

Soil Cleanup Levels for Industrial Land Use

Table 745-1

Notes on Developing Method A Table Values
Washington State Department of Ecology
Clarc Notes

Method A Notes.doc

Notes on the Development of Method A Cleanup Levels WAC 173-340-720, 740, and 745

The following tables were prepared as part of the rule-making process for the amended MTCA rule adopted February 12, 2001. The information in the tables was used when Ecology developed the Method A Cleanup Levels for the revised regulation.

The tables compile cleanup level calculations for various exposure pathways for both carcinogenic and noncarcinogenic heath effects, applicable state and federal laws, laboratory practical quantitation limits and other relevant information that was used to develop the Method A cleanup levels. While this is useful background information, the values in these tables are not the adopted rule and should not be used as Method A cleanup levels. Use the tables, footnotes and accompanying text in the adopted regulation to develop Method A cleanup levels.

NOTE: Some columns in these tables refer to "current" and "proposed" Method A values. "Current" as used in these tables refers to the cleanup levels as they existed prior to the adoption of the February 12, 2001 rule amendments. "Proposed" as used in these tables are the cleanup levels that were adopted on February 12, 2001.

February 9, 2001

November 23, 2004 revision (1)

TO: Interested Persons

FROM: Pete Kmet, Senior Environmental Engineer

Toxics Cleanup Program

SUBJECT: Calculations for Table 745-1

Method A Soil Cleanup Levels for Industrial Properties

Attached are several tables in excel format providing information on the development of the Method A soil cleanup levels for industrial properties in Table 745-1, WAC 173-340-900.

<u>Table 1</u>: A quick summary providing Method A cleanup levels for industrial properties (Table 745-1) and a brief explanation of the reasoning in the development of Method A values

<u>Table 2</u>: A detailed compilation of the information considered in the development of Method A soil cleanup levels for unrestricted land uses. This information includes:

- The Method B direct contact exposure pathway soil values for each substance. This includes values for both soil ingestion and soil ingestion plus dermal adsorption (adsorption through the skin) for both carcinogens and non-carcinogens, where sufficient information was available for the calculations as of February, 2001;
- The results for the soil leaching pathway from the 3 and 4 phase models as
 of February, 2001;
- Terrestrial ecological evaluation values from Tables 749-2 and 749-3;
- Regulatory values from other laws as of February, 2001; and
- Natural background, practical quantitation limits and other relevant information available as of February, 2001.

<u>Table 3</u>: Describes the assumptions used to calculate the standard Method C soil direct contact cleanup values for industrial land uses for carcinogens using equation 745-2 in WAC 173-340-745(5)(b)(iii)(B)(II).

<u>Table 4</u>: Describes the assumptions used to calculate the standard Method C soil direct contact cleanup values for industrial land uses for non-carcinogens using equation 745-1 in WAC 173-340-745(5)(b)(iii)(B)(I).

Table 5: Describes the assumptions and equation used to calculate the modified Method C values for industrial land uses assuming concurrent soil ingestion plus dermal (skin) absorption for carcinogens using equation 745-5 in WAC173-340-745(3)(b)(iii)(B).

<u>Table 6</u>: Describes the assumptions and equation used to calculate the modified Method C values for industrial land uses assuming concurrent soil ingestion plus dermal (skin) absorption for noncarcinogens using equation 745-4 in WAC173-340-745(3)(b)(iii)(A).

<u>Table 7</u>: Describes the assumptions and equations used to calculate soil concentrations protective of ground water for drinking water use, using the 3 phase leaching model.

<u>Tables 8-10</u>: 4-phase model results summary sheets for 2 brands of fresh gasoline and these same gasolines using various weathered compositions.

(1) This memo and attached excel tables explain the basis for the Method A cleanup levels in the MTCA rule adopted February 12, 2001. The memos and tables have been slightly revised from the originals issued on February 9, 2001 to clarify certain information in response to questions received since issuance of the original memos and tables. The original memos and tables can be found in appendix D of the concise explanatory statement for the February 12, 2001 rule amendments (http://www.ecy.wa.gov/programs/tcp/regs/reg_main.html)

	Та	ble 1: Quid	ck Summary	y Basis for Method A Industrial Land Use Soil Values
		1991	2001	D in
Hazardous Substance	CAS Number	Method A Cleanup Level	adopted Cleanup Level	Basis for
Hazardous Substance	CAS Number	mg/kg	mg/kg	Standard
Arsenic	7440-38-2	200	20	Protection of drinking water, adjusted for background (1)
Benzene	71-43-2	0.5	0.03	Protection of drinking waterbased on both 3 and 4 phase models.
Benzo(a)Pyrene	50-32-8	none	2	Protection of drinking water3 phase model.
Cadmium	7440-43-9	10	2	Protection of drinking water, adjusted for PQL.
Chromium (total)	7440-47-3	500.0	none	Replaced by values for Cr III and Cr VI.
Chromium VI	18540-29-9		19	Protection of drinking water3 phase model.
Chromium III	16065-83-1		2000	Protection of drinking water3 phase model.
DDT	50-29-3	5	4	Protection of drinking water3 phase model.
Ethylbenzene	100-41-4	20	6	Protection of drinking water3 phase model.
Ethylene dibromide (EDB)	106-93-4	0.001	0.005	Protection of drinking water, adjusted for PQL
Lead	7439-92-1	1000.0	1000	Ingestion (3)
Lindane	58-89-9	20	0.01	Protection of drinking water, adjusted for PQL
Methylene chloride	75-09-2	0.5	0.02	Protection of drinking water3 phase model.
Mercury (inorganic)	7439-97-6	1	2	Protection of drinking water3 phase model.
MTBE	1634-04-4	none	0.1	Protection of drinking water3 phase model.
Naphthalenes	91-20-3	none	5	Protection of drinking water3 phase model. Total of naphthalene, 1-methyl naphthalene & 2-methyl naphthalene
PAHs (carcinogenic)		20	none	Replaced by benzo(a)pyrene.
PCB Mixtures	1336-36-3	10.0	10	ARAR. This is a total value for all PCBs in the soil sample.
Tetrachloroethylene	127-18-4	0.5	0.05	Protection of drinking water3 phase model.
Toluene	108-88-3	40	7	Protection of drinking water3 phase model.
1,1,1 Trichloroethane	71-55-6	20	2	Protection of drinking water3 phase model.
Trichloroethylene	79-01-5	0.5	0.03	Protection of drinking water3 phase model.
Xylenes	1330-20-7	20	9	Protection of drinking water3 phase model. Total of all m, o & p xylene.
TPH (total)	14280-30-9			
Gasoline range organics	6842-59-6			
GRO with benzene		100	30	Protection of drinking water4 phase model, assuming weathered gasoline composition.
GRO w/o benzene		100	100 (5)	Protection of drinking water4 phase model, assuming highly weathered gasoline composition.
Diesel Range Organics		200	2000	Protection of drinking waterresidual saturation
Heavy Oils		200	2000	Protection of drinking waterresidual saturation for diesel.
Electrical Insulating Mineral Oil		200 (4)	4000	Protection of drinking waterresidual saturation
(1) Based on background value	in table 740-1.	Ecology intends	s to review and, i	f appropriate, update this value in a future rulemaking.
(2) This can also be used as the				
				if appropriate, update this value in a future rulemaking.
				2000 mg/kg at electrical substations and switchyards.
With the adoption of the rule in 2				
(5) To use this value no benzer	ne must be pres	ent in the soil a	na the total of eth	yl benzene, toluene & xylene must be less than 1% of the gasoline mixture.

Method A Soil Cleanup Levels -for Industrial Land Uses												
2011 adopted Method A Ingestion In		т	able 2: Su	mmary Tabl	e for Meth	od A Indus	strial Soil C	leanup Va	lues in Tab	le 745-1		
Method A Ingestion Inges	Method A Soil Cleanup Levels -for In	dustrial Land Us	ses								1	
Method A Topestion Ingestion Inges												
Hazardous Substance CAS Number Cleanup Level Cardrongen Noncarc. Cardrongen Noncarc. Model CU level Vapor Other												
March Marc	Hazardous Substanco	CAS Number								Vapor	Othor	
Assence 7440-38-2 20.0 88.0 1,550 39 4666 29 0.5 0.1 5662 5662 5662 5662 5662 5662 5662 566	Tiazardous Substance	CAS Number										
Benzona First Fi	Arconic	7440 29 2								1 3 3 ()	1 3 3 (1)	
Denze(a)Pyrene S0-32-8 none 18							400				0.1	
Cadmium					-,							
Chromium (total)				10	3.500	4.3	1.460					
Chromium III					-,		,					
DT			300.0		10.500		1,226	19	5		500	
DDT												
Ethylenzene 100-41-4 20.0 350,000 148,655 6.1 70	DDT		5.0	386		158		41	0.03			
Ethylene dibromide (EDB)				230		.55						
Lindane	Ethylene dibromide (EDR)	106-93-4	0.001	15		0.66		0.00005	0.001			
Lindane 58-89-9 20.0 101 1,050 33 341 0,0062 0.02						0.00						
Methylene chloride	Lindane		20.0		1.050	33	3/11		0.02			
Mercury (inorganic)												
Naphthalene	•			,		- 7						
Naphthalene					1,030		232					
PAHs (carcinogenic)(11)					70.000		16 612					
PCB Mixtures (12) 1336-36-3 10.0 66/328/1,875 70/245 14/70/401 15/52 0.2/1.6 0.01 Tetrachloroethylene 127-18-4 0.5 2,574 35,000 1,093 0.053 0.5 Toluene 108-88-3 40.0 700,000 297,309 7.3 100 1,1,1 Trichloroethane 71-55-6 20.0 pure pure 1.6 20 Trichloroethylene 79-01-5 0.5 11,932 5,068 pure 0.033 0.5 Xylenes 1330-20-7 20.0 pure 9.1 100 (1) From WAC 173-340-740 Table 2 [1/26/96 revision]. (2) Calculated using equation 745-2. (3) Calculated using equation 745-5. For comparison only. Not used in setting cleanup levels since defaults not changed for other pathways. (6) Calculated using equation 745-4. For comparison only. Not used in setting cleanup levels since defaults not changed for other pathways. (6) Calculated using equation 745-4. For comparison only. Not used in setting cleanup levels since defaults not changed for other pathways. (6) Calculated using equation 745-4. For comparison only. Not used in setting cleanup levels since defaults not changed for other pathways. (6) Calculated using equation 745-1 and proposed Table 720-1 ground water cleanup levels. Except for Cr III used 100 ppb and for PAHs used Methods A and B values for B(a)P. (7) Calculated using 100 X table 720-1 ground water cleanup levels. Except for Cr III used 100 ppb and for PAHs used Methods A and B values for B(a)P. (8) Vapor values not calculated. (9) Benzene from 4 phase leaching model; Chromium VI is dust value documented in 1991 MTCA responsiveness summary. (10) Value documented in 1991 MTCA responsiveness summary. (11) Based on benzo (a) pyrene. For leaching, first value is based on Method B ground water cleanup level, second value is based on Method A ground water cleanup level for B(a)P.		91-20-3		18	70,000	4.3	10,013					
Tetrachloroethylene	, , , ,	1226.26.2			70/245		15/52					
Toluene 108-88-3 40.0 700,000 297,309 7.3 100 1,1,1 Trichloroethane 71-55-6 20.0 pure pure 1.6 20 1,1,1 Trichloroethylene 79-01-5 0.5 11,932 5,068 pure 0.033 0.5							13/32					
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(9) Benzene from 4 phase leaching model; Chromium VI is dust value documented in 1991 MTCA responsiveness summary. (10) Value documented in 1991 MTCA responsiveness summary. (11) Based on benzo (a) pyrene. For leaching, first value is based on Method B ground water cleanup level, second value is based on Method A ground water cleanup level for B(a)P.		ground water clea	anup level. Exce	ept for Cr III used	100 ppb and cl	PAH used curren	nt Method A valu	e.				
(10) Value documented in 1991 MTCA responsiveness summary. (11) Based on benzo (a) pyrene. For leaching, first value is based on Method B ground water cleanup level, second value is based on Method A ground water cleanup level for B(a)P.		del: Chromium VI	is dust value do	cumented in 199	1 MTCA respor	l nsiveness summa	arv.					
	(10) Value documented in 1991 MTCA	responsiveness s	summary.		-							
(12) PCB values based on various arochlors and IRIS values for PCB mixtures.					ater cleanup le	vel, second value	e is based on Me	ethod A ground	water cleanup le	vel for B(a)P.		
	(12) PCB values based on various aroo	chlors and IRIS va	lues for PCB mi	xtures.								
						H	1		+			

	T	able 2: Sun	nmary Tab	le for Meth	nod A Indust	rial Soil C	leanup Val	ues in Tab	le 745-1			
Method A Soil Cleanup Levels -for	r Industrial Land Us	ses										
Metrica A Con Cicaria Levelo 101	Illudotriui Euriu Ot	500										
		2001 adopted		Dermal +	Leaching		100 X					
		Method A	Ingestion	Ingestion	Using	Residual	Ground water					
Hazardous Substance	CAS Number	Cleanup Level	Noncarc.	Noncarc.	4-phase Model	Saturation	C/U level	Vapor				
		mg/kg (1)	mg/kg (2)	mg/kg (3)	mg/kg (4)	mg/kg (5)	mg/kg (6)	mg/kg (7)				
TPH (total)	14280-30-9											
Gasoline range organics	6842-59-6	100										
GRO with benzene	00.2000	.00	210,000	150,000	1 / 23 to 28	1,000	80	unknown				
GRO without benzene			210,000	100,000	105	1,000	100	unknown				
Diesel Range Organics		200	170,000	39,000	No upper limit	2,000	50	>10,000				
Heavy Oils (8)		200	170,000	39,000	No upper limit	2,000	50	>10,000				
Electrical Insulating Mineral Oil		2000 (9)	340,000	70,000		4,000	100	Not volatile	-			
_iecuidai insulating Mineral Oil		2000 (9)	3 4 0,000	70,000	No upper limit	4,000	100	NOL VOIAUIE				
(1) From WAC 173-340-740 Table 2	[1/26/96 revision]											
(2) Calculated using surrogates. See		b memo			1		1					
(3) Calculated using surrogates and			Robb memo		1		1					
(4) Calculated using 4 phase model.				s (3% henzene)	2nd values assu	me weathered	gas (~0.1% her					
For GRO without benzene, assu												
For diesel, heavy oils and minera												
(5) Residual saturation for coarse so						ve the water to	DIC.					
6) Calculated using 1991 method of					nai oii.							
(7) Gasoline vapors not calculated.					vonor nothway	ional vanara ha	and an qualitati	a chaor ations	at aites by DLI	^		
	THE CUITEIN METHOD	A value of 100 pp	om mought to be	e protective for	vapoi pairiway. D	iesei vapois ba	aseu on quantan	e observations	at sites by FLI	۸.		
(8) Based on diesel composition.(9) Ecology also issued a fact sheet	in 1005 /#05 157 TC	CD) allowing the r	100 of 2000 mg/	ka at alaatriaal	aubatations and au	vitah varda						
With the adoption of the rule in 2				kg at electrical :	substations and sv	viicriyarus.						
with the adoption of the rule in 2	1001, this fact sheet i	nas been withdra	WII.									
								1				

		Table 2: S	ummary Ta	ble for Met	hod A Industrial So	l Cleanup V	alues in Ta	ble 745-1				
Method A Soil Cleanup Levels -for In	dustrial Land Us	SAS										
metriou A con cicariap Levels for in	duotinai Lana Os	505										
	Ecological	Ecological					1991	2001 adopted				
	Simplified	Indicator	Most Stringent	Controlling			Method A	Method A			Basis	
Hazardous Substance	Evaluation	Concentration	Non-Eco Path	Non-Eco	ARARs PQL	Background	Cleanup Level	Cleanup Level			for	
	mg/kg (1)	mg/kg (2)	mg/kg	Pathway	mg/kg mg/kg (3)	mg/kg (4)	mg/kg	mg/kg			Standard	
Arsenic	20	7	2.9	Leaching	1 (SW7060	7 & 20	200.0	20	Leaching,	adjusted	for backgroun	d (5)
Benzene			0.1	Leaching	0.005 (SW82	60)	0.5	0.1	Protection	of drinkin	ng water4 ph	ase model
Benzo(a)Pyrene	300	12	1.9	Leaching	0.05 (SW827	0)	none	2	Protection	of drinkin	na water3 nh	ase model (6)
Cadmium	36	14	0.69	Leaching	2 (SW6010A		10.0	2			for PQL. (7)	ase model (6)
					,	,		_				
Chromium (total) Chromium VI	135	67	19	Leaching	2 (SW6010A		500.0	19	Drotootion	of dripkin	ng water3 ph	ana madal
Chromium III			2,000	Leaching	2 (SW6010)			2000			ng water3 ph	
					,	,						
DDT	1	0.75	4.1	Leaching	0.05 (SW808		5.0	4			ng water3 ph	
Ethylbenzene			6.1	Leaching	0.005 (SW82	5U)	20.0	6	Protection	ot drinkin	ng water3 ph	ase model
Ethylene dibromide (EDB)			0.00005	Leaching	0.005 (SW82		0.001	0.001	Leaching,		for PQL	
Lead	220	118	1,000	Ingestion	5.0 (SW6010	A) 17	1000.0	1000	Ingestion	(8)		
Lindane	10	6	0.0062	Leaching	0.01 (SW808	1)	20.0	0.01	Leaching,	adjusted	for POI	
Methylene chloride		Ů	0.022	Leaching	0.005 (SW82		0.5	0.02			ng water3 ph	ase model
*	9	F F	2.1				1.0	2				
Mercury (inorganic) MTBE	9	5.5	0.085	Leaching Leaching	0.1 (SW747 0.005 (SW82		none	0.1			ng water3 ph ng water3 ph	
Naphthalenes			4.5	Leaching	0.5 (SW826		none	5				ase model (10)
PAHs (carcinogenic)	300	12	1.9	Leaching	0.05 (SW827	0)	20.0	none	Replaced	with benz	o(a)pyrene.	
PCB Mixtures	2	0.65	0.2	Leaching	10 0.04 (SW808	2)	10.0	10	ARAR (9)			
Tetrachloroethylene			0.053	Leaching	0.005 (SW82	60)	0.5	0.05	Protection	of drinkin	ng water3 ph	ase model
Toluene			7.3	Leaching	0.005 (SW82	60)	40.0	7	Protection	of drinkin	ng water3 ph	ase model
1,1,1 Trichloroethane			1.6	Leaching	0.005 (SW82		20.0	2			ng water3 ph	
Trichloroethylene			0.033	Leaching	0.005 (SW82		0.5	0.03			ng water3 ph	
Xylenes			9.1	Leaching	0.005 (SW82		20.0	9			ng water3 ph ng water3 ph	
Ayleries			3.1	Leadining	0.013 (84402	10)	20.0	3	TOLECTION	OI GIIIIKII	ig water-5 pri	ase model
(1) Value from Table 749-2 for industria	l land use. For re	eference only, no	t used in develop	ing Method A v	alues.							
(2) Wildlife protection value from Table (3) From Manchester Lab												
(4) For arsenic, 1st value from upper 90	% for WA State.	documented in r	eport #94-115 an	d 2nd value fror	n a 1989 report by PTI Enviro	mental Services	All others uppe	r 90% in WA St	ate from re	port # 94-	-115.	
(5) Based on background value in table												
(6) This can also be used as the total to	xic equivalents fo	or all cPAHs. Se	ee WAC 173-340-	-708(8).								
(7) For cadmium, there are two possible								t method.				
(8) Ecology decision not to change curre												
(9) Cleanup level is sum of all PCBs. A							of PCB contamin	ated facilities ur	nder TSCA).		
(10) This is a total of all naphthalene, 1-	-Methyl naphthale	ene & 2-Methyl N	iaphthalene. Also	, use SW 82700	to measure all three types o	naphthalene.			-			
									 			
							-	-				-
									1		1	

		Table 2: S	ummary Tak	alo for Mo	thad A Inc	lustrial Soil (Noanun V	alues in Ta	blo 745-1	
		Table 2. 3	unimary rai	JIE IOI IVIE	lilou A ilic	iustriai son c	Jicanup v	aiues iii Ta	DIC 743-1	
Method A Soil Cleanup Levels -for	Industrial Land He	205			П			T.		
method A don Gleanup Levels -lor	ilidustriai Land Os									
	Ecological	Ecological						1991	2001 adopted	
	Simplified	Indicator	Most Stringent	Controlling				Method A	Method A	Basis
Hazardous Substance	Evaluation	Concentration	Non-Eco Path	Non-Eco	ARARs	PQL	Background	Cleanup Level		
	mg/kg (1)	mg/kg (2)	mg/kg	Pathway	mg/kg	mg/kg (3)	mg/kg	mg/kg	mg/kg	Standard
TPH (total)										
Gasoline range organics										
GRO with benzene	1,000 to 12,000	1,000 to 5,000	23 to 28	Leaching		5 (NWTPH-Gx)		100	30	Protection of drinking water(4)
GRO without benzene	1,000 to 12,000	1,000 to 5,000	105	Leaching		5 (NWTPH-Gx)		100	100	Protection of drinking water(5)
Diesel Range Organics	2,000 to 15,000	2,000 to 6,000	2000	Leaching		25 (NWTPH-Dx)		200	2000	Residual Saturation
Heavy Oils (6)	2,000 to 15,000	2,000 to 6,000	2000	Leaching		100 (NWTPH-Dx))	200	2000	Residual Saturation
Electrical Insulating Mineral Oil			4000	Leaching		100 (NWTPH-Dx)	1	200 (7)	4000	Residual Saturation
i										
(1) Value from Table 749-2 for unres										
(2) Most stringent indicator value from	n rable /49-3. For	reterence only, r	not used in develo	ping Method A	values.			1		
(3) From Manchester Lab.		ish 0 40/ !-	anna a tunic - l :	alua fan aac - l'		d aite a				
(4) Based on 4-phase model results							+ (In/ of the masslin		
(5) Based on 4-phase model results (6) Based on diesel composition.	ior wearnered gason	ne assuming no	benzene present	in soil and tha	i eiriyi benzene	e, toluerie & xylene	are less than	1% of the gasolin	ie mixture.	
(6) Based on diesel composition. (7) Ecology also issued a fact sheet i	in 1005 (#05 157 TC	P) allowing the	uso of 2000 mg/k/	a at alactrical c	ubstations and	ewitchvarde		1		
With the adoption of the rule in 2				y at electrical S	นมอเสแบกอ สกัน	SWIIGHYAIUS.		+		
with the adoption of the full in 2	oo i, iiiis idel sileel i	ias peeri Williura	AVVII.		 			1		
					<u> </u>			1		

	Table	3: Met	hod C I	ndustria	l Soil Cal	culation	s for Ca	rcinogen	s			
gonic Effects	of Soil Inc	restion								1		
genic Enecis	or son my	Jestion			Cancer							
	Risk	Ava Body	Lifetime	Unit Conv		G I Ahs	Soil	Duration	Frequency	Method C	ΔRΔR (3)	Risk @
CAS No.	TAIGIA		Liiotiiiio		,				. ,		7110111 (0)	ARAR(4)
0,10,110.	(unitless)		(years)				U	(years)	(unitless)		(mg/kg)	(unitless)
7440-38-2	0.00001		75				50	20	0.4			
71-43-2	0.00001	70	75	, ,	0.029	1.0	50	20	0.4			
7440-43-9		-	-	, ,	not available							
7440-47-3												
					not available							
18540-29-9												
	0.00004	70	75	1 000 000			50	20	0.4	206		
	0.00001	70	75	1,000,000			50	20	0.4	300		
	0.00001	70	75	1,000,000			50	20	0.4	1.5		
7439-92-1					not available							
58-89-9	0.00001	70	75	1,000,000	1.3	1.0	50	20	0.4	101		
75-09-2	0.00001	70	75	1,000,000	0.0075	1.0	50	20	0.4	17,500		
7439-97-6					not available							
1634-04-4												
91-20-3					not available							
na												
56-55-3					not available							
205-99-2					not available							
207-08-9					not available							
50-32-8	0.00001	70	75	1,000,000	7.3	1.0	50	20	0.4	18		
207-08-9					not available							
y Factor is the	oral slope	factors from	EPA's IRI	S database,	except for Lin	dane which	is from HE	AST.				
quation 745-2 a	and default											
ibles (Feb, 199	96 edition) (use a GI abs	sorbtion fra	iction of 0.4.	I hat numbe	r is no longe	er thought to	be valid and	1.0 is used h	ere.		
											1	
											1	
	CAS No. 7440-38-2 71-43-2 7440-43-9 7440-47-3 16065-83-1 18540-29-9 50-29-3 100-41-4 106-93-4 7439-92-1 58-89-9 75-09-2 7439-97-6 1634-04-4 91-20-3 na 56-55-3 205-99-2 207-08-9 50-32-8 218-01-9 53-70-3 207-08-9	genic Effects of Soil Ing Risk CAS No. (unitless) 7440-38-2 0.00001 71-43-2 0.00001 7440-43-9 7440-47-3 16065-83-1 18540-29-9 50-29-3 0.00001 100-41-4 106-93-4 0.00001 7439-92-1 58-89-9 0.00001 75-09-2 0.00001 75-09-2 0.00001 7439-97-6 1634-04-4 91-20-3 na 56-55-3 205-99-2 207-08-9 50-32-8 0.00001 218-01-9 53-70-3 207-08-9 by Factor is the oral slope quation 745-2 and default appropriate requirement. B value in column K. Bo	Risk Avg. Body Weight (unitless) (kg)	Risk Avg. Body Lifetime	Risk Avg. Body Lifetime Unit Conv.	Page Page	Pagenic Effects of Soil Ingestion	Risk Avg. Body Lifetime Unit Conv. Potency G.I. Abs. Soil CAS No. Weight Factor Factor Fraction Ing. Rate (hg) (years) (ug/mg) (kg-day/mg) (unitless) (mg/day) (mg/day)	Risk Avg. Body Lifetime Unit Conv. Potency G.I. Abs. Soil Duration Factor Factor Fraction Ing. Rate of Exposure (unitless) (kg) (years) (years) (kg-day/mg) (unitless) (mg/day) (years) (years) (years) (1.5	Risk Avg. Body Lifetime Unit Conv. Potency G.I. Abs. Soil Duration Frequency G.I. Abs. Soil Converted Cas No. Weight Factor Factor Factor Fractor Fractor Fractor Fractor Fractor Fractor G.I. Abs. Soil Duration Frequency G.I. Abs. Soil Duration Frequency G.I. Abs. Soil Cas No. Cas No. Cas No. Weight Factor Fractor F	Risk Avg. Body Lifetime Unit Corv. Factor Factor Factor Factor Ing. Rate Of Exposure Of Contact Carinogen Of Contact Of Exposure Of	Risk Avg. Body Lifetime Unit Conv. Pactor Fraction Ing. Rate Of Exposure of Contact Carcinggen Carci

Risk CalculationsCarcino	genic Effects	of Soil Ing	jestion										
						Cancer							
		Risk	Avg. Body	Lifetime	Unit Conv.	Potency	G.I. Abs.	Soil	Duration	Frequency	Method C	ARAR (3)	Risk @
Parameter	CAS No.		Weight		Factor	Factor	Fraction	Ing. Rate	of Exposure	of Contact	Carcinogen		ARAR(4
		(unitless)	(kg)	(years)	(ug/mg)	(kg-day/mg)	(unitless)	(mg/day)	(years)	(unitless)	(mg/kg)	(mg/kg)	(unitless
PCB mixtures	1336-36-3									I		1.0	
High Risk & Persistence	.000 00 0	0.00001	70	75	1.000.000	2.0	1.0	50	20	0.4	66	1.0	0.02
Low Risk & Persistence		0.00001	70	75	1,000,000	-	1.0	50	20	0.4	328	1.0	0.003
Lowest Risk & Persistence		0.00001	70	75	1,000,000		1.0	50	20	0.4	1.875	1.0	0.001
Aroclor 1016	12674-11-2				, ,	not available	-			-	,		
Arochlor 1248	12672-29-6					not available							
Arochlor 1254	11097-69-1					not available							
Arochlor 1260						not available							
Tetrachloroethylene (PCE)	127-18-4	0.00001	70	75	1,000,000	0.051	1.0	50	20	0.4	2,574		
Toluene	108-88-3	0.0000.			.,000,000	not available				0	2,011		
1.1.1 Trichloroethane	71-55-6					not available							
Trichloroethylene	79-01-6	0.00001	70	75	1,000,000		1.0	50	20	0.4	11,932		
Xylenes	1330-20-7					not available						_	
m-Xylene	108-38-3					not available							
o-xylene	95-47-6					not available							
p-xylene						not available							
													<u> </u>
(1) Source of Cancer Potence	v Factor is the	oral slope	factors from	FPA's IR	IS database	except for te	rachloroeth	vlene, trichl	orothylene an	d vinyl chlorid	de which are f	rom HEAS	† .
(2) Value calculated using eq						, copt for to		,.c.,om	S. S. Hylorio dir	2y. oo	20		1
(3) Applicable, relevant and a						761.61(a)(4)(i)	(A).						
(4) ARAR divided by Method								t risk not ex	ceed 1 X 10-5	lie >101			

							ulation				
Risk CalculationsNoncar	cinogenic Ef	fects of Soil	Ingestion								
			Avg. Body		Hazard	Soil	G.I. Abs.	Frequency	Method C	ARAR (3)	
Parameter	CAS No.	Dose (1)	Weight	Factor	Quotient	Ing. Rate	Fraction	of Contact	Noncarc(2)		ARAR (4
		(mg/kg-day)	(kg)	(ug/mg)	(unitless)	(mg/day)	(unitless)	(unitless)	(mg/kg)	(mg/kg)	(unitless
Arsenic (5)	7440-38-2	0.0003	70	1,000,000	1	50	1.0	0.4	1,050		
Benzene	71-43-2	0.003	70	1,000,000	1	50	1.0	0.4	10,500		
Cadmium	7440-43-9	0.001	70	1,000,000	1	50	1.0	0.4	3,500		
T Chromium	7440-47-3	not available									
Chromium III	16065-83-1	1.5	70	1,000,000	1	50	1.0	0.4	5,250,000		
Chromium VI	18540-29-9		70	1,000,000	1	50	1.0	0.4	10,500		
DDT	50.20.2	0.0005	70	1 000 000	4	FO	1.0	0.4	1.750		
Ethylbenzene	50-29-3 100-41-4	0.0005 0.1	70 70	1,000,000	1	50 50	1.0	0.4	1,750 350.000		
•		· · · ·		1,000,000	I	50	1.0	0.4	350,000		
Ethylene dibromide (EDB)		not available									
Lead	7439-92-1	not available									
Lindane	58-89-9	0.0003	70	1,000,000	1	50	1.0	0.4	1,050		
Methylene chloride	75-09-2	0.06	70	1,000,000	1	50	1.0	0.4	210,000		
Mercury (inorganic)	7439-97-6	0.0003	70	1,000,000	1	50	1.0	0.4	1,050		
MTBE	1634-04-4	not available									
Naphthalene	91-20-3	0.02	70	1,000,000	1	50	1.0	0.4	70,000		
cPAH Mixtures	na	not available									
Benzo[a]anthracene		not available									
Benzo[b]fluoranthene		not available									
Benzo[k]fluoranthene	207-08-9	not available									
Benzo[a]pyrene	50-32-8	not available									
Chrysene	218-01-9	not available									
Dibenzo[a,h]anthracene	53-70-3	not available									
Ideno[1,2,3-cd]pyrene	207-08-9	not available									
(1) Source of RfDs is EPA's	IRIS database	e except for b	enzene whi	ch is from E	PA's NCE	\.					
(2) Value calculated using ed									1		
(3) Applicable, relevant and			p						1		
(4) ARAR divided by Method			led values i	ndicate ARA	R exceeds	MTCA rec	uirement t	hat HQ not ex	ceed 1.0.		
(5) The MTCA 2.0 CLARC ta										.0 is used h	nere.

Table 4	l: Soil In	gestion -	- Metho	d C Indu	istrial S	oil Cald	culation	s for Nor	ncarcinoge	ens	
Risk CalculationsNoncarc	inogenic Ef	fects of Soil	Ingestion								
		Reference	,	Unit Conv.	Hazard	Soil	G.I. Abs.	Frequency	Method C	ARAR (3)	HQ @
Parameter	CAS No.	Dose (1)	Weight	Factor	Quotient	Ing. Rate		of Contact	Noncarc(2)		ARAR (4)
		(mg/kg-day)	(kg)	(ug/mg)	(unitless)	(mg/day)	(unitless)	(unitless)	(mg/kg)	(mg/kg)	(unitless)
PCB mixtures	1336-36-3	not available								1.0	
High Risk & Persistence		not available									
Low Risk & Persistence		not available									
Lowest Risk & Persistence		not available									
Aroclor 1016	12674-11-2	0.00007	70	1,000,000	1	50	1.0	0.4	245.0	1.0	0.004
Arochlor 1248	12672-29-6	not available									
Arochlor 1254	11097-69-1	0.00002	70	1,000,000	1	50	1.0	0.4	70.0	1.0	0.01
Arochlor 1260		not available									
Tetrachloroethylene (PCE)	127-18-4	0.01	70	1,000,000	1	50	1.0	0.4	35,000		
Toluene	108-88-3	0.2	70	1,000,000	1	50	1.0	0.4	700,000		
1,1,1 Trichloroethane	71-55-6	0.9	70	1,000,000	1	50	1.0	0.4	3,150,000		
Trichloroethylene	79-01-6	not available									
Xylenes	1330-20-7	2.0	70	1,000,000	1	50	1.0	0.4	7,000,000		
m-Xylene	108-38-3	not available									
o-xylene	95-47-6	not available									
p-xylene		not available									
(1) Source of RfDs is EPA's II	 RIS database	e except for 1	.1.1. TCF w	hich is from	HEAST						
(2) Value calculated using eq											
(3) Applicable, relevant and a						1.61(a)(4)(i)(A).				
(4) ARAR divided by Method	B value in co	olumn K Bolo	led values i	ndicate ARA	R exceeds	MTCA rec	uirement t	hat HQ not ex	ceed 1.0		
(.,		J. J. III I II DOIG	7414001		0/100000				1.0.		

Risk CalculationsCarcino	genic Effects of	of Soil Inges	stion + Der	mal Contac	:t											
		Risk	Ava Body	Averaging	Exposure	Evposuro	Soil	G.I. Abs.	Oral	Unit Conv.	Surface	Adherence	Dermal	G.I. Conv.	Dermal	Method C (3)
Parameter	CAS No.	IXISK	Weight	Time	Frequency	Duration	Ing. Rate	Fraction	CPF (1)	Factor	Area	Factor	Abs. Fraction	Factor	CPF (2)	Carcinogen
- didiliotoi	0/10/140.	(unitless)	(kg)	(days)	(days/yr)	(yrs)	(mg/day)	(unitless)	, ,	(ug/mg)	(cm ²)	(mg/cm ² -day)	(unitless)	(unitless)	(kg-day/mg)	(mg/kg)
A!-	7440.00.0															
Arsenic Benzene	7440-38-2 71-43-2	0.00001 0.00001	70 70	27,375 27,375	250 250	20 20	50 50	1.0	1.5 0.029	1,000,000	2,500 2,500	0.2	0.03 0.0005	0.95 0.80	1.6 0.036	38.84 2,627
		0.00001	70	21,313	230	20	30	1.0		1,000,000	2,300	0.2	0.0003	0.00	0.030	2,021
Cadmium	7440-43-9								not available					-		
T Chromium	7440-47-3															
Chromium III	16065-83-1								not available							
Chromium VI	18540-29-9								not available							
DDT	50-29-3	0.00001	70	27,375	250	20	50	1.0	0.34	1,000,000	2,500	0.2	0.03	0.70	0.49	157.8
Ethylbenzene	100-41-4								not available							
Ethylene dibromide (EDB)	106-93-4	0.00001	70	27,375	250	20	50	1.0	85	1,000,000	2,500	0.2	0.03	0.80	106	0.656
Lead	7439-92-1								not available	.,,	_,-,	7.2				
Lindane	58-89-9	0.00001	70	27,375	250	20	50	1.0	1.3	1,000,000	2,500	0.2	0.04	0.50	2.6	32.76
Methylene chloride	75-09-2	0.00001	70	27,375	250	20	50	1.0	0.0075	1,000,000	2,500	0.2	0.0005	0.80	0.0094	10,157
•		0.0000		2.,0.0	200					1,000,000	2,000	0.2	0.0000	0.00	0.000	10,101
Mercury (inorganic) MTBE	7439-97-6 1634-04-4								not available not available					-		
Naphthalene	91-20-3								not available							
cPAH Mixtures	na															
Benzo[a]anthracene	56-55-3								not available							
Benzo[b]fluoranthene	205-99-2								not available							
Benzo[k]fluoranthene	207-08-9								not available							
Benzo[a]pyrene	50-32-8	0.00001	70	27,375	250	20	50	1.0	7.3	1,000,000	2,500	0.2	0.13	0.89	8.2	4.27
Chrysene Dibenzo[a,h]anthracene	218-01-9 53-70-3								not available not available					-		
Ideno[1,2,3-cd]pyrene	207-08-9								not available					-		
ideno[1,2,0 ed]pyrene	207-00-3								not available					+		
(1) Source of Cancer Potence																
(2) Dermal CPF = Oral CPF/				factor is ch	emical spec	ific. See ec	uation 745	-5 for defau	Its and 1/25/99	memo for c	hemical spe	cific factors us	ed here.	<u> </u>	<u> </u>	
(3) Calculated using equation	n 745-5 and def	ault assump	tions.											-	 	+
															 	+
															 	+
														<u> </u>	 	+
															<u> </u>	
															 	+
														 	 	
														+	+	+
									 					 		+
	1															

Risk CalculationsCarcinog	genic Effects o	of Soil Inge	stion + Der	mal Contac	t											
		6:1	A . D. I				0.3	01.41	01	11.7.0	0 (A II	D	01.0	5	M. (1 . 1 O (0)
D	CAS No.	Risk			Exposure		Soil Ing. Rate	G.I. Abs.	Oral CPF (1)	Unit Conv.	Surface Area	Adherence Factor	Dermal Abs. Fraction	G.I. Conv.	Dermal	Method C (3)
Parameter	CAS No.	(Weight	Time	. ,	Duration			. ,	Factor				Factor	CPF (2)	Carcinogen
		(unitless)	(kg)	(days)	(days/yr)	(yrs)	(mg/day)	(unitless)	(kg-day/mg)	(ug/mg)	(cm ²)	(mg/cm ² -day)	(unitless)	(unitless)	(kg-day/mg)	(mg/kg)
PCB mixtures	1336-36-3															
High Risk & Persistence		0.00001	70	27,375	250	20	50	1.0	2.0	1,000,000	2,500	0.2	0.14	0.81	2.5	14.05
Low Risk & Persistence		0.00001	70	27,375	250	20	50	1.0	0.4	1,000,000	2,500	0.2	0.14	0.81	0.49	70.2
Lowest Risk & Persistence		0.00001	70	27,375	250	20	50	1.0	0.07	1,000,000	2,500	0.2	0.14	0.81	0.0864	401
Aroclor 1016	12674-11-2								not available							
Arochlor 1248	12672-29-6								not available							
Arochlor 1254	11097-69-1								not available					0.81		
Arochlor 1260									not available							
Tetrachloroethylene (PCE)	127-18-4	0.00001	70	27.375	250	20	50	1.0	0.051	1,000,000	2.500	0.2	0.03	0.80	0.064	1.093
Toluene	108-88-3	0.00001		21,010	200	20			not available	1,000,000	2,000	0.2	0.00	0.00	0.001	1,000
1,1,1 Trichloroethane	71-55-6								not available							
Trichloroethylene	79-01-6	0.00001	70	27,375	250	20	50	1.0	0.011	1,000,000	2,500	0.2	0.03	0.80	0.014	5,068
Xylenes	1330-20-7								not available							
m-Xylene	108-38-3								not available							
o-xylene	95-47-6								not available							
p-xylene									not available							
																-
(1) Source of Cancer Potency																
(2) Dermal CPF = Oral CPF/	GI abs convers	ion factor.	The GI abs.	factor is ch	emical spec	ific. See ed	quation 745-	5 for defau	ts and 1/25/99	memo for c	hemical spe	ecific factors use	ed here.			

		Та	ble 6: M	lethod C	Industri	al Calcu	lations for	r Noncar	cinogens	s for Soil	Ingestion	n plus Derm	nal Conta	ict		
Risk CalculationsNoncar	cinogenic E	ffects of S	oil Ingestion	n + Dermal (Contact											
	J															
		Hazard	Avg. Body	Averaging	Exposure	Exposure	Oral Ref.	Soil	G.I. Abs.	Unit Conv.	G.I. Conv.	Dermal	Surface	Adherence	Dermal Abs.	Method C
Parameter	CAS No.	Index	Weight	Time	Frequency	Duration	Dose (1)	Ing. Rate	Fraction	Factor	Factor	Rfd (2)	Area	Factor	Fraction	Noncarc(2)
		(unitless)	(kg)	(days)	(days/yr)	(years)	(mg/kg-day)	(mg/day)	(unitless)	(mg/kg)	(unitless)	(mg/kg-day)	(cm ²)	(mg/cm ²)	(unitless)	(mg/kg)
Arsenic	7440-38-2	1	70	7,300	250	20	0.0003	50	1	1,000,000	0.95	0.00029	2,500	0.2	0.03	466
Benzene	71-43-2	1	70	7,300	250	20	0.003	50	1	1,000,000	0.80	0.0024	2,500	0.2	0.0005	
Cadmium	7440-43-9	1	70	7,300	250	20	0.001	50	1	1,000,000	0.025	0.000025	2,500	0.2	0.001	1,460
T Chromium	7440-47-3						not available									
Chromium III	16065-83-1	1	70	7,300	250	20	1.5	50	1	1,000,000	0.013	0.020	2,500	0.2	0.01	352,726
Chromium VI	18540-29-9		70	7,300	250	20	0.003	50	1	1,000,000	0.025	0.000075	2,500	0.2	0.01	1,226
DDT	50-29-3	1	70	7,300	250	20	0.0005	50	1	1,000,000	0.70	0.00035	2,500	0.2	0.03	715
Ethylbenzene	100-41-4	1	70	7,300	250	20	0.0005	50	1	1,000,000	0.80	0.080	2,500	0.2	0.03	148,655
Estada a dibas (11 /EBS)	400.00.1													1		
Ethylene dibromide (EDB) Lead	106-93-4 7439-92-1						not available not available									
	==							=0		1 000 05 -	0.50		0.500			
Lindane	58-89-9	1	70	7,300	250	20	0.0003	50	1	1,000,000	0.50	0.00015	2,500	0.2	0.04	341
Methylene chloride	75-09-2	1	70	7,300	250	20	0.06	50	1	1,000,000	0.80	0.048	2,500	0.2	0.0005	121,878
Mercury (inorganic)	7439-97-6	1	70	7,300	250	20	0.0003	50	1	1,000,000	0.07	0.000021	2,500	0.2	0.01	252
MTBE	1634-04-4						not available									
Naphthalene	91-20-3	1	70	7,300	250	20	0.02	50	1	1,000,000	0.89	0.018	2,500	0.2	0.13	16,613
cPAH Mixtures	na						not available									
Benzo[a]anthracene	56-55-3						not available									
Benzo[b]fluoranthene	205-99-2						not available									
Benzo[k]fluoranthene	207-08-9						not available									
Benzo[a]pyrene	50-32-8						not available									
Chrysene	218-01-9						not available									
Dibenzo[a,h]anthracene	53-70-3						not available									
Ideno[1,2,3-cd]pyrene	207-08-9						not available									
(1) Source of oral RfDs is EF																
(2) Dermal RfD = Oral RfD X				aps. tactor is	cnemical sp	ecitic. See	equation 745-4	tor defaults a	and 1/25/99 n	nemo tor cher	nical specific	ractors used here	9.	1		+
(3) Calculated using equation	n /45-4 and	default ass	umptions.													
<u> </u>	-	1		-										1		
		<u> </u>														

Risk CalculationsNoncare	cinogenic E	fects of So	oil Ingestion	n + Dermal C	Contact											
		Hazard	Avg. Body	Averaging	Exposure	Exposure	Oral Ref.	Soil	G.I. Abs.	Unit Conv.	G.I. Conv.	Dermal	Surface	Adherence	Dermal Abs.	Method C
Parameter	CAS No.	Index	Weight	Time	Frequency	Duration	Dose (1)	Ing. Rate	Fraction	Factor	Factor	Rfd (2)	Area	Factor	Fraction	Noncarc(2)
		(unitless)	(kg)	(days)	(unitless)	(years)	(mg/kg-day)	(mg/day)	(unitless)	(mg/kg)	(unitless)	(mg/kg-day)	(mg/cm ²)	(mg/cm ²)	(unitless)	(mg/kg)
PCB mixtures	1336-36-3			I			not available									
High Risk & Persistence							not available									
Low Risk & Persistence							not available									
Lowest Risk & Persistence							not available									
Aroclor 1016	12674-11-2	1	70	7,300	250	20	0.00007	50	1	1,000,000	0.81	0.000057	2,500	0.2	0.14	52.4
Arochlor 1248	12672-29-6						not available									
Arochlor 1254	11097-69-1	1	70	7,300	250	20	0.00002	50	1	1,000,000	0.81	0.000016	2,500	0.2	0.14	15.0
Arochlor 1260							not available									
Tetrachloroethylene (PCE)	127-18-4	1	70	7.300	250	20	0.01	50	1	1.000.000	0.80	0.0080	2.500	0.2	0.03	14.865
Toluene	108-88-3	1	70	7,300	250	20	0.2	50	1	1,000,000	0.80	0.16	2,500	0.2	0.03	297,309
1.1.1 Trichloroethane	71-55-6	1	70	7.300	250	20	0.9	50	1	1.000.000	0.80	0.72	2.500	0.2	0.0005	1,828,174
Trichloroethylene	79-01-6			1,000			not available			1,000,000		***	_,			.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
Xylenes	1330-20-7	1	70	7.300	250	20	2.0	50	1	1.000.000	0.80	1.6	2,500	0.2	0.03	2,973,091
m-Xylene	108-38-3		-	,			not available			, ,			,			72 272
o-xylene	95-47-6						not available									
p-xylene							not available									
(1) Source of oral RfDs is EF	PA's IRIS dat	abase exce	pt for benze	ne which is f	rom EPA's N	CEA.										
(2) Dermal RfD = Oral RfD X	GLabs con	version fact	or. This fac	tor is chemic	al specific. S	See equation	n 745-4.									

				Table 7	′: 3-Phas	se Model	Assumpti	ons and F	Results				
			ı	1			•	ı	1				1
-Phase Model Results		0.111.0											
		Gd H ₂ O								Dilution	Soil		
	CAS No.	C/U Level	Bulk Density		Soil Air	H'	Koc	foc	Kd	Factor	C/U Level		
		(mg/l) (1)	(g/cc) (2)	(CC/CC) (2)	(cc/cc) (2)	(cc/cc) (3)	(ml/g) (3)	(%) (4)	(cc/g) (5)	(dimensionless)	(mg/kg) (6)		
Arsenic	7440-38-2	0.005	1.5	0.3	0.13	0	-	-	29	20	2.92		
enzene	71-43-2	0.005	1.5	0.3	0.13	0.228	61.7	0.1%	0.062	20	0.028		
Cadmium	7440-43-9	0.005	1.5	0.3	0.13	0	-	-	6.7	20	0.69		
Chromium (total)	7440-47-3												
Chromium VI	18540-29-9	0.05	1.5	0.3	0.13	0	-	-	19	20	19		
Chromium III	16065-83-1	0.10	1.5	0.3	0.13	0	-	-	1000	20	2000		
DT	50-29-3	0.0003	1.5	0.3	0.13	0.000332	386,977	0.1%	387	20	2.32	 	
thyl Benzene	100-41-4	0.0003	1.5	0.3	0.13	0.323	204	0.1%	0.204	20	6.05		
,													
thylene dibromide (EDB)	106-93-4	0.00001	1.5	0.3	0.13 0.13	0.0336	66	0.1%	0.066 10000	20 20	0.000054 3000		1
ead	7439-92-1	0.015	1.5	0.3	0.13	0	-	-	10000	20	3000		
indane	58-89-9	0.0002	1.5	0.3	0.13	0.000574	1,352	0.1%	1.4	20	0.0062		
lethylene Chloride	75-09-2	0.005	1.5	0.3	0.13	0.0898	10	0.1%	0.010	20	0.022		
lercury (inorganic)	7439-97-6	0.002	1.5	0.3	0.13	0.467		-	52	20	2.09		1
TBE	1634-04-4	0.02	1.5	0.3	0.13	0.018	11	0.1%	0.011	20	0.085		
			-										
laphthalene	91-20-3	0.16	1.5	0.3	0.13	0.0198	1,191	0.1%	1.191	20	4.46		
PAH Mistures	na												
Benzo[a]anthracene	56-55-3	0.000012	1.5	0.3	0.13	0.000137	357,537	0.1%	358	20	0.086		
Benzo[b]fluoranthene	205-99-2	0.000012	1.5	0.3	0.13	0.00455	1,230,000	0.1%	1,230	20	0.30		
Benzo[k]fluoranthene	207-08-9	0.000012	1.5	0.3	0.13	0.000034	1,230,000	0.1%	1,230	20	0.30		
enzo[a]pryene	50-32-8	0.000012	1.5	0.3	0.13	0.0000463	968,774	0.1%	969	20	0.23		
Chrysene	218-01-9	0.000012	1.5	0.3	0.13	0.00388	398,000	0.1%	398	20	0.10		
Dibenzo[a,h]anthracene	53-70-3	0.000012	1.5	0.3	0.13	6.03E-07	1,789,101	0.1%	1,789	20	0.43		
ndeno[1,2,3-cd]pyrene	207-08-9	0.000012	1.5	0.3	0.13	0.0000656	3,470,000	0.1%	3470.00	20	0.83		
												1	
												1	1
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				Table 7	7: 3-Phas	se Model	Assumpti	ons and F	Results				
3-Phase Model Results	1		T		l			l	l				
5-1 Hase Model Nesults		Gd H ₂ O								Dilution	Soil	-	
	CAS No.	C/U Level	Bulk Density	Soil Water	Soil Air	H'	Koc	foc	Kd	Factor	C/U Level		+
	CAS NO.	(mg/l) (1)	(g/cc) (2)		(cc/cc) (2)		(ml/g) (3)	(%) (4)	(cc/g) (5)	(dimensionless)	(mg/kg) (6)		
		(1119/1) (17	(9/00) (2)	(00/00) (2)	(00/00) (2)	(00/00) (0)	(1111/9) (0)	(70) (1)	(00/9) (0)	(dirricricionicos)	(mg/ng) (o)		
PCB Mixtures	1336-36-3	0.0004			0.40	0.440	107.005	0.40/	407				
Arochlor 1016	12674-11-2	0.0001	1.5	0.3	0.13	0.119	107,285	0.1%	107	20	0.21		
Arochlor 1260		0.0001	1.5	0.3	0.13	0.189	822,422	0.1%	822	20	1.65		
Tetrachlorothylene (PCE)	127-18-4	0.005	1.5	0.3	0.13	0.754	265	0.1%	0.265	20	0.053		
Toluene	108-88-3	1.0	1.5	0.3	0.13	0.272	140	0.1%	0.140	20	7.27		
1,1,1 Trichlorothane	71-55-6	0.2	1.5	0.3	0.13	0.705	135	0.1%	0.135	20	1.58	-	
Trichlorocthylene	79-01-6	0.005	1.5	0.3	0.13	0.703	94	0.1%	0.094	20	0.033		+
<u> </u>													
Xylenes	1330-20-7	1.0	1.5	0.3	0.13	0.279	233	0.1%	0.233	20	9.14		
m-xylene	108-38-3	1.0	1.5	0.3	0.13	0.301	196	0.1%	0.196	20	8.44	-	+
o-xylene	95-47-6	1.0	1.5	0.3	0.13	0.213	241	0.1%	0.241	20	9.19		
p-xylene	1	1.0	1.5	0.3	0.13	0.314	311	0.1%	0.311	20	10.76		+
(1) Ground water cleanup le	oval upped for	anlowlation F	rom proposed	table 720 1	avaant for C	r III wood 0 1	ma/l and for D/	La used Meth	and Bugling for I	P(a)D			
If the Method A ground									lou b value for i	5(a)P.			
(2) From equation 747-1. E													
(3) Source: Soil Screening													
EDB values from ATSD				EIII. EFA/5º	+0/K-95/12B	. May, 1990	. Exceptions are	;. 					
MTBE from USGS final				206)									
Arochlor values for Hen					ngical Profile	(Dec 1998)	· Arochlor Koc f	rom ΕΡΔ 1994	L draft of soil scr	eening guidance			
Values for total xylenes													
That is: m = 51% of total						position date	2 110111 11 11 0110	That Working C	Jioup Volume	2 (Way 1550).			
H' for all metals except						a Guidance							
DDT value for Koc base							7 934 and soil o	leanun level e	guals 4 07 mg/k	n			
(4) Based on review of data						00, 1100 = 07	7,001 4114 5011 6	louriup lovor o	qualo 1.07 mg/l	y.			
(5) From equation 747-2 for					able from the	literature an	d WA State site	S					
(6) Calculated using equation									n in this table.				
(c) cancalance asing equality				(0.0 0.11		J							
												1	1
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			Т	able 7:	3-Phase Mo	odel Assumption	s and Res	sults				
3-Phase Model Results										1		
		Pore Water		NAPL		Pore Water		Vapor		Soil		Sum
	CAS No.	Concentration	Solubility	in	Csat	Concentration		Concentration	Vapor Mass	Concentration	Soil Mass	Mass
		(mg/l) (7)	(mg/l) (3)	Soil? (8)	(mg/kg) (9)	(mg/l) (7)	(mg/kg) (10)	(mg/m ³) (11)	(mg/kg) (12)	(mg/kg) (13)	(mg/kg) (14)	(mg/kg) (15)
Arsenic	7440-38-2	-	-	n/a	-	0.10	0.020	-	-	2.90	2.90	2.92
Benzene	71-43-2	0.10	1,750	No	493	0.10	0.020	22.8	0.0020	0.0062	0.0062	0.028
			-									
Cadmium	7440-43-9	0.10	-	n/a	-	0.10	0.020	-	-	0.67	0.67	0.69
Chromium (total)	7440-47-3											
Chromium VI	18540-29-9		-	n/a	-	1.0	0.20	-	-	19	19	19
Chromium III	16065-83-1	2.0	-	n/a	-	2.0	0.40	-	-	2000	2,000	2000
DDT	50-29-3	0.0060	0.0250	No	10	0.0060	0.0012	0.0020	1.73E-07	2.32	2.32	2.32
Ethyl Benzene	100-41-4	14	169	No	73	14	2.8	4522	0.39	2.86	2.86	6.05
Ethylene dibromide (EDB)	106-93-4	0.00020	4,000	No	1,076	0.00020	0.000040	0.0067	5.82E-07	0.000013	0.000013	0.000054
Lead	7439-92-1	0.30	-	n/a	-	0.30	0.060	-	-	3000	3000	3000
Lindane	58-89-9	0.0040	6.8	No	11	0.0040	0.00080	0.0023	1.99E-07	0.0054	0.0054	0.006
Methylene Chloride	75-09-2	0.10	13,000	No	2,831	0.10	0.0000	9.0	0.00078	0.0010	0.0010	0.022
•												
Mercury (inorganic) MTBE	7439-97-6 1634-04-4	0.040 0.40	50,000	n/a No	10,628	0.040	0.008	19 7.2	0.0016 0.00062	2.08 0.0044	2.08 0.0044	2.09 0.085
			· · · · · · · · · · · · · · · · · · ·			0.40						
Naphthalene	91-20-3	3.2	31	No	43	3.2	0.64	63	0.0055	3.81	3.81	4.46
cPAH Mistures	na											
Benzo[a]anthracene	56-55-3	0.00024	0.0094	No	3.4	0.00024	0.000048	3.29E-05	2.85E-09	0.09	0.086	0.09
Benzo[b]fluoranthene	205-99-2	0.00024	0.0015	No	1.8	0.00024	0.000048	1.09E-03	9.46E-08	0.30	0.30	0.30
Benzo[k]fluoranthene	207-08-9	0.00024	0.0008	No	1.0	0.00024	0.000048	8.16E-06	7.07E-10	0.30	0.30	0.30
Benzo[a]pryene	50-32-8	0.00024	0.00162	No	1.6	0.00024	0.000048	1.11E-05	9.63E-10	0.23	0.23	0.23
Chrysene	218-01-9	0.00024	0.0016	No	0.64	0.00024	0.000048	9.31E-04	8.07E-08	0.10	0.096	0.10
Dibenzo[a,h]anthracene Indeno[1,2,3-cd]pyrene	53-70-3 207-08-9	0.00024 0.00024	0.00249	No Yes	4.5 0.076	0.00024 0.00024	0.000048 0.000048	1.45E-07 1.57E-05	1.25E-11 1.36E-09	0.43 0.83	0.43 0.83	0.43 0.83
indeno[1,2,3-cd]pyrene	207-00-9	0.00024	0.000022	168	0.076	0.00024	0.000046	1.57 E-05	1.30E-09	0.63	0.63	0.63
					 					+	+	
										+		
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			_		:				•				
			٦	Table 7:	3-Phase	Model A	Assumption	is and Re	sults				
3-Phase Model Results													
		Pore Water		NAPL			Pore Water		Vapor		Soil		Sum
	CAS No.	Concentration	Solubility	in	Csat		Concentration	Water Mass	Concentration	Vapor Mass	Concentration	Soil Mass	Mass
		(mg/l) (7)	(mg/l) (3)	Soil? (8)	(mg/kg) (9)		(mg/l) (7)	(mg/kg) (10)	(mg/m ³) (11)	(mg/kg) (12)	(mg/kg) (13)	(mg/kg) (14)	(mg/kg) (15)
PCB Mixtures	1336-36-3												
Arochlor 1016	12674-11-2	0.0020	0.42	No	45		0.0020	0.00040	0.24	2.06E-05	0.21	0.21	0.21
Arochlor 1260		0.0020	0.08	No	66		0.0020	0.00040	0.38	3.28E-05	1.64	1.64	1.65
Tetrachlorothylene (PCE)	127-18-4	0.10	200	No	106		0.10	0.020	75	0.0065	0.0265	0.0265	0.053
Toluene	108-88-3	20	526	No	191		20	4.0	5440	0.47	2.80	2.80	7.3
1,1,1 Trichlorothane	71-55-6	4.0	1,330	No	527		4.0	0.80	2820	0.24	0.54	0.54	1.58
Trichlorocthylene	79-01-6	0.10	1,100	No	364		0.10	0.020	42	0.0037	0.0094	0.0094	0.033
Xylenes	1330-20-7	20	171	No	78		20	4.0	5580	0.48	4.66	4.66	9.1
m-xylene	108-38-3	20	161	No	68		20	4.0	6020	0.52	3.92	3.92	8.4
o-xylene	95-47-6	20	178	No	82		20	4.0	4260	0.37	4.82	4.82	9.2
p-xylene		20	185	No	100		20	4.0	6280	0.54	6.22	6.22	10.8
(7) Pore water concentration	on – ground v	vater cleanun le	vel X dilution	factor									
(8) There is NAPL in the so					v limit								
(9) C sat is the soil concent						ostitutina the	solubility limit fo	or the laround	water cleanup le	vel X DF1 in equa	tion 747-1.		
(10) Water mass = [Pore w										, , , , ,			
(11) Vapor concentration =	Pore water	concentration X	Henry's Cons	tant X 1000									
(12) Vapor mass = [Vapor of	(12) Vapor mass = [Vapor concentration X soil air fraction] / soil bulk density. This is the mass of contaminant in the vapor phase.												
(13) Soil concentration = Po													
(14) Soil mass = [Pore water							of contaminant in	the soil phase	e.				
(15) Sum mass = water ma	ass + vapor n	nass + soil mass	. This value	equals the s	oil cleanup l	evel.							

Table 8: 4-Phase Model Results using Fresh ARCO Gasoline

Solid: 46.1% Air: 33.0% Water: 20.9% NAPL: NONE 100.0%

	Equilibrium Composition	Protective Soil	Predicted G.W
	%	ppm	ug/l
<u>Aliphatics</u>	ARCO 1		
EC >5-6	29.93%	0.27	3.49
EC >6-8	15.31%	0.14	1
EC >8-10	3.77%	0.03	0.0
EC >10-12	2.56%	0.02	0.00
EC >12-16		0.00	0.00
EC >16-21		0.00	0.00
<u>Aromatics</u>		0.00	
Benzene	3.67%	0.033	5.86
Toluene	14.62%	0.13	18
Ethylbenzene	2.73%	0.02	3
Xylenes	13.45%	0.12	13
EC >8-10	4.15%	0.04	1
EC >10-12	7.47%	0.07	1
EC >12-16	0.0191	0.02	0
EC >16-21		0.00	0
EC >21-35		0.00	0
Naphthalene	0.43%	0.00	0
MTBE		0.00	0
Total	100.00%	0.90	47

21%	0%	%
33%		

Soil - Mass Distribution

Solid:
Air:
Water:
NAPL:

Total soil porosity: default is 0.43	n	0.430	Unitless
Volumetric water content: default is 0.3	Qw	0.300	Unitless
Initial volumetric air content: default is 0.13	Qa	0.130	Unitless
Soil bulk density measured: default is 1.5	rb	1.500	kg/l
*or, use soil bulk density computed @solid density=2.65kg/l:		1.811	kg/l
Fraction Organic Carbon: default is 0.001	foc	0.0010	Unitless
Dilution Factor: default is 20	DF	20.0	Unitless

Soil Concentration:	0.90
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Predicted Ground Water TPH (ug/l:	47
HI @ Predicted G.W. Concentration:	0.27

Volumetric NAPI Content ONAPI :	NAPI phase is not existing

Volumetric NAPL Content, QNAPL:

NAPL Saturation (%), QNAPL/n:

Type of model used for computation:

Computation completed?

NAPL phase is not existing!

N/A

3-Phase Model

Yes!

TPH Distribution @ 4-phase in soil pore system:

Total Mass distributed in Water Phase: 20.89% in Solid: 46.11%

Total Mass distributed in Air Phase: 33.00% in NAPL: NONE

Soil Concentration = 0.90

Gasoline composition from 9/3/98 neat product analysis conducted by Northcreek Analytical, Inc under contract to Ecology.

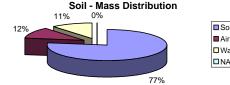
This is a summary sheet from an Excel program created by Hun Seak Park while at the Pollution Liability Insurance Agency (PLIA) and modified by Ecology staff.

For this particular composition, the allowable soil concentration is controlled by the predicted concentration of benzene (5.86 ug/l) in the ground water.

Table 9: 4-Phase Model Results using ARCO #5 (ARCO composition closest to 0.1% benzene)

Solid:	77.2%
Air:	11.8%
Water:	11.1%
NAPL:	NONE
	100.0%

			D 11 4 1
	Equilibrium	Protective	Predicted G.W.
	Composition	Soil	O.VV.
	%	ppm	ug/l
Aliphatics	ARCO 5	PPIII	ug/i
		0.00	4.00
EC >5-6	1.36%	0.38	4.93
EC >6-8	13.4%	3.74	22
EC >8-10	12.8%	3.59	4.6
EC >10-12	10.8%	3.02	0.58
EC >12-16		0.00	0.00
EC >16-21		0.00	0.00
<u>Aromatics</u>		0.00	
Benzene	0.066%	0.019	3.29
Toluene	2.8%	0.80	109
Ethylbenzene	1.8%	0.51	59
Xylenes	10.0%	2.81	308
EC >8-10	11.6%	3.26	89
EC >10-12	26.3%	7.35	135
EC >12-16	7.7%	2.16	21
EC >16-21		0.00	0
EC >21-35		0.00	0
Naphthalene	1.27%	0.35	17
MTBE		0.00	0
Total	100.00%	28.00	774



■ Solid:	
■ Air:	
■ Water:	
□NAPL:	

Total soil porosity: default is 0.43	n	0.430	Unitless
Volumetric water content: default is 0.3	Qw	0.300	Unitless
Initial volumetric air content: default is 0.13	Qa	0.130	Unitless
Soil bulk density measured: default is 1.5	rb	1.500	kg/l
*or, use soil bulk density computed @solid density=2.65kg/l:		1.811	kg/l
Fraction Organic Carbon: default is 0.001	foc	0.0010	Unitless
Dilution Factor: default is 20	DF	20.0	Unitless

Soil Concentration: 28.00

Predicted Ground Water TPH (ug/l: 774 HI @ Predicted G.W. Concentration: 1.01

Volumetric NAPL Content, QNAPL: NAPL phase is not existing! NAPL Saturation (%), QNAPL/n: N/A Type of model used for computation: 3-Phase Model Computation completed? Yes! TPH Distribution @ 4-phase in soil pore system:

Total Mass distributed in Water Phase: 11.05% in Solid: 77.18%

Total Mass distributed in Air Phase: 11.76% in NAPL: NONE

Soil Concentration = 28.00

Gasoline composition is fresh product weathered to approximately 0.1% benzene, simulated by removal of mass in dissolved and vapor phases by successive model runs. This benzene composition is typical of soil benzene concentrations found in soils at gasoline contaminated sites in WA State.

This is a summary sheet from an Excel program created by Hun Seak Park while at the Pollution Liability Insurance Agency (PLIA) and modified by Ecology staff. For this particular composition, the allowable soil concentration is controlled by the predicted hazard index of the gasoline mixture in the ground water.

Table 10: 4-Phase Model Results using Fresh BP Gasoline

T-4-1 --!! -----!t-- -!-f---!t !- 0.40

Soil - Mass Distribution

Solid:	52.9%
Air:	32.4%
Water:	14.8%
NAPL:	NONE
	100.0%

	Equilibrium Composition	Protecti ve Soil	Predicted G.W.
	%	ppm	ug/l
<u>Aliphatics</u>	Fresh BP		
EC >5-6	28.48%	0.28	3.69
EC >6-8	17.2%	0.17	1
EC >8-10	4.6%	0.05	0.1
EC >10-12	5.5%	0.06	0.01
EC >12-16		0.00	0.00
EC >16-21		0.00	0.00
<u>Aromatics</u>		0.00	
Benzene	2.9%	0.029	5.16
Toluene	7.7%	0.08	11
Ethylbenzene	1.7%	0.02	2
Xylenes	8.9%	0.09	10
EC >8-10	5.5%	0.06	2
EC >10-12	9.2%	0.09	2
EC >12-16	6.6%	0.07	1
EC >16-21	0.0%	0.00	0
EC >21-35	0.0%	0.00	0
Naphthalene	1.6%	0.02	1
MTBE	0.0%	0.00	0
Total	100.0%	1.00	37

15% 0%	Solid: Air: Water:
32%	□NAPL:

Total soil porosity: default is 0.43	n	0.430	Unitless
Volumetric water content: default is 0.3	Qw	0.300	Unitless
Initial volumetric air content: default is 0.13	Qa	0.130	Unitless
Soil bulk density measured: default is 1.5	rb	1.500	kg/l
*or, use soil bulk density computed @solid density=2.65kg/l:		1.811	kg/l
Fraction Organic Carbon: default is 0.001	foc	0.0010	Unitless
Dilution Factor: default is 20	DF	20.0	Unitless
Soil Concentration:	1.00		
Predicted Ground Water TPH (ug/l:	37		
HI @ Predicted G.W. Concentration:	0.24		

Volumetric NAPL Content, QNAPL : NAPL Saturation (%), QNAPL/n:	NAPL phase is not existing! N/A
Type of model used for computation:	3-Phase Model
Computation completed? TPH Distribution @ 4-phase in soil pore system:	Yes!

Total Mass distributed in Water Phase: 14.75% in Solid: 52.87%

Total Mass distributed in Air Phase: 32.38% in NAPL: NONE

Soil Concentration = 1.00

Gasoline composition from 9/3/98 neat product analysis conducted by Northcreek Analytical, Inc under contract to Ecology.

This is a summary sheet from an Excel program created by Hun Seak Park while at the Pollution Liability Insurance Agency (PLIA) and modified by Ecology staff. For this particular composition, the allowable soil concentration is controlled by the predicted concentration of benzene (5.16 ug/l) in the ground water.

Table 11: 4-Phase Model Results for BP #4 (BP composition closest to 0.1% benzene)

Solid:	78.7%
Air:	12.4%
Water:	8.9%
NAPL:	NONE
	100.0%

	Equilibrium Composition %	Protective Soil ppm	Predicted G.W.
<u>Aliphatics</u>	BP #4		
EC >5-6	2.640%	0.58	7.53
EC >6-8	14.131%	3.11	18
EC >8-10	9.935%	2.19	2.8
EC >10-12	13.808%	3.04	0.58
EC >12-16		0.00	0.00
EC >16-21		0.00	0.00
<u>Aromatics</u>			
Benzene	0.127%	0.028	4.95
Toluene	2.003%	0.44	61
Ethylbenzene	1.135%	0.25	29
Xylenes	6.427%	1.41	155
EC >8-10	10.248%	2.25	62
EC >10-12	20.242%	4.45	82
EC >12-16	16.106%	3.54	34
EC >16-21	0.000%	0.00	0
EC >21-35	0.000%	0.00	0
Naphthalene	3.198%	0.70	34
MTBE	0.000%	0.00	0
			0
Total	100.000%	22.00	490

Soil - Mass Distribution □ Solid: □ Air: □ Water: □ NAPL:

Total soil porosity: default is 0.43	n	0.430	Unitless
Volumetric water content: default is 0.3	Qw	0.300	Unitless
Initial volumetric air content: default is 0.13	Qa	0.130	Unitless
Soil bulk density measured: default is 1.5	rb	1.500	kg/l
*or, use soil bulk density computed @solid density=2.65kg/l:		1.811	kg/l
Fraction Organic Carbon: default is 0.001	foc	0.0010	Unitless
Dilution Factor: default is 20	DF	20.0	Unitless

Soil Concentration: 22.00

Predicted Ground Water TPH (ug/l: 490
HI @ Predicted G.W. Concentration: 0.92

Volumetric NAPL Content, QNAPL:

NAPL Saturation (%), QNAPL/n:

Type of model used for computation:

Computation completed?

NAPL phase is not existing!

N/A

3-Phase Model 78.72%

Yes!

TPH Distribution @ 4-phase in soil pore system:

Total Mass distributed in Water Phase: 8.90% in Solid: NONE

Total Mass distributed in Air Phase: 12.37% in NAPL:

Soil Concentration = 22.00

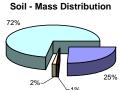
Gasoline composition is fresh product weathered to approximately 0.1% benzene, simulated by removal of mass in dissolved and vapor phases by successive model runs. This benzene composition is typical of soil benzene concentrations found in soils at gasoline contaminated sites in WA State.

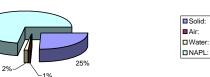
This is a summary sheet from an Excel program created by Hun Seak Park while at the Pollution Liability Insurance Agency (PLIA) and modified by Ecology staff. For this particular composition, the allowable soil concentration is controlled by the predicted concentration of benzene (4.95 ug/l) in the ground water.

Table 12: 4-Phase Model Results for BP #24 (least weathered composition with HI<1 at 100 PPM in the Soil)

Solid:	25.5%
Air:	0.6%
Water:	1.5%
NAPL:	72.4%
	100.0%

	Equilibrium Composition %	Protective Soil ppm	Predicted G.W.	
Aliphatics	BP #24		· ·	
EC >5-6	0.0%	0.00	0.00	
EC >6-8	0.1%	0.06	0	
EC >8-10	10.5%	10.98	2.8	
EC >10-12	31.4%	32.94	0.61	
EC >12-16	0.0%	0.00	0.00	
EC >16-21	0.0%	0.00	0.00	
<u>Aromatics</u>		0.00		
Benzene	0.0%	0.000	0.00	
Toluene	0.0%	0.00	0	
Ethylbenzene	0.0%	0.00	0	
Xylenes	0.0%	0.01	1	
EC >8-10	3.7%	3.93	71	
EC >10-12	21.2%	22.31	206	
EC >12-16	31.3%	32.84	88	
EC >16-21	0.0%	0.00	0	
EC >21-35	0.0%	0.00	0	
Naphthalene	1.8%	1.92	30	
MTBE	0.0%	0.00	0	
Total	100.0%	105.00	399	





Total soil porosity: default is 0.43	n	0.430	Unitless
Volumetric water content: default is 0.3	Qw	0.300	Unitless
Initial volumetric air content: default is 0.13	Qa	0.130	Unitless
Soil bulk density measured: default is 1.5	rb	1.500	kg/l
*or, use soil bulk density computed @solid density=2.65kg/l:		1.811	kg/l
Fraction Organic Carbon: default is 0.001	foc	0.0010	Unitless
Dilution Factor: default is 20	DF	20.0	Unitless

Soil Concentration: 105.00

Predicted Ground Water TPH (ug/l: 399 HI @ Predicted G.W. Concentration: 1.00

Volumetric NAPL Content, QNAPL: 0.000 0.03% NAPL Saturation (%), QNAPL/n: Type of model used for computation: 4-Phase Model Computation completed? Yes!

TPH Distribution @ 4-phase in soil pore system:

Total Mass distributed in Water Phase: 1.52% in Solid: 25.49%

Total Mass distributed in Air Phase: 0.62% in NAPL: 72.37%

Soil Concentration = 105.00

Gasoline composition is fresh product weathered until 100 PPM in the soil will pass, simulated by removal of mass in dissolved and vapor phases by successive model runs. This composition represents highly weathered gasoline with no detectable benzene in the soil.

This is a summary sheet from an Excel program created by Hun Seak Park while at the Pollution Liability Insurance Agency (PLIA) and modified by Ecology staff. For this particular composition, the allowable soil concentration is controlled by the predicted hazard index of the gasoline mixture in the ground water.