

Table 5-24
Total Water Body Loading of COPCs to the Kawkawlin River

Chemical	L_{Dep} (g/yr)	L_I (g/yr)	L_{RI} (g/yr)	L_R (g/yr)	L_E (g/yr)	L_{Dif} (g/yr)	L_T (g/yr)
Mercury (Hg+2)	5.6E-02	0.0E+00	2.3E+00	1.4E-02	7.2E-01	2.2E-03	3.0E+00
Mercury (MeHg)	0.0E+00	0.0E+00	0.0E+00	2.0E-03	3.8E-02	0.0E+00	4.0E-02
Mercury (Hg0)							
Lead	1.3E+00	0.0E+00	4.7E+01	1.4E+01	1.1E+01	0.0E+00	7.4E+01

Table 5-25
Total Water Body Concentration of COPCs in the Kawkawlin River

Chemical	L_T (g/yr)	Vf_x (m^3/yr)	f_{wc} ( )	d_{wc} (m)	d_{bs} (m)	k_{wt} (yr^{-1})	A_W (m^2)	C_{wtot} (mg/L)
Mercury (Hg+2)	3.0E+00	6.10E+07	0.002	1.45	0.03	5.01E-01	4.19E+05	7.1E-06
Mercury (MeHg)	4.0E-02	6.10E+07	0.031	1.45	0.03	4.92E-01	4.19E+05	1.8E-08
Mercury (Hg0)								
Lead	7.4E+01	6.10E+07	0.051	1.45	0.03	4.76E-01	4.19E+05	2.2E-05

Table 5-26
Fraction of COPCs in Kawkawlin River Water Column and Benthic Sediment

Chemical	Kd_{sw} (L/kg)	TSS (mg/L)	d_{wc} (m)	d_{bs} (m)	d_z (m)	θ_{bs} (L_w/L)	Kd_{bs} (L/kg)	C_{BS} (g/cm^3)	f_{bs} ( )	f_{wc} ( )
Mercury (Hg+2)	1.0E+05	10.0	1.45	0.03	1.48	0.60	5.0E+04	1.0	0.998	0.002
Mercury (MeHg)	1.0E+05	10.0	1.45	0.03	1.48	0.60	3.0E+03	1.0	0.969	0.031
Mercury (Hg0)										
Lead	9.0E+02	10.0	1.45	0.03	1.48	0.60	9.0E+02	1.0	0.949	0.051

Table 5-27
Overall Total Water Body Dissipation Rate Constants for COPCs in the Kawkawlin River

Chemical	f_{wc} ( )	k_v (yr^{-1})	f_{bs} ( )	k_b (yr^{-1})	k_{wt} (yr^{-1})
Mercury (Hg+2)	0.002	2.8E-04	0.998	0.50	5.0E-01
Mercury (MeHg)	0.031	1.9E-01	0.969	0.50	4.9E-01
Mercury (Hg0)					
Lead	0.051	0.0E+00	0.949	0.50	4.8E-01

Table 5-28
Water Column Volatilization Loss Rate Constants for COPCs in the Kawkawlin River

Chemical	K_v (m/yr)	d_w (m)	d_b (m)	d_z (m)	Kd_{sw} (L/kg)	TSS (mg/L)	k_v (yr^{-1})
Mercury (Hg+2)	8.33E-04	1.45	0.03	1.48	1.0E+05	10.0	2.8E-04
Mercury (MeHg)	5.48E-01	1.45	0.03	1.48	1.0E+05	10.0	1.9E-01
Mercury (Hg0)							
Lead	0.00E+00	1.45	0.03	1.48	9.0E+02	10.0	0.0E+00

Table 5-29
Overall Transfer Rates for COPCs in the Kawkawlin River

Chemical	K_L (m/yr)	K_G (m/yr)	H (atm-m^3/mol)	R (atm-m^3/mol-K)	T_{wk} (K)	θ ( )	K_V (m/yr)
Mercury (Hg+2)	1.18E+02	3.7E+04	7.1E-10	8.205E-05	281.4	1.026	8.3E-04
Mercury (MeHg)	1.28E+02	3.7E+04	4.7E-07	8.205E-05	281.4	1.026	5.5E-01
Mercury (Hg0)							
Lead	1.61E+02	3.7E+04	0.0E+00	8.205E-05	281.4	1.026	0.0E+00

Table 5-30
Liquid Phase Transfer Coefficients for COPCs in the Kawkawlin River

Chemical	D_W (cm^2/s)	u (m/s)	d_Z (m)	C_d ( )	W (m/s)	ρ_a (g/cm^3)	ρ_w (g/cm^3)	k ( )	λ_z ( )	μ_w (g/cm-s)	K_L (m/yr)
Mercury (Hg+2)	5.2E-06	0.04	1.48	1.1E-03	4.04	1.2E-03	1.0	0.4	4	1.69E-02	1.2E+02
Mercury (MeHg)	6.1E-06	0.04	1.48	1.1E-03	4.04	1.2E-03	1.0	0.4	4	1.69E-02	1.3E+02
Mercury (Hg0)											
Lead	9.6E-06	0.04	1.48	1.1E-03	4.04	1.2E-03	1.0	0.4	4	1.69E-02	1.6E+02

Table 5-31
Total Water Column Concentration of COPCs in the Kawkawlin River

Chemical	f_{wc} ( )	C_{wtot} (mg/L)	d_{wc} (m)	d_{bs} (m)	C_{wctot} (mg/L)
Mercury (Hg+2)	0.002	7.1E-06	1.45	0.03	1.4E-08
Mercury (MeHg)	0.031	1.8E-08	1.45	0.03	5.7E-10
Mercury (Hg0)					
Lead	0.051	2.2E-05	1.45	0.03	1.1E-06

Table 5-32
Dissolved Water Concentration of COPCs in the Kawkawlin River

Chemical	C_{wctot} (mg/L)	Kd_{sw} (L/kg)	TSS (mg/L)	C_{dw} (mg/L)
Mercury (Hg+2)	1.4E-08	1.0E+05	10.0	5.9E-09
Mercury (MeHg)	5.7E-10	1.0E+05	10.0	1.3E-09
Mercury (Hg0)				
Lead	1.1E-06	9.0E+02	10.0	1.1E-06

Table 5-33
Modeled Concentration of COPCs in Fish Tissue from the Kawkawlin River

Chemical	C_{dw} (mg/L)	BAF (L/kg)	C_{fish} (mg/kg)	C_{wctot} (mg/L)	C_{wctot} [Comb] (mg/L)	BAF (L/kg)	C_{fish} (mg/kg)
	USEPA Approach			MDEQ Approach			
Mercury (Hg+2)	5.9E-09	1.0E+00	5.9E-09	1.4E-08			
Mercury (MeHg)	1.3E-09	5.6E+06	7.4E-03	5.7E-10	1.5E-08	1.1E+05	1.6E-03
Mercury (Hg0)							
Lead	1.1E-06	0.0E+00	1.0E-07				1.0E-07

Table 5-34

Bioaccumulation Factors for Modeling Fish Tissue Concentrations of Mercury

Parameter	MDEQ Daily Fish Intake[1] (g/d)	Fractional Intake ( )	MDEQ BAF[2] (L/kg)	TL-Adjusted MDEQ BAF (L/kg)	USEPA BAF[3] (L/kg)	TL-Adjusted USEPA BAF (L/kg)
Trophic Level 4	11.4	0.76	1.40E+05	1.06E+05	6.80E+06	5.17E+06
Trophic Level 3	3.6	0.24	2.79E+04	6.70E+03	1.60E+06	3.84E+05
Total	15.0	1.00		1.13E+05		5.55E+06

[1] Average for Michigan sports anglers and sports-caught fish.

[2] Per the MDEQ water quality standards derivation protocol [Bob Sills, Personal Communication]

[3] Mercury Study Report to Congress [USEPA, 1997].

Table 5-35
Exposure Parameters Considered in the HHRA

Parameter [1]	Symbol	Units	Resident	Resident Child	Recreational Fisher	Fisher Child
Daily Consumption Rate of Soil	CR_{soil}	g/d	0.1	0.2	0.1	0.2
Fraction of Soil Contaminated	F_{soil}	( )	1	1	1	1
Daily Consumption Rate of Fish (Recreational Fisher) [2]	CR_{fish}	g FW/d	0	0	15	2.3
Daily Consumption Rate of Trophic Level 3 Fish [2]	CR_{fish}	g FW/d	0	0	3.6	0.54
Daily Consumption Rate of Trophic Level 4 Fish [2]	CR_{fish}	g FW/d	0	0	11.4	1.71
Fraction of Fish Contaminated [2]	F_{fish}	( )	1	1	1	1
Daily Consumption Rate (Above-Ground Produce)	CR_{ag}	g DW/d	22.4	11.55	22.4	11.55
Daily Consumption Rate (Below-Ground Produce)	CR_{bg}	g DW/d	9.8	3. 45	9.8	3.45
Daily Consumption Rate (Prot. Above-Ground Produce)	CR_{pp}	g DW/d	42.7	22.5	42.7	22.5
Fraction of Produce Contaminated	F_{ag}	( )	1	1	1	1
Exposure Frequency	EF	d/yr	350	350	350	350
Exposure Duration	ED	yr	30	6	30	6
Body Weight	BW	kg	70	15	70	15
Averaging Time (Non-Carcinogens)	AT_{nc}	yr	30	6	30	6

[1] Unless otherwise noted, values are from USEPA (2005).

[2] Fish consumption rates for adults recommended by Bob Sills, MDEQ AQD based on average value for recreational Michigan fishermen.

Table 5-36
Daily Intake of COPCs Via Incidental Soil Ingestion
Resident

Chemical	$Cs_{untilled}$ (mg/kg)	CR_{soil} (kg/d)	F_{soil} ( )	I_{soil} (mg/d)
Mercury (Hg+2)	5.5E-04	0.0001	1.0	5.5E-08
Mercury (MeHg)	1.1E-05	0.0001	1.0	1.1E-09
Mercury (Hg0)	0.0E+00	0.0001	1.0	0.0E+00
Lead	8.9E-03	0.0001	1.0	8.9E-07

Table 5-37
Daily Intake of COPCs Via Incidental Soil Ingestion
Resident Child

Chemical	$Cs_{untilled}$ (mg/kg)	CR_{soil} (kg/d)	F_{soil} ( )	I_{soil} (mg/d)
Mercury (Hg+2)	5.5E-04	0.0002	1.0	1.1E-07
Mercury (MeHg)	1.1E-05	0.0002	1.0	2.2E-09
Mercury (Hg0)	0.0E+00	0.0002	1.0	0.0E+00
Lead	8.9E-03	0.0002	1.0	1.8E-06

Table 5-38
Daily Intake of COPCs Via Incidental Soil Ingestion
Recreational Fisher

Chemical	$Cs_{untilled}$ (mg/kg)	CR_{soil} (kg/d)	F_{soil} ( )	I_{soil} (mg/d)
Mercury (Hg+2)	5.5E-04	0.0001	1.0	5.5E-08
Mercury (MeHg)	1.1E-05	0.0001	1.0	1.1E-09
Mercury (Hg0)	0.0E+00	0.0001	1.0	0.0E+00
Lead	8.9E-03	0.0001	1.0	8.9E-07

Table 5-39
Daily Intake of COPCs Via Incidental Soil Ingestion
Recreational Fisher Child

Chemical	$Cs_{untilled}$ (mg/kg)	CR_{soil} (kg/d)	F_{soil} ( )	I_{soil} (mg/d)
Mercury (Hg+2)	5.5E-04	0.0002	1.0	1.1E-07
Mercury (MeHg)	1.1E-05	0.0002	1.0	2.2E-09
Mercury (Hg0)	0.0E+00	0.0002	1.0	0.0E+00
Lead	8.9E-03	0.0002	1.0	1.8E-06

Table 5-40
Daily Intake of COPCs Via Ingestion of Homegrown Produce
Resident

Chemical	Pd (mg/kg)	Pv (mg/kg)	Pr (mg/kg)	Pr_{bg} (mg/kg)	CR_{ag} (kg/d)	CR_{pp} (kg/d)	CR_{bg} (kg/d)	F_{veg} ( )	I_{veg} (mg/d)
Mercury (Hg+2)	2.6E-07	7.5E-07	7.8E-07	2.0E-06	0.0224	0.0427	0.0098	1.0	9.3E-08
Mercury (MeHg)	7.3E-08	2.1E-07	3.3E-08	1.1E-07	0.0224	0.0427	0.0098	1.0	9.6E-09
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0224	0.0427	0.0098	1.0	0.0E+00
Lead	8.8E-05	0.0E+00	1.7E-05	1.1E-05	0.0224	0.0427	0.0098	1.0	3.2E-06

Table 5-41
Daily Intake of COPCs Via Ingestion of Homegrown Produce
Resident Child

Chemical	Pd (mg/kg)	Pv (mg/kg)	Pr (mg/kg)	Pr_{bg} (mg/kg)	CR_{ag} (kg/d)	CR_{pp} (kg/d)	CR_{bg} (kg/d)	F_{veg} ( )	I_{veg} (mg/d)
Mercury (Hg+2)	2.6E-07	7.5E-07	7.8E-07	2.0E-06	0.01155	0.0225	0.00345	1.0	4.5E-08
Mercury (MeHg)	7.3E-08	2.1E-07	3.3E-08	1.1E-07	0.01155	0.0225	0.00345	1.0	4.8E-09
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.01155	0.0225	0.00345	1.0	0.0E+00
Lead	8.8E-05	0.0E+00	1.7E-05	1.1E-05	0.01155	0.0225	0.00345	1.0	1.6E-06

Table 5-42
Daily Intake of COPCs Via Ingestion of Homegrown Produce
Recreational Fisher

Chemical	Pd (mg/kg)	Pv (mg/kg)	Pr (mg/kg)	Pr_{bg} (mg/kg)	CR_{ag} (kg/d)	CR_{pp} (kg/d)	CR_{bg} (kg/d)	F_{veg} ( )	I_{veg} (mg/d)
Mercury (Hg+2)	2.6E-07	7.5E-07	7.8E-07	2.0E-06	0.0224	0.0427	0.0098	1.0	9.3E-08
Mercury (MeHg)	7.3E-08	2.1E-07	3.3E-08	1.1E-07	0.0224	0.0427	0.0098	1.0	9.6E-09
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0224	0.0427	0.0098	1.0	0.0E+00
Lead	8.8E-05	0.0E+00	1.7E-05	1.1E-05	0.0224	0.0427	0.0098	1.0	3.2E-06

Table 5-43
Daily Intake of COPCs Via Ingestion of Homegrown Produce
Recreational Fisher Child

Chemical	Pd (mg/kg)	Pv (mg/kg)	Pr (mg/kg)	Pr_{bg} (mg/kg)	CR_{ag} (kg/d)	CR_{pp} (kg/d)	CR_{bg} (kg/d)	F_{veg} ( )	I_{veg} (mg/d)
Mercury (Hg+2)	2.6E-07	7.5E-07	7.8E-07	2.0E-06	0.01155	0.0225	0.00345	1.0	4.5E-08
Mercury (MeHg)	7.3E-08	2.1E-07	3.3E-08	1.1E-07	0.01155	0.0225	0.00345	1.0	4.8E-09
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.01155	0.0225	0.00345	1.0	0.0E+00
Lead	8.8E-05	0.0E+00	1.7E-05	1.1E-05	0.01155	0.0225	0.00345	1.0	1.6E-06

Table 5-44
Daily Intake of COPCs Via Ingestion of Fish
Recreational Fisher

Chemical	$C_{fish-USEPA}$ (mg/kg)	$C_{fish-MDEQ}$ (mg/kg)	CR_{fish} (kg/d)	F_{fish} ( )	$I_{fish-USEPA}$ (mg/d)	$I_{fish-MDEQ}$ (mg/d)
Mercury (Hg+2)	5.9E-09	0.0E+00	0.015	1.0	8.9E-11	0.0E+00
Mercury (MeHg)	7.4E-03	1.6E-03	0.015	1.0	1.1E-04	2.5E-05
Mercury (Hg0)	0.0E+00	0.0E+00	0.015	1.0	0.0E+00	0.0E+00
Lead	1.0E-07	1.0E-07	0.015	1.0	1.5E-09	1.5E-09

Table 5-45
Daily Intake of COPCs Via Ingestion of Fish
Recreational Fisher Child

Chemical	$C_{fish-USEPA}$ (mg/kg)	$C_{fish-MDEQ}$ (mg/kg)	CR_{fish} (kg/d)	F_{fish} ( )	$I_{fish-USEPA}$ (mg/d)	$I_{fish-MDEQ}$ (mg/d)
Mercury (Hg+2)	5.9E-09	0.0E+00	0.0023	1.0	1.4E-11	0.0E+00
Mercury (MeHg)	7.4E-03	1.6E-03	0.0023	1.0	1.7E-05	3.8E-06
Mercury (Hg0)	0.0E+00	0.0E+00	0.0023	1.0	0.0E+00	0.0E+00
Lead	1.0E-07	1.0E-07	0.0023	1.0	2.3E-10	2.3E-10

Table 5-46
Combined Daily Intake of COPCs Via Indirect Exposure Pathways
Resident

Chemical	I_{soil} (mg/d)	I_{veg} (mg/d)	I_{dw} (mg/d)	I_{tot} (mg/d)
Mercury (Hg+2)	5.5E-08	9.3E-08	0.0E+00	1.5E-07
Mercury (MeHg)	1.1E-09	9.6E-09	0.0E+00	1.1E-08
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lead	8.9E-07	3.2E-06	0.0E+00	4.0E-06

Table 5-47
Combined Daily Intake of COPCs Via Indirect Exposure Pathways
Resident Child

Chemical	I_{soil} (mg/d)	I_{veg} (mg/d)	I_{dw} (mg/d)	I_{tot} (mg/d)
Mercury (Hg+2)	1.1E-07	4.5E-08	0.0E+00	1.6E-07
Mercury (MeHg)	2.2E-09	4.8E-09	0.0E+00	6.9E-09
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lead	1.8E-06	1.6E-06	0.0E+00	3.4E-06

Table 5-48
Combined Daily Intake of COPCs Via Indirect Exposure Pathways
Recreational Fisher

Chemical	I_{soil} (mg/d)	I_{veg} (mg/d)	$I_{fish\text{-}EPA}$ (mg/d)	I_{fish_MDEQ} (mg/d)	I_{dw} (mg/d)	$I_{tot\text{-}EPA}$ (mg/d)	$I_{tot\text{-}MDEQ}$ (mg/d)
Mercury (Hg+2)	5.5E-08	9.3E-08	8.9E-11	0.0E+00	0.0E+00	1.5E-07	1.5E-07
Mercury (MeHg)	1.1E-09	9.6E-09	1.1E-04	2.5E-05	0.0E+00	1.1E-04	2.5E-05
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lead	8.9E-07	3.2E-06	1.5E-09	1.5E-09	0.0E+00	4.0E-06	4.0E-06

Table 5-49
Combined Daily Intake of COPCs Via Indirect Exposure Pathways
Recreational Fisher Child

Chemical	I_{soil} (mg/d)	I_{veg} (mg/d)	$I_{fish-EPA}$ (mg/d)	I_{fish_MDEQ} (mg/d)	I_{dw} (mg/d)	$I_{tot-EPA}$ (mg/d)	$I_{tot-MDEQ}$ (mg/d)
Mercury (Hg+2)	1.1E-07	4.5E-08	1.4E-11	0.0E+00	0.0E+00	1.6E-07	1.6E-07
Mercury (MeHg)	2.2E-09	4.8E-09	1.7E-05	3.8E-06	0.0E+00	1.7E-05	3.8E-06
Mercury (Hg0)	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Lead	1.8E-06	1.6E-06	2.3E-10	2.3E-10	0.0E+00	3.4E-06	3.4E-06

Table 5-50
IEUBK Operating Parameters Selected for the Assessment of Lead

Operating Parameter	Units	Selected Value(s)	Reference
Target Blood Lead	(µg/dL)	10	CDC, 1991
Time Spent Outdoors	(hr/d)	1-4	USEPA, 2002
Ventilation Rate	(m^3/d)	2-7	USEPA, 2002
Indoor Air Concentration (% of Outdoor)	(%)	30	USEPA, 2002
Soil/dust Ingestion Rate	(mg/d)	85-135	USEPA, 2002
Soil Ingestion Rate (% of Soil/dust Ingestion)	(%)	45	USEPA, 2002
Gastrointestinal Absorption (Soil/Dust Lead)	(%)	30	USEPA, 2002
Gastrointestinal Absorption (Dietary Lead)	(%)	50	USEPA, 2002
Gastrointestinal Absorption (Drinking Water Lead)	(%)	50	USEPA, 2002
Age-Related Water Consumption Rates	(L/d)	0.20-0.59	USEPA, 2002

CDC, 1991 - Preventing Lead Poisoning in Young Children. Centers for Disease Control.

USEPA, 2002 - User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows Version-32 Bit Version

Table 5-51

Media Concentrations Selected for the IEUBK Assessment of Lead

Selected Medium	Units	Background		Proposed ASCPC Boiler Impacts		Value Selected for IEUBK
		Value	Reference	Value	Reference	
Soil Lead Concentration	(mg/kg)	2.100E+01	MDEQ, 2006b	8.89E-03	HHRA Table 5-41	2.101E+01
Indoor Dust Lead [No Pb-Based Paint and Tracked Soil Pb]	(mg/kg)	1.570E+01	Calculated (see below)	8.12E-03	Calculated (see below)	1.571E+01
Indoor Dust Lead [Pb-Based Paint In Good Condition and Tracked Soil]	(mg/kg)	2.00E+02	USEPA, 2002	8.12E-03	Calculated (see below)	2.00E+02
Air Lead Concentration	($\mu g/m^3$)	1.00E-02	MDEQ, 2005	1.90E-05	HHRA Table 5-2	1.00E-02
Background Drinking Water Concentration	(µg/L)	1.96E+01	Bay, 2007	n/a	n/a	1.96E+01
Dietary Lead Intake	(µg/d)	5.53-7.00	USEPA, 2002	1.62E-03	HHRA Table 5-49	5.532-7.002
Maternal Blood Lead Concentration	(µg/dL)	2.50E+00	USEPA, 2002	n/a	n/a	2.50E+00

Calculated: 0.70 x Soil Lead Concentration + Air Lead Contribution at rate of 100 mg/kg Soil Lead per 1 ug/m^3 Air Lead.

Bay, 2007 - [90th Percentile Value] 2007 Water Quality Report. City of Bay City Municipal Water Treatment Plant.

MDEQ, 2005 - [Table 5-1] 2005 Annual Air Quality Report, Michigan Department of Environmental Quality, Air Quality Division.

MDEQ, 2006b - [Table 2] Soil: Residential and Commercial I Part 201 Generic Cleanup Criteria and Screening Levels; Part 213 Tier 1 Risk-Based Screening Levels (RBSLs).

USEPA, 2002 - User's Guide for the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) Windows Version-32 Bit Version

Table 6-1

Chronic Toxicity Criteria Used in HHRA

Chemical	RfD (mg/kg-d)	Reference	RfC (mg/m^3)	Reference
Divalent Mercury [Hg^{+2}]	3.0E-04	IRIS	9.0E-05	CalEPA
Methylmercury [MeHg]	1.0E-04	IRIS	---	
Elemental Mercury [Hg^{0}]	---		3.0E-04	IRIS
Lead [Pb]	---		---	

Source: On-line IRIS Database (USEPA, 2007)

Source: On-line chronic reference exposure level (REL) database (CalEPA, 2002)

Table 7-1
Hazard Indices for COPCs Resulting from Indirect Exposure Pathways
Resident

Chemical	I_{tot} (mg/d)	EF (d/yr)	BW (kg)	UCF (d/yr)	ADD (mg/kg-d)	RfD (mg/kg-d)	HI ( )
Mercury (Hg+2)	1.5E-07	350	70	365	2.0E-09	3.0E-04	7E-06
Mercury (MeHg)	1.1E-08	350	70	365	1.5E-10	1.0E-04	1E-06
Mercury (Hg0)	0.0E+00	350	70	365	0.0E+00	0.0E+00	0E+00
Lead	4.0E-06	350	70	365	5.5E-08	0.0E+00	0E+00

Table 7-2
Hazard Indices for COPCs Resulting from Indirect Exposure Pathways
Resident Child

Chemical	I_{tot} (mg/d)	EF (d/yr)	BW (kg)	UCF (d/yr)	ADD (mg/kg-d)	RfD (mg/kg-d)	HI ( )
Mercury (Hg+2)	1.6E-07	350	15	365	9.9E-09	3.0E-04	3E-05
Mercury (MeHg)	6.9E-09	350	15	365	4.4E-10	1.0E-04	4E-06
Mercury (Hg0)	0.0E+00	350	15	365	0.0E+00	0.0E+00	0E+00
Lead	3.4E-06	350	15	365	2.2E-07	0.0E+00	0E+00

Table 7-3
Hazard Indices for COPCs Resulting from Indirect Exposure Pathways
Recreational Fisher

Chemical	$I_{tot\text{-}EPA}$ (mg/d)	$I_{tot\text{-}MDEQ}$ (mg/d)	EF (d/yr)	BW (kg)	UCF (d/yr)	ADD_{EPA} (mg/kg-d)	ADD_{MDEQ} (mg/kg-d)	RfD (mg/kg-d)	HI_{EPA} ( )	HI_{MDEQ} ( )
Mercury (Hg+2)	1.5E-07	1.5E-07	350	70	365	2.0E-09	2.0E-09	3.0E-04	7E-06	7E-06
Mercury (MeHg)	1.1E-04	2.5E-05	350	70	365	1.5E-06	3.4E-07	1.0E-04	2E-02	3E-03
Mercury (Hg0)	0.0E+00	0.0E+00	350	70	365	0.0E+00	0.0E+00	0.0E+00	0E+00	0E+00
Lead	4.0E-06	4.0E-06	350	70	365	5.5E-08	5.5E-08	0.0E+00	0E+00	0E+00

Table 7-4
Hazard Indices for COPCs Resulting from Indirect Exposure Pathways
Recreational Fisher Child

Chemical	$I_{tot-EPA}$ (mg/d)	$I_{tot-MDEQ}$ (mg/d)	EF (d/yr)	BW (kg)	UCF (d/yr)	ADD_{EPA} (mg/kg-d)	ADD_{MDEQ} (mg/kg-d)	RfD (mg/kg-d)	HI_{EPA} ( )	HI_{MDEQ} ( )
Mercury (Hg+2)	1.6E-07	1.6E-07	350	15	365	9.9E-09	9.9E-09	3.0E-04	3E-05	3E-05
Mercury (MeHg)	1.7E-05	3.8E-06	350	15	365	1.1E-06	2.4E-07	1.0E-04	1E-02	2E-03
Mercury (Hg0)	0.0E+00	0.0E+00	350	15	365	0.0E+00	0.0E+00	0.0E+00	0E+00	0E+00
Lead	3.4E-06	3.4E-06	350	15	365	2.2E-07	2.2E-07	0.0E+00	0E+00	0E+00

Table 7-5
Average Daily COPC Exposure Concentration
Resident/Recreational Fisher

Chemical	C_{air} ($\mu g/m^3$)	EF (d/yr)	ED (yr)	UCF (d/yr)	EC ($\mu g/m^3$)
Mercury (Hg+2)	1.1E-06	350	30	365	1.0E-06
Mercury (MeHg)	0.0E+00	350	30	365	0.0E+00
Mercury (Hg0)	1.1E-06	350	30	365	1.0E-06
Lead	1.9E-05	350	30	365	1.8E-05

Table 7-6
Average Daily COPC Exposure Concentration
Resident Child/Recreational Fisher Child

Chemical	C_{air} ($\mu g/m^3$)	EF (d/yr)	ED (yr)	UCF (d/yr)	EC ($\mu g/m^3$)
Mercury (Hg+2)	1.1E-06	350	6	365	1.0E-06
Mercury (MeHg)	0.0E+00	350	6	365	0.0E+00
Mercury (Hg0)	1.1E-06	350	6	365	1.0E-06
Lead	1.9E-05	350	6	365	1.8E-05

Table 7-7
Hazard Quotients for COPCs Resulting from Direct Inhalation Exposures
Resident/Recreational Fisher

Chemical	C_{air} (μg/m^3)	EC (μg/m^3)	RfC (mg/m^3)	UCF (mg/μg)	HQ_i ( )
Mercury (Hg+2)	1.1E-06	1.0E-06	9.0E-05	0.001	1E-05
Mercury (MeHg)				0.001	
Mercury (Hg0)	1.1E-06	1.0E-06	3.0E-04	0.001	3E-06
Lead	1.9E-05	1.8E-05	0.0E+00	0.001	

Table 7-8
Hazard Quotients for COPCs Resulting from Direct Inhalation Exposures
Resident Child/Recreational Fisher Child

Chemical	C_{air} ($\mu g/m^3$)	EC ($\mu g/m^3$)	RfC (mg/m^3)	UCF ($mg/\mu g$)	HQ_i ( )
Mercury (Hg+2)	1.1E-06	1.0E-06	9.0E-05	0.001	1E-05
Mercury (MeHg)				0.001	
Mercury (Hg0)	1.1E-06	1.0E-06	3.0E-04	0.001	3E-06
Lead	1.9E-05	1.8E-05	0.0E+00	0.001	

Table 7-9

Combined Hazard Indices Resulting from Exposure to Emitted Mercury [1]

Chemical	Resident			Resident Child			Recreational Fisher			Recreational Fisher Child		
	Indirect HI ( )	Direct HQ ( )	Total HI ( )	Indirect HI ( )	Direct HQ ( )	Total HI ( )	Indirect HI [2] ( )	Direct HQ ( )	Total HI ( )	Indirect HI [2] ( )	Direct HQ ( )	Total HI ( )
Mercury (Divalent)	7E-6	1E-5	2E-5	3E-5	1E-5	4E-5	7E-6	1E-5	2E-5	3E-5	1E-5	4E-5
Mercury (Methyl)	1E-6		1E-6	4E-6		4E-6	2E-2		2E-2	1E-2		1E-2
Mercury (Elemental)		3E-6	3E-6		3E-6	3E-6		3E-6	3E-6		3E-6	3E-6
Combined HI			2E-5			5E-5			2E-2			1E-2

[1] Consistent with agency guidance, hazard values are expressed to one significant figure [USEPA, 1989].

[2] Indirect HI values for Recreational Fisher and Fisher Child are based on C_{fish} developed for the Kawkawlin River using HHRA guidance [USEPA, 2005].

Table 7-10

IEUBK Predicted Blood Lead Levels Under Modeled Exposure Scenarios

Scenario	Description	Description of Lead Paint in Homes	Predicted Blood Lead Concentration [1] (µg/dL)	Probability of Exceeding 10 µg/dL (%)
1	Background	None	2.905	0.427
2	Background	Lead Paint: Good Condition	3.975	2.482
3	Background + ASCPC Emissions	None	2.905	0.427
4	Background + ASCPC Emissions	Lead Paint: Good Condition	3.975	2.483

[1] Geometric mean blood lead concentration predicted by IEUBK.

Table 7-11
Summary of IEUBK Modeled Output Parameters from Scenario 4 Run [1]

Year	Daily Lead Intake by Medium (µg/d)						Blood Lead (µg/dL)
	Air	Diet	Alternate	Water	Soil+Dust	Total	
0.5-1	0.002	2.55	0	1.81	2.81	7.16	3.9
1-2	0.003	2.61	0	4.43	4.37	11.42	4.7
2-3	0.006	2.97	0	4.66	4.42	12.05	4.5
3-4	0.007	2.89	0	4.81	4.48	12.18	4.3
4-5	0.007	2.83	0	5.07	3.37	11.27	3.8
5-6	0.009	3.00	0	5.38	3.05	11.43	3.5
6-7	0.009	3.32	0	5.49	2.89	11.71	3.3

[1] Results are for combined impacts of emissions from proposed ASCPC Boiler and background lead levels. Conservative assumption is that lead paint in good condition may be present in area homes.