CONCISE EXPLANATORY STATEMENT
for the
Amendments
to the
Model Toxics Control Act
Cleanup Regulation
Chapter 173-340 WAC

Appendix D

Calculations for Method A Cleanup Levels

DEPARTMENT OF ECOLOGY

February 9, 2001

TO: Interested Persons

FROM: Pete Kmet, Senior Environmental Engineer
Toxics Cleanup Program

SUBJECT: Calculations for Table 720-1
Method A **Ground Water** Cleanup Levels

Attached are several spreadsheets providing background information leading to the Method A ground water cleanup levels in Table 720-1. These tables include:

Table 1: A **"quick summary"** illustrating the current Method A ground water cleanup levels, proposed ground water cleanup levels and a brief explanation of the reasoning for the new Method A values. The values that are proposed to be changed are highlighted with boxes.

Table 2: A **detailed compilation** of the information considered in the development of the Method A ground water cleanup levels. This includes: The current federal or state drinking water standard (MCL), the Method B drinking water value for each substance (both as a carcinogen and noncarcinogen), the practical quantitation limit, the pure substance solubility limit, and other relevant information such as natural background and odor thresholds, where available.

Table 3: Provides the assumptions used in calculating the Method B drinking water values for noncarcinogens.

Table 4: Provides the assumptions used in calculating the Method B drinking water values for carcinogens.

Table 1: Quick Summary -- Basis for Method A Groundwater Table Values

Parameter	CAS No.	Current Method A ug/l	Proposed Method A ug/l	Basis for Proposed Cleanup Level
Arsenic	7440-38-2	5	5	Natr'l bkgd--MCL exceeds allowable risk.
Benzene	71-43-2	5	5	MCL
Benzo(a)Pyrene	50-32-8	none	0.1	MCL adjusted to 1 X 10-5 risk. This can also be used as the total toxic equivalents for all cPAHs. See WAC 173-340-708(8).
Cadmium	7440-43-9	5	5	MCL
T Chromium	7440-47-3	50	50	Method B--based on Chromium VI. If just Cr (III) is present, can use 100 ug/l.
Chromium VI	18540-29-9	none	none	
Chromium III	16065-83-1	none	none	
DDT	50-29-3	0.1	0.3	Method B (current Method A value appears to be in error)
1,2 Dichloroethane	107-06-2	5	5	MCL
Ethylbenzene	100-41-4	30	700	MCL
Ethylene dibromide (EDB)	106-93-4	0.01	0.01	Method B adjusted to PQL--MCL exceeds allowable risk.
Lead	7439-92-1	5	15	MCL
Lindane	58-89-9	0.2	0.2	MCL
Methylene chloride	75-09-2	5	5	MCL
Mercury (inorganic)	7439-97-6	2	2	MCL
MTBE	1634-04-4	none	20	Lower limit of EPA Advisory level
Naphthalenes	91-20-3	none	160	Method B for naphthalene. This is a total of all naphthalene, 1-Methyl naphthalene & 2-Methyl Naphthalene in the water.
PAHs(carcinogenic)(1)	na	0.1	none	Replaced by Benzo(a)Pyrene, above.
PCB mixtures	1336-36-3	0.1	0.1	Method B adjusted to PQL (MCL exceeds MTCA allowable HQ and cancer risk). This is a total for all PCBs.
Tetrachloroethylene (PCE)	127-18-4	5	5	MCL
Toluene	108-88-3	40	1000	MCL
TPH (total)	14280-30-9	1,000	none	Replaced with TPH for specific products.
Gasoline	6842-59-6			
GRO w/o benzene			1,000	Equation 720-3, assuming no benzene is present in gasoline contaminated water.
GRO with benzene			800	Equation 720-3, assuming benzene restored to 5 ug/l.
Diesel			500	Equation 720-3.
Heavy Oils			500	Equation 720-3.
Electrical Insulating Oil			500	Equation 720-3.
1,1,1 Trichloroethane	71-55-6	200	200	MCL
Trichloroethylene	79-01-6	5	5	MCL
Vinyl Chloride	75-01-4	0.2	0.2	MCL adjusted to 1 X 10-5 risk.
Xylene (total)	1330-20-7	20	1000	Not to exceed total TPH for gasoline & aesthetic considerations (odor)
Gross Alpha Particle Act.		15 pCi/l	15 pCi/l	MCL.
Gross Beta Particle Act.		4 mrem/yr	4 mrem/yr	MCL (4 mrem/yr equals 50 pCi/l)
Radium 226 & 228		5 pCi/l	5 pCi/l	MCL
Radium 226		3 pCi/l	3 pCi/l	MCL

Table 2: Summary Table for Method A Ground Water Values in Table 720-1

Basis for Method A Ground Water Table Values								
Parameter	CAS No.	MCL ug/l (1)	Method B Carc. ug/l (2)	Method B NonC.ug/l (3)	MTCA Risk @ MCL **HQ @ MCL** (4)	PQL ug/l (5)	Solubility Limit ug/l (6)	Other ug/l (7)
Arsenic	7440-38-2	50	0.058	4.8	8.6x10-4/**10**	2 (SW7060)		5 (natr'l bkgd)
Benzene	71-43-2	5	1.5	24	3.3X10-6/**0.21**	1 (SW8260B)	1,750,000	1,100 (odor)
Benzo(a)Pyrene	50-32-8	0.2	0.012		1.7X10-5	0.02 (SW8270C SIM)	1.6	
Cadmium	7440-43-9	5		8.0	**0.62**	0.1 (SW7131)		
T Chromium	7440-47-3	100			**2.1**	5 (SW6010A)		
Chromium VI	18540-29-9	none		48		2 (SW7196)		
Chromium III	16065-83-1	none		24,000		5 (SW6010A)		
DDT	50-29-3	none	0.26	8.0		0.1 (SW8081)	25	
1,2 Dichloroethane	107-06-2	5	0.48		1X10-5	1 (SW8260B)	8,520,000	
Ethylbenzene	100-41-4	700		800	**0.88**	1 (SW8260B)	169,000	120 (odor)
Ethylene dibromide (EDB)	106-93-4	0.05	0.00051		9.7X10-5	0.01 (EPA504.1)	4,000,000	
Lead	7439-92-1	zero/15				2 (SW7421)		5 (natr'l bkgd)
Lindane	58-89-9	0.2	0.067	4.8	3X10-6/**0.04**	0.1 (EPA504.1)	6,800	
Methylene chloride	75-09-2	5	5.8	480	8.6X10-7/**0.1**	1 (SW8260B)	13,000,000	
Mercury (inorganic)	7439-97-6	2		4.8	**0.4**	0.1 (SW7470)		
MTBE	1634-04-4	20-40				1 (SW8260B)	50,000,000	5 - 40 (odor)
Naphthalene	91-20-3	none		160		1 (SW8260B) (10)	31,000	15 (odor)
PAHs(carcinogenic)(8)	na	0.2	0.012		1.7X10-5	0.02 (SW8270C SIM)	1.6	
PCB mixtures(9)	1336-36-3	0.5	0.044	0.32	1.14X10-5/**1.6**	0.1 (SW8082)	12 to 57	

(1) Maximum contaminant level from 40 CFR 141.61 and WAC 246-290-310 except for lead and MTBE. MTBE is an EPA Advisory range.
Lead is the MCL goal of zero and the EPA action level from 40 CFR 141.80 for which no more than 10% of samples can exceed at the tap.
(2) Value calculated using equation 720-2 and cancer potency factor from IRIS or HEAST.
(3) Value calculated using equation 720-1 and reference dose from IRIS or HEAST [Except for benzene which uses a Rfd from the NCEA].
(4) Risk posed by MCL, calculated using equations 720-1 and 720-2. Non carcinogen related values are highlighted with bolding.
(5) From Manchester Laboratory.
(6) Source: EPA Soil Screening Guidance: Technical Background Document. EPA/540/R-95/12B. May, 1996, except EDB and PCB's from ATSDR Toxicological Profiles; and, MTBE from USGS final draft report on fuel oxygenates, March, 1996
(7) Odor threshold is median of values reported in literature. Background values for As and Pb from PTI, 1989.
(8) The cPAH values shown are based on benzo(a)pyrene.
(9) For PCBs, the noncarcinogenic risk is based on the Rfd for Arochlor 1254. The carcinogenic risk is based on the most potent CPF in IRIS.
(10) Use SW 8270C to measure all three types of naphthalene.

Table 2: Summary Table for Method A Ground Water Values in Table 720-1

Basis for Method A Ground Water Table Values								
Parameter	CAS No.	MCL ug/l (1)	Method B Carc. ug/l (2)	Method B NonC.ug/l (3)	MTCA Risk @ MCL HQ @ MCL (4)	PQL ug/l (5)	Solubility Limit ug/l (6)	Other ug/l (7)
Tetrachloroethylene (PCE)	127-18-4	5	0.86	80	5.8X10-6/0.06	1 (SW8260B)	200,000	
Toluene	108-88-3	1,000		1,600	0.62	1 (SW8260B)	526,000	500 (odor)
TPH (total)	14280-30-9	none						
Gasoline	6842-59-6	none				250 (NWTPH-Gx)	~100,000	340 (odor)
GRO w/o benzene				1,000				
GRO with benzene				800				
Diesel		none		500		250 (NWTPH-Gx)	<1,000-5,000	200 (odor)
Heavy Oils		none		500		500 (NWTPH-Dx)	<1,000-6,300	500 (odor)
Electrical Insulating Oil		none		500		500 (NWTPH-Dx)	~1,000-1,700	2,500 (odor)
1,1,1 Trichloroethane	71-55-6	200		7200	0.028	1 (SW8260B)	1,330,000	
Trichloroethylene	79-01-6	5	4.0		1.3X10-6	1 (SW8260B)	1,100,000	
Vinyl Chloride	75-01-4	2	0.023		8.7X10-5	0.01 (SW8260B SIM)	2,760,000	
Xylene (total)	1330-20-7	10,000		16,000	0.62	3 (SW8260B)	176,000	760 (odor)
Gross Alpha Particle Act.		15 pCi/l				4 pCi/l		0.25-3 pCi/l (natr'l bkgd)
Gross Beta Particle Act.		4 mrem/yr				1 pCi/l		3-9 pCi/l (natr'l bkgd)
Radium 226 & 228		5 pCi/l				0.2-0.7 pCi/l		0.3 pCi/l (natr'l bkgd)
Radium 226		3 pCi/l						<0.3 pCi/l (natr'l bkgd)

(1) Maximum contaminant level from 40 CFR 141.61 and WAC 246-290-310.

(2) Value calculated using equation 720-2 and cancer potency factor from IRIS or HEAST.

(3) Value calculated using equation 720-1 and reference dose from IRIS or HEAST. Basis for TPH values is documented in a May 18, 1999 memo by Steve Robb.

Gasoline w/benzene: Based on equation 720-3 using dissolved phase compostion derived with 4 phase model adjusted for benzene being present at the MCL of 5 PPB.

Gasoline w/o benzene: Based on equation 720-3 using dissolved phase composition derived with 4 phase model and assuming no benzene is present in water.

Diesel: Based on equation 720-3 using dissolved phase compostion derived with 4 phase model and in water/diesel partitioning experiment.

Heavy Oil: Based on equation 720-3 using dissolved phase compostion derived with 4 phase model and in water/diesel partitioning experiment.

Mineral Oil: Based on equation 720-3 using dissolved phase compostion derived with 4 phase model and in water/mineral oil partitioning experiment.

(4) Risk posed by MCL, calculated using equations 720-1 and 720-2. Non carcinogen related values are highlighted with bolding.

(5) PQLs from Manchester Laboratory, except radionuclides from Ecology's Nuclear Waste Program.

(6) Source: EPA Soil Screening Guidance: Technical Background Document. EPA/540/R-95/12B. May, 1996, except TPH from various sources. The value for total xylenes is a weighted average of m, o & p xylene based on gasoline composition data from TPH Criteria Working Group--Vol. 2 (May, 1998).

(7) Odor threshold is median of values reported in literature. Background for radionuclides from Ecology's Nuclear Waste Program.

Table 2: Summary Table for Method A Ground Water Values in Table 720-1

Parameter	Current Method A ug/l	Proposed Method A ug/l	Basis for Proposed Cleanup Level
Arsenic	5	5	Natr'l bkgd--MCL exceeds allowable risk.
Benzene	5	5	MCL
Benzo(a)Pyrene	none	0.1	Method B cleanup level for B(a)P. The total toxic equivalents of all cPAHs cannot exceed this value. See WAC 173-340-708(1).
Cadmium	5	5	MCL
T Chromium	50	50	Method B--based on Chromium VI.
Chromium VI	none	none	
Chromium III	none	none	
DDT	0.1	0.3	Method B (current Method A value appears to be in error)
1,2 Dichloroethane	5	5	MCL
Ethylbenzene	30	700	MCL
Ethylene dibromide (EDB)	0.01	0.01	Method B adjusted to PQL--MCL exceeds allowable risk.
Lead	5	15	MCL
Lindane	0.2	0.2	MCL
Methylene chloride	5	5	MCL
Mercury (inorganic)	2	2	MCL
MTBE	none	20	Lower limit of EPA Advisory level
Naphthalene(s)	none	160	Method B for naphthalene. This is a total of all naphthalene, 1-Methyl naphthalene & 2-Methyl Naphthalene in the water.
PAHs (carcinogenic)	0.1	none	Replaced by Benzo(a)Pyrene, above.
PCB mixtures	0.1	0.1	Method B adjusted to PQL (MCL exceeds MTCA allowable HQ and cancer risk). This is a total for all PCBs.

Table 2: Summary Table for Method A Ground Water Values in Table 720-1

Parameter	Current Method A ug/l	Proposed Method A ug/l	Basis for Proposed Cleanup Level
Tetrachloroethylene (PCE)	5	5	MCL
Toluene	40	1,000	MCL
TPH (total)	1,000	none	Replaced with TPH for specific products.
Gasoline			
GRO w/o benzene		1,000	Equation 720-3.
GRO with benzene		800	Equation 720-3.
Diesel		500	Equation 720-3.
Heavy Oils		500	Equation 720-3.
Electrical Insulating Oil		500	Equation 720-3.
1,1,1 Trichloroethane	200	200	MCL
Trichloroethylene	5	5	MCL
Vinyl Chloride	0.2	0.2	MCL adjusted to 1 X 10-5 risk.
Xylene (total)	20	1,000	Not to exceed maximum allowable total TPH for gasoline & aesthetic considerations (odor). This is the total of m, o & p xylenes.
Gross Alpha Particle Act.	15 pCi/l	15 pCi/l	MCL. [It is anticipated radionuclide cleanup standards will be subject to future review.]
Gross Beta Particle Act.	4 mrem/yr	4 mrem/yr	MCL (4 mrem/yr equals 50 pCi/l)
Radium 226 & 228	5 pCi/l	5 pCi/l	MCL
Radium 226	3 pCi/l	3 pCi/l	MCL

Table 3: Drinking Water -- Method B Calculations for Noncarcinogens

Risk Calculations--Noncarcinogenic Effects of Drinking Water Ingestion											
Parameter	CAS No.	Reference Dose (1) (mg/kg-day)	Avg. Body Weight (kg)	Unit Conv. Factor (ug/mg)	Hazard Quotient (unitless)	Drinking H2O Ing. Rate (liter/day)	Inhalation Corr. Factor (unitless)	Drinking H2O Fraction (unitless)	Method B Noncarc(2) (ug/l)	MCL(3) (ug/l)	HQ @ MCL(4) (unitless)
Arsenic	7440-38-2	0.0003	16	1,000	1	1.0	1	1.0	4.8	50	**10**
Benzene	71-43-2	0.003	16	1,000	1	1.0	2	1.0	24	5	0.2
Cadmium	7440-43-9	0.0005	16	1,000	1	1.0	1	1.0	8.0	5	0.6
T Chromium	7440-47-3	not available								100	
Chromium III	16065-83-1	1.5	16	1,000	1	1.0	1	1.0	24,000	none	
Chromium VI	18540-29-9	0.003	16	1,000	1	1.0	1	1.0	48	none	
DDT	50-29-3	0.0005	16	1,000	1	1.0	1	1.0	8.0	none	
1,2 Dichloroethane	107-06-2	not available								5	
Ethylbenzene	100-41-4	0.1	16	1,000	1	1.0	2	1.0	800	700	0.9
Ethylene dibromide (EDB)	106-93-4	not available								0.05	
Lead	7439-92-1	not available								zero / 15	
Lindane	58-89-9	0.0003	16	1,000	1	1.0	1	1.0	4.8	0.2	0.04
Methylene chloride	75-09-2	0.06	16	1,000	1	1.0	2	1.0	480	5	0.01
Mercury (inorganic)	7439-97-6	0.0003	16	1,000	1	1.0	1	1.0	4.8	2	0.4
MTBE	1634-04-4	not available								20-40	
Naphthalene	91-20-3	0.02	16	1,000	1	1.0	2	1.0	160	none	
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								0.2	
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 except for benzene which is from EPA's NCEA.
(2) Value calculated using equation 720-1 and default assumptions in that equation.
(3) Maximum contaminant level from 40 CFR 141.61 and WAC 246-290-310. Except for MTBE which is not an MCL but the EPA Advisory range.
For lead, this is the MCL goal of zero and an EPA action level from 40 CFR 141.80, for which no more than 10% of water samples can exceed at the tap.
(4) MCL divided by Method B value. Bolded values indicate MCL exceeds MTCA requirement that HQ not exceed 1.0.

Table 3: Drinking Water – Method B Calculations for Noncarcinogens

Risk Calculations--Noncarcinogenic Effects of Drinking Water Ingestion											
Parameter	CAS No.	Reference Dose (1) (mg/kg-day)	Avg. Body Weight (kg)	Unit Conv. Factor (ug/mg)	Hazard Quotient (unitless)	Drinking H2O Ing. Rate (liter/day)	Inhalation Corr. Factor (unitless)	Drinking H2O Fraction (unitless)	Method B Noncarc(2) (ug/l)	MCL(3) (ug/l)	HQ @ MCL(4) (unitless)
PCB mixtures	1336-36-3	not available								0.5	
High Risk & Persistence		not available									
Low Risk & Persistence		not available									
Lowest Risk & Persistence		not available									
Aroclor 1016	12674-11-2	0.00007	16	1,000	1	1.0	1	1.0	1.1	0.5	0.4
Arochlor 1248	12672-29-6	not available									
Arochlor 1254	11097-69-1	0.00002	16	1,000	1	1.0	1	1.0	0.32	0.5	**1.6**
Arochlor 1260		not available									
Tetrachloroethylene (PCE)	127-18-4	0.01	16	1,000	1	1.0	2	1.0	80	5	0.1
Toluene	108-88-3	0.2	16	1,000	1	1.0	2	1.0	1,600	1,000	0.6
1,1,1 Trichloroethane	71-55-6	0.9	16	1,000	1	1.0	2	1.0	7,200	200	0.03
Trichloroethylene	79-01-6	not available								5	
Vinyl Chloride	75-01-4	not available								2	
Xylenes	1330-20-7	2.0	16	1,000	1	1.0	2	1.0	16,000	10,000	0.6
m-Xylene	108-38-3	not available									
o-xylene	95-47-6	not available									
p-xylene		not available									
Gross Alpha Particle Act.		not available								15 pCi/l	
Gross Beta Particle Act.		not available								4 mrem/yr	
Radium 226 & 228		not available								5 pCi/l	
Radium 226		not available								3 pCi/l	
(1) Source of RfDs is EPA's IRIS database except for 1,1,1 TCE, which is from HEAST											
(2) Value calculated using equation 720-1 and default assumptions in that equation.											
(3) Maximum contaminant level from 40 CFR 141.61 and WAC 246-290-310.											
(4) MCL divided by Method B value. Bolded values indicate MCL exceeds MTCA requirement that HQ not exceed 1.0.											

Table 4: Drinking Water -- Method B Calculations for Carcinogens

Risk Calculations--Carcinogenic Effects of Drinking Water Ingestion													
Parameter	CAS No.	Risk (unitless)	Avg. Body Weight (kg)	Lifetime (years)	Unit Conv. Factor (ug/mg)	Cancer Potency Factor (kg-day/mg)	Drinking H_2O Ing. Rate (liter/day)	Duration of Exposure (years)	Inhalation Corr. Factor (unitless)	Drinking H_2O Fraction (unitless)	Method B Carcinogen (ug/l)	MCL(3) (ug/l)	Risk @ MCL(4) (unitless)
Arsenic	7440-38-2	0.000001	70	75	1,000	1.5	2.0	30	1	1.0	0.058	50	**857**
Benzene	71-43-2	0.000001	70	75	1,000	0.029	2.0	30	2	1.0	1.51	5	3.3
Cadmium	7440-43-9					not available						5	
T Chromium	7440-47-3											100	
Chromium III	16065-83-1					not available						none	
Chromium VI	18540-29-9					not available						none	
DDT	50-29-3	0.000001	70	75	1,000	0.34	2.0	30	1	1.0	0.26	none	
1,2 Dichloroethane	107-06-2	0.000001	70	75	1,000	0.091	2.0	30	2	1.0	0.48	5	10
Ethylbenzene	100-41-4					not available						700	
Ethylene dibromide (EDB)	106-93-4	0.000001	70	75	1,000	85	2.0	30	2	1.0	0.00051	0.05	**97**
Lead	7439-92-1					not available						zero / 15	
Lindane	58-89-9	0.000001	70	75	1,000	1.3	2.0	30	1	1.0	0.067	0.2	3.0
Methylene chloride	75-09-2	0.000001	70	75	1,000	0.0075	2.0	30	2	1.0	5.8	5	0.9
Mercury (inorganic)	7439-97-6					not available						2	
MTBE	1634-04-4					not available						20-40	
Naphthalene	91-20-3					not available						none	
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	0.000001	70	75	1,000	7.3	2.0	30	1	1.0	0.012	0.2	**17**
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 Cancer Potency Factor is the oral slope factors from EPA's IRIS database, except for Lindane which is from HEAST.
(2) Value calculated using equation 720-2 and default assumptions in that equation.
(3) Maximum contaminant level from 40 CFR 141.61 & 141.62 and WAC 246-290-310 except for lead and MTBE. MTBE is an EPA Advisory range.
Lead is the MCL goal of zero and the EPA action level from 40 CFR 141.80 for which no more than 10% of samples can exceed at the tap.
(4) MCL divided by Method B value. Bolded values indicate MCL greater than MTCA acceptable risk of 1X10-5 [i.e. >10].

Table 4: Drinking Water -- Method B Calculations for Carcinogens

Risk Calculations--Carcinogenic Effects of Drinking Water Ingestion													
Parameter	CAS No.	Risk	Avg. Body Weight	Lifetime	Unit Conv. Factor	Cancer Potency Factor	Drinking H2O Ing. Rate	Duration of Exposure	Inhalation Corr. Factor	Drinking H2O Fraction	Method B Carcinogen	MCL(3)	Risk @ MCL(4)
		(unitless)	(kg)	(years)	(ug/mg)	(kg-day/mg)	(liter/day)	(years)	(unitless)	(unitless)	(ug/l)	(ug/l)	(unitless)
PCB mixtures	1336-36-3												
High Risk & Persistence		0.000001	70	75	1,000	2.0	2.0	30	1	1.0		0.5	
Low Risk & Persistence		0.000001	70	75	1,000	0.4	2.0	30	1	1.0	0.044	0.5	**11**
Lowest Risk & Persistence		0.000001	70	75	1,000	0.07	2.0	30	1	1.0	0.22	0.5	2.3
Aroclor 1016	12674-11-2					not available					1.25	0.5	0.40
Arochlor 1248	12672-29-6					not available						0.5	
Arochlor 1254	11097-69-1					not available							
Arochlor 1260						not available						0.5	
Tetrachloroethylene (PCE)	127-18-4	0.000001	70	75	1,000	0.051	2.0	30	2	1.0	0.86	5	6
Toluene	108-88-3					not available						1,000	
1,1,1 Trichloroethane	71-55-6					not available						200	
Trichloroethylene	79-01-6	0.000001	70	75	1,000	0.011	2.0	30	2	1.0	4.0	5	1.3
Vinyl Chloride	75-01-4	0.000001	70	75	1,000	1.9	2.0	30	2	1.0	0.023	2	**87**
Xylenes	1330-20-7					not available						10,000	
m-Xylene	108-38-3					not available							
o-xylene	95-47-6					not available							
p-xylene						not available							
Gross Alpha Particle Act.						not available						15 pCi/l	
Gross Beta Particle Act.						not available						4 mrem/yr	
Radium 226 & 228						not available						5 pCi/l	
Radium 226						not available						3 pCi/l	

(1) Source of Cancer Potency Factor is the oral slope factors from EPA's IRIS database, except for tetrachloroethylene, trichlorothylene and vinyl chloride which are from HEAST.

(2) Value calculated using equation 720-2 and default assumptions in that equation.

(3) Maximum contaminant level from 40 CFR 141.61 and WAC 246-290-310.

(4) MCL divided by Method B value. Bolded values indicate MCL greater than MTCA acceptable risk of 1X10-5 [i.e. >10].

DEPARTMENT OF ECOLOGY

February 9, 2001

TO: Interested Persons

FROM: Pete Kmet, Senior Environmental Engineer P. Kmet
Toxics Cleanup Program

SUBJECT: Calculations for Table 740-1; Method A **Soil** Cleanup Levels
for Unrestricted Land Uses

Attached are several spreadsheets providing background information leading to the Method A soil cleanup levels in Table 740-1. These tables include:

Table 1: A **"quick summary"** illustrating the current Method A soil cleanup levels, proposed Method A soil cleanup levels, and a brief explanation of the reasoning for the new Method A values. The values that are proposed to be changed are highlighted with boxes.

Table 2: A **detailed compilation** of the information considered in the development of the Method A soil cleanup levels. This includes: The Method B direct contact values for soil ingestion and soil ingestion plus dermal (skin) absorption (for both carcinogenic effects and noncarcinogenic effects), the Method B soil leaching values using the 100 X ground water rule and the proposed 3 and 4 phase models, the proposed terrestrial ecological evaluation values, values from other laws, the practical quantitation limit, natural background, and other relevant information.

Table 3: Describes the assumptions and equation used to calculate the Method B values assuming **soil ingestion** (for carcinogens).

Table 4: Describes the assumptions and equation used to calculate the Method B values assuming **soil ingestion** (for noncarcinogens).

Table 5: Describes the assumptions and equation used to calculate the Method B values assuming **concurrent soil ingestion plus dermal** (skin) absorption (for carcinogens).

Table 6: Describes the assumptions and equation used to calculate the Method B values assuming **concurrent soil ingestion plus dermal (skin) absorption** (for noncarcinogens).

Table 7: Describes the assumptions and equations used to calculate soil concentrations protective of drinking water using the proposed **3 phase leaching model.**

Tables 8-12 **4-Phase model results** summary sheets for 2 brands of fresh **gasoline** and these same gasolines using various weathered compositions.

Table 1: Quick Summary – Basis for Method A, Table 740-1, Unrestricted Land Use Soil Values

Hazardous Substance	CAS Number	Current Method A Cleanup Level mg/kg	Proposed Method A Cleanup Level mg/kg	Basis for Standard
Arsenic	7440-38-2	20.0	20	Soil ingestion using equation 740-2, and leaching using 3-phase model, adjusted for natural background (1).
Benzene	71-43-2	0.5	0.03	Protection of drinking water – based on both 3 and 4 phase models.
Benzo(a)Pyrene	50-32-8	none	0.1	Soil ingestion using equation 740-2. This can also be used as the total toxic equivalents for all cPAHs. See WAC 173-340-708(8).
Cadmium	7440-43-9	2	2	Protection of drinking water, adjusted for PQL.
Chromium (total)	7440-47-3	100.0	none	Replaced by values for Cr III and Cr VI.
Chromium VI	18540-29-9		19	Protection of drinking water--3 phase model.
Chromium III	16065-83-1		2000	Protection of drinking water--3 phase model.
DDT	50-29-3	1	3	Soil ingestion using equation 740-2.
Ethylbenzene	100-41-4	20.0	6	Protection of drinking water--3 phase model.
Ethylene dibromide (EDB)	106-93-4	0.001	0.005	Protection of drinking water--3 phase model, adjusted for PQL.
Lead	7439-92-1	250.0	250	Soil ingestion. See 1991 responsiveness summary for explaination of calculation. (1)
Lindane	58-89-9	1	0.01	Protection of drinking water--3 phase model, adjusted for PQL.
Methylene chloride	75-09-2	0.5	0.02	Protection of drinking water--3 phase model.
Mercury (inorganic)	7439-97-6	1	2	Protection of drinking water--3 phase model.
MTBE	1634-04-4	none	0.1	Protection of drinking water--3 phase model.
Naphthalenes	91-20-3	none	5	Protection of drinking water--3 phase model. Total of all naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.
PAHs (carcinogenic)		1.0	none	Replaced by Benzo(a)Pyrene, above.
PCB Mixtures	1336-36-3	1	1	ARAR. This is a total value for all PCBs in the soil sample.
Tetrachloroethylene	127-18-4	0.5	0.05	Protection of drinking water--3 phase model.
Toluene	108-88-3	40.0	7	Protection of drinking water--3 phase model.
1,1,1 Trichloroethane	71-55-6	20	2	Protection of drinking water--3 phase model.
Trichloroethylene	79-01-5	0.5	0.03	Protection of drinking water--3 phase model.
Xylenes	1330-20-7	20.0	9	Protection of drinking water--3 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 water--4 phase model, assuming weathered gasoline composition.
GRO w/o benzene		100	100 (3)	Protection of drinking water--4 phase model, assuming highly weathered gasoline composition.
Diesel Range Organics		200	2000	Protection of drinking water--residual saturation
Heavy Oils		200	2000	Protection of drinking water--residual saturation for diesel.
Electrical Insulating Mineral Oil		200 (2)	4000	Protection of drinking water--residual saturation

(1) Ecology decision not to change at this time. Ecology intends to review and, if appropriate, update these values in a future rulemaking.
(2) Ecology has also issued a fact sheet (#95-157-TCP) allowing the use of 2000 mg/kg at electrical substations and switchyards.
(3) To use this value no benzene must be present in the soil and the total of ethyl benzene, toluene & xylene must be less than 1% of the gasoline mixture.

Table 2: Summary Table for Method A Soil Cleanup Values in Table 740-1

Method A Soil Cleanup Levels -for Unrestricted Land Uses										
Hazardous Substance	CAS Number	Current Method A Cleanup Level mg/kg (1)	Ingestion Carcinogen mg/kg (2)	Ingestion Noncarc. mg/kg (3)	Dermal + Ingestion Carcinogen mg/kg (4)	Dermal + Ingestion Noncarc. mg/kg (5)	Leaching 3-Phase M odel mg/kg (6)	100 X Ground water C/U level mg/kg (7)	Vapor mg/kg (8)	Other mg/kg (9)
Arsenic	7440-38-2	20.0	0.67	24	0.62	22	2.9	0.5		
Benzene	71-43-2	0.5	34	240	34		0.028	0.5		0.028
Benzo(a)Pyrene	50-32-8	none	0.14		0.10		0.23/1.9 (11)	0.01		
Cadmium	7440-43-9	2.0		80		74	0.69	0.5		
Chromium (total)	7440-47-3	100.0								
Chromium VI	18540-29-9			240		128	19	5		100
Chromium III	16065-83-1			120,000		45,000	2,000	10		
DDT	50-29-3	1.0	2.9	40	2.7	37	4.1	0.03		
Ethylbenzene	100-41-4	20.0		8,000		7,400	6.1	70		
Ethylene dibromide (EDB)	106-93-4	0.001	0.012		0.011		0.00005	0.001		
Lead	7439-92-1	250.0		250/370(10)			3,000	1.5		
Lindane	58-89-9	1.0	0.77	24	0.65	20	0.0062	0.02		
Methylene chloride	75-09-2	0.5	130	4,800	130	4,800	0.022	0.5		
Mercury (inorganic)	7439-97-6	1.0		24		18	2.1	0.2		
MTBE	1634-04-4	none					0.085	2		
Naphthalene	91-20-3	none		1,600		1,200	4.5	16		
PAHs (carcinogenic)(11)		1.0	0.14		0.10		0.23/1.9 (11)	0.01		
PCB Mixtures (12)	1336-36-3	1.0	0.5/2.5/14	1.6/5.6	0.4/1.8/10	1.2/4.1	0.2/1.6	0.01		
Tetrachloroethylene	127-18-4	0.5	20	800	18	740	0.053	0.5		
Toluene	108-88-3	40.0		16,000		15,000	7.3	100		
1,1,1 Trichloroethane	71-55-6	20.0		72,000		72,000	1.6	20		
Trichloroethylene	79-01-5	0.5	91		84		0.033	0.5		
Xylenes	1330-20-7	20.0		160,000		150,000	9.1	100		

(1) From WAC 173-340-740 Table 2 [1/26/96 revision].
(2) Calculated using equation 740-2.
(3) Calculated using equation 740-1.
(4) Calculated using equation 740-5. Except for petroleum mixtures, not used in setting cleanup levels since defaults not changed for other pathways.
(5) Calculated using equation 740-4. Except for petroleum mixtures, not used in setting cleanup levels since defaults not changed for other pathways.
(6) Calculated using equation 747-1 and proposed Table 720-1 ground water cleanup levels. Except for Cr III used 100 ppb and for PAHs used Method B value for B(a)P.
(7) Calculated using 1991 method of 100 X table 720-1 ground water cleanup level. Except for Cr III used 100 ppb.
(8) Vapor values not calculated.
(9) Benzene from 4 phase leaching model, assuming part of weathered gasoline mixture; Chromium VI is dust value documented in 1991 MTCA responsiveness summary.
(10) 1st value using IEUBK model with 200 mg/day soil ingestion rate and is also value documented in 1991 responsiveness summary; 2nd value using IEUBK model with EPA defaults.
(11) Based on benzo (a) pyrene. First value for 3-phase model results is using the Method B ground water cleanup level, the second value is using the Method A value in proposed Table 720-1.
(12) PCB values based on various arochlors and IRIS values for PCB mixtures.

Table 2: Summary Table for Method A Soil Cleanup Values in Table 740-1

Method A Soil Cleanup Levels -for Unrestricted Land Uses										
Hazardous Substance	CAS Number	Current Method A Cleanup Level mg/kg (1)	Ingestion Noncarc. mg/kg (2)	Dermal + Ingestion Noncarc. mg/kg (3)	Leaching Using 4-phase Model mg/kg (4)	Residual Saturation mg/kg (5)	100 X Ground water C/U level mg/kg (6)	Vapor mg/kg (7)		
TPH (total)	14280-30-9									
Gasoline range organics	6842-59-6	100								
GRO with benzene			4,700	4,700	1 / 23 to 28	1,000	80	unknown		
GRO without benzene					105	1,000	100	unknown		
Diesel Range Organics		200	3,900	3,000	No upper limit	2,000	50	>10,000		
Heavy Oils (8)		200	3,900	3,000	No upper limit	2,000	50	>10,000		
Electrical Insulating Mineral Oil		200 (9)	7,800	5,800	No upper limit	4,000	100	Not volatile		
(1) From WAC 173-340-740 Table 2 [1/26/96 revision].										
(2) Calculated using surrogates. See 1/29/99 Steve Robb memo.										
(3) Calculated using surrogates and equation 740-4. See 1/29/99 Steve Robb memo.										
(4) Calculated using 4 phase model. For GRO with benzene, 1st value assumes fresh gas (3% benzene); 2nd values assume weathered gas (~0.1% benzene)										
For GRO without benzene, assumes no benzene present in gasoline mixture and that ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture.										
For diesel, heavy oils and mineral oil, "no upper limit" means HI of 1 never exceeded. This is true only if the soil is above the water table.										
(5) Residual saturation for coarse soils from Coen and Mercer for gas and diesel and BPA study for mineral oil.										
(6) Calculated using 1991 method of 100 X table 720-1 proposed ground water cleanup level.										
(7) Gasoline vapors not calculated. The current Method A value of 100 ppm thought to be protective for vapor pathway. Diesel vapors based on qualitative observations at sites by PLIA.										
(8) Based on diesel composition.										
(9) Ecology has also issued a fact sheet (#95-157-TCP) allowing the use of 2000 mg/kg at electrical substations and switchyards.										

Table 2: Summary Table for Method A Soil Cleanup Values in Table 740-1

Method A Soil Cleanup Levels -for Unrestricted Land Uses

Hazardous Substance	Ecological Simplified Evaluation mg/kg (1)	Ecological Indicator Concentration mg/kg (2)	Most Stringent Non-Eco Path mg/kg	Controlling Non-Eco Pathway	ARARs mg/kg	PQL mg/kg (3)	Background mg/kg (4)	Current Method A mg/kg	Proposed Standard mg/kg	Basis for Standard
Arsenic	20	7	0.7	Ingestion		1 (SW7060)	7 & 20	20	20	Natural background. (5)
Benzene			0.03	Leaching		0.005 (SW8260B)		0.5	0.03	Protection of drinking water--4 phase model
Benzo(a)Pyrene	30	12	0.1	Ingestion		0.05 (SW8270C)		none	0.1	Ingestion (7)
Cadmium	25	4	0.69	Leaching		2 (SW6010A)	1	2.0	2	Leaching, adjusted for PQL. (6)
Chromium (total)	42	42				2 (SW6010A)	42	100		
Chromium VI			19	Leaching		1 (SW3060A)			19	Protection of drinking water--3 phase model.
Chromium III			2,000	Leaching		2 (SW6010A)			2000	Protection of drinking water--3 phase model.
DDT	1	0.75	2.9	Ingestion		0.05 (SW8081)		1.0	3	Ingestion.
Ethylbenzene			6.1	Leaching		0.005 (SW8260B)		20	6	Protection of drinking water--3 phase model.
Ethylene dibromide (EDB)			0.00005	Leaching		0.005 (SW8260B)		0.001	0.005	Leaching, adjusted for PQL
Lead	220	50	250	Ingestion		5.0 (SW6010A)	17	250	250	Ingestion (5)
Lindane	10	6	0.0062	Leaching		0.01 (SW8081)		1.0	0.01	Leaching, adjusted for PQL
Methylene chloride			0.022	Leaching		0.005 (SW8260B)		0.5	0.02	Protection of drinking water--3 phase model.
Mercury (inorganic)	9	0.1	2.1	Leaching		0.1 (SW7471)	0.07	1.0	2	Protection of drinking water--3 phase model.
MTBE			0.085	Leaching		0.005 (SW8260B)		none	0.1	Protection of drinking water--3 phase model.
Naphthalenes			4.5	Leaching		0.5 (SW8260B)		none	5	Protection of drinking water--3 phase model. (9)
PAHs (carcinogenic)	30	12	0.1	Ingestion		0.05 (SW8270C)		1.0	none	Replaced with benzo(a)pyrene.
PCB Mixtures	2	0.65	0.2	Leaching	1.0	0.04 (SW8082)		1.0	1	ARAR (8)
Tetrachloroethylene			0.05	Leaching		0.005 (SW8260B)		0.5	0.05	Protection of drinking water--3 phase model.
Toluene		200	7.3	Leaching		0.005 (SW8260B)		40	7	Protection of drinking water--3 phase model.
1,1,1 Trichloroethane			1.6	Leaching		0.005 (SW8260B)		20	2	Protection of drinking water--3 phase model.
Trichloroethylene			0.033	Leaching		0.005 (SW8260B)		0.5	0.03	Protection of drinking water--3 phase model.
Xylenes			9.1	Leaching		0.015 (SW8260B)		20	9	Protection of drinking water--3 phase model.

(1) Value from Table 749-2 for unrestricted land use. For reference only, not used in developing Method A values.
(2) Most stringent indicator value from Table 749-3. For reference only, not used in developing Method A values.
(3) From Manchester Lab
(4) For arsenic, 1st value from upper 90% for WA State, documented in report #94-115 and 2nd value from a 1989 report by PTI Environmental Services. All others upper 90% in WA State from report # 94-115.
(5) Ecology decision not to change at this time. Ecology intends to review and, if appropriate, update these values in a future rulemaking.
(6) For cadmium, there are two possible PQLs: 0.1 PPM using SW7131 and 2 PPM using SW6010A. The later has been used since this is the more commonly used test method.
(7) This can also be used as the total toxic equivalents for all cPAHs. See WAC 173-340-708(8).
(8) Cleanup level is sum of all PCBs. ARAR is for high occupancy areas with no cap, from 40 CFR Part 761.61 (EPA rule governing disposal and cleanup of PCB contaminated facilities under TSCA).
(9) This is a total of all naphthalene, 1-Methyl naphthalene & 2-Methyl Naphthalene. Also, use SW 8270C to measure all three types of naphthalene.

Table 2: Summary Table for Method A Soil Cleanup Values in Table 740-1

Method A Soil Cleanup Levels -for Unrestricted Land Uses

Hazardous Substance	Ecological Simplified Evaluation mg/kg (1)	Ecological Indicator Concentration mg/kg (2)	Most Stringent Non-Eco Path mg/kg	Controlling Non-Eco Pathway	ARARs mg/kg	PQL mg/kg (3)	Background mg/kg	Current Method A mg/kg	Proposed Standard mg/kg	Basis for Standard
TPH (total)										
Gasoline range organics										
GRO with benzene	200	100	23 to 28	Leaching		5 (NWTPH-Gx)	0	100	30	Protection of drinking water (4)
GRO without benzene	200	100	105	Leaching		5 (NWTPH-Gx)	0	100	100	Protection of drinking water (5)
Diesel Range Organics	460	200	2000	Leaching		25 (NWTPH-Dx)	0	200	2000	Residual Saturation
Heavy Oils (6)	460	200	2000	Leaching		100 (NWTPH-Dx)	0	200	2000	Residual Saturation
Electrical Insulating Mineral Oil			4000	Leaching		100 (NWTPH-Dx)	0	200 (7)	4000	Residual Saturation

(1) Value from Table 749-2 for unrestricted land use. For reference only, not used in developing Method A values.
(2) Most stringent indicator value from Table 749-3. For reference only, not used in developing Method A values.
(3) From Manchester Lab.
(4) Based on 4-phase model results for weathered gasoline with 0.1% benzene, a typical value for gasoline contaminated sites.
(5) Based on 4-phase model results for weathered gasoline assuming no benzene present in soil and that ethyl benzene, toluene & xylene are less than 1% of the gasoline mixture.
(6) Based on diesel composition.
(7) Ecology has also issued a fact sheet (#95-157-TCP) allowing the use of 2000 mg/kg at electrical substations and switchyards.

Table 3: Soil Ingestion – Method B Calculations for Carcinogens

Risk Calculations–Carcinogenic Effects of Soil Ingestion													
Parameter	CAS No.	Risk	Avg. Body Weight	Lifetime	Unit Conv. Factor	Cancer Potency Factor	G.I. Abs. Fraction	Soil Ing. Rate	Duration of Exposure	Frequency of Contact	Method B Carcinogen	ARAR (3)	Risk @ ARAR(4)
		(unitless)	(kg)	(years)	(ug/mg)	(kg-day/mg)	(unitless)	(mg/day)	(years)	(unitless)	(mg/kg)	(mg/kg)	(unitless)
Arsenic (5)	7440-38-2	0.000001	16	75	1,000,000	1.5	1.0	200	6	1	0.67		
Benzene	71-43-2	0.000001	16	75	1,000,000	0.029	1.0	200	6	1	34		
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	0.000001	16	75	1,000,000	0.34	1.0	200	6	1	2.9		
Ethylbenzene	100-41-4					not available							
Ethylene dibromide (EDB)	106-93-4	0.000001	16	75	1,000,000	85	1.0	200	6	1	0.012		
Lead	7439-92-1					not available							
Lindane	58-89-9	0.000001	16	75	1,000,000	1.3	1.0	200	6	1	0.77		
Methylene chloride	75-09-2	0.000001	16	75	1,000,000	0.0075	1.0	200	6	1	133		
Mercury (inorganic)	7439-97-6					not available							
MTBE	1634-04-4					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	0.000001	16	75	1,000,000	7.3	1.0	200	6	1	0.14		
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 Cancer Potency Factor is the oral slope factors fromEPA's IRIS database, except for Lindane which is from HEAST.
(2) Value calculated using equation 740-2 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement.
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that risk not exceed 1 X 10-5 [i.e. >10].
(5) The MTCA CLARC tables currently use a GI absorbtion fraction of 0.4. That number is no longer thought to be valid and 1.0 is used here.

Table 3: Soil Ingestion – Method B Calculations for Carcinogens

Risk Calculations–Carcinogenic Effects of Soil Ingestio													
Parameter	CAS No.	Risk (unitless)	Avg. Body Weight (kg)	Lifetime (years)	Unit Conv. Factor (ug/mg)	Cancer Potency Factor (kg-day/mg)	G.I. Abs. Fraction (unitless)	Soil Ing. Rate (mg/day)	Duration of Exposure (years)	Frequency of Contact (unitless)	Method B Carcinogen (mg/kg)	ARAR (3) (mg/kg)	Risk @ ARAR(4) (unitless)
PCB mixtures	1336-36-3												
High Risk & Persistence		0.000001	16	75	1,000,000	2.0	1.0	200	6	1		1.0	
Low Risk & Persistence		0.000001	16	75	1,000,000	0.4	1.0	200	6	1	0.5	1.0	2.0
Lowest Risk & Persistence		0.000001	16	75	1,000,000	0.07	1.0	200	6	1	2.5	1.0	0.40
Aroclor 1016	12674-11-2					not available					14	1.0	0.07
Arochlor 1248	12672-29-6					not available							
Arochlor 1254	11097-69-1					not available							
Arochlor 1260						not available							
Tetrachloroethylene (PCE)	127-18-4	0.000001	16	75	1,000,000	0.051	1.0	200	6	1	20		
Toluene	108-88-3					not available							
1,1,1 Trichloroethane	71-55-6					not available							
Trichloroethylene	79-01-6	0.000001	16	75	1,000,000	0.011	1.0	200	6	1	91		
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 Factor is the oral slope factors from EPA's IRIS database, except for tetrachloroethylene, trichlorothylene and vinyl chloride which are from HEAST.
(2) Value calculated using equation 740-2 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement. Source for PCBs is 40 CFR Part 761.61(a)(4)(i)(A).
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that risk not exceed 1 X 10-5 [i.e. >10].

Table 4: Soil Ingestion -- Method B Calculations for Noncarcinogens

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion											
Parameter	CAS No.	Reference Dose (1) (mg/kg-day)	Avg. Body Weight (kg)	Unit Conv. Factor (ug/mg)	Hazard Quotient (unitless)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Frequency of Contact (unitless)	Method B Noncarc(2) (mg/kg)	ARAR (3) (mg/kg)	HQ @ ARAR (4) (unitless)
Arsenic (5)	7440-38-2	0.0003	16	1,000,000	1	200	1.0	1.0	24		
Benzene	71-43-2	0.003	16	1,000,000	1	200	1.0	1.0	240		
Cadmium	7440-43-9	0.001	16	1,000,000	1	200	1.0	1.0	80		
T Chromium	7440-47-3	not available									
Chromium III	16065-83-1	1.5	16	1,000,000	1	200	1.0	1.0	120,000		
Chromium VI	18540-29-9	0.003	16	1,000,000	1	200	1.0	1.0	240		
DDT	50-29-3	0.0005	16	1,000,000	1	200	1.0	1.0	40		
Ethylbenzene	100-41-4	0.1	16	1,000,000	1	200	1.0	1.0	8,000		
Ethylene dibromide (EDB)	106-93-4	not available									
Lead	7439-92-1	not available									
Lindane	58-89-9	0.0003	16	1,000,000	1	200	1.0	1.0	24		
Methylene chloride	75-09-2	0.06	16	1,000,000	1	200	1.0	1.0	4,800		
Mercury (inorganic)	7439-97-6	0.0003	16	1,000,000	1	200	1.0	1.0	24		
MTBE	1634-04-4	not available									
Naphthalene	91-20-3	0.02	16	1,000,000	1	200	1.0	1.0	1,600		
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 RfDs is EPA's IRIS database except for benzene which is from EPA's NCEA.
(2) Value calculated using equation 740-1 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement.
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that HQ not exceed 1.0.
(5) The MTCA CLARC tables currently use a GI absorbtion fraction of 0.4. That number is no longer thought to be valid and 1.0 is used here.

Table 4: Soil Ingestion -- Method B Calculations for Noncarcinogens

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion											
Parameter	CAS No.	Reference Dose (1) (mg/kg-day)	Avg. Body Weight (kg)	Unit Conv. Factor (ug/mg)	Hazard Quotient (unitless)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Frequency of Contact (unitless)	Method B Noncarc(2) (mg/kg)	ARAR (3) (mg/kg)	HQ @ ARAR (4) (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	16	1,000,000	1	200	1.0	1.0	5.6	1.0	0.2
Arochlor 1248	12672-29-6	not available									
Arochlor 1254	11097-69-1	0.00002	16	1,000,000	1	200	1.0	1.0	1.6	1.0	0.6
Arochlor 1260		not available									
Tetrachloroethylene (PCE)	127-18-4	0.01	16	1,000,000	1	200	1.0	1.0	800		
Toluene	108-88-3	0.2	16	1,000,000	1	200	1.0	1.0	16,000		
1,1,1 Trichloroethane	71-55-6	0.9	16	1,000,000	1	200	1.0	1.0	72,000		
Trichloroethylene	79-01-6	not available									
Xylenes	1330-20-7	2.0	16	1,000,000	1	200	1.0	1.0	160,000		
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 IRIS database except for 1,1,1, TCE which is from HEAST.
(2) Value calculated using equation 740-1 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement. Source for PCBs is 40 CFR Part 761.61(a)(4)(i)(A).
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that HQ not exceed 1.0.

Table 5: Method B Calculations for Carcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations–Carcinogenic Effects of Soil Ingestion + Dermal Contact																
Parameter	CAS No.	Risk	Avg. Body Weight	Averaging Time	Exposure Frequency	Exposure Duration	Soil Ing. Rate	G.I. Abs. Fraction	Oral CPF (1)	Unit Conv. Factor	Surface Area	Adherence Factor	Dermal Abs. Fraction	G.I. Abs. Conv. Factor	Dermal CPF (2)	Method B (3) 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)
Arsenic	7440-38-2	0.000001	16	27,375	365	6	200	1.0	1.5	1,000,000	2,200	0.2	0.03	0.95	1.6	0.62
Benzene	71-43-2	0.000001	16	27,375	365	6	200	1.0	0.029	1,000,000	2,200	0.2	0.0005	0.80	0.036	34
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	0.000001	16	27,375	365	6	200	1.0	0.34	1,000,000	2,200	0.2	0.03	0.70	0.49	2.7
Ethylbenzene	100-41-4								not available							
Ethylene dibromide (EDB)	106-93-4	0.000001	16	27,375	365	6	200	1.0	85	1,000,000	2,200	0.2	0.03	0.80	106	0.011
Lead	7439-92-1								not available							
Lindane	58-89-9	0.000001	16	27,375	365	6	200	1.0	1.3	1,000,000	2,200	0.2	0.04	0.50	2.6	0.65
Methylene chloride	75-09-2	0.000001	16	27,375	365	6	200	1.0	0.0075	1,000,000	2,200	0.2	0.0005	0.80	0.0094	133
Mercury (inorganic)	7439-97-6								not available							
MTBE	1634-04-4								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	0.000001	16	27,375	365	6	200	1.0	7.3	1,000,000	2,200	0.2	0.13	0.89	8.2	0.10
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 Cancer Potency Factor is the oral slope factors from EPA's IRIS database, except for Lindane which is from HEAST.
(2) Dermal CPF = Oral CPF/ GI abs conversion factor. The GI abs. factor is chemical specific. See equation 740-5 for defaults and 1/25/99 memo for chemical specific factors used here.
(3) Calculated using equation 740-5 and default assumptions.

Table 5: Method B Calculations for Carcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations–Carcinogenic Effects of Soil Ingestion + Dermal Contact																
Parameter	CAS No.	Risk	Avg. Body Weight	Averaging Time	Exposure Frequency	Exposure Duration	Soil Ing. Rate	G.I. Abs. Fraction	Oral CPF (1)	Unit Conv. Factor	Surface Area	Adherence Factor	Dermal Abs. Fraction	G.I. Abs. Conv. Factor	Dermal CPF (2)	Method B (3) 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		0.000001	16	27,375	365	6	200	1.0	2.0	1,000,000	2,200	0.2	0.14	0.81	2.5	0.36
Low Risk & Persistence		0.000001	16	27,375	365	6	200	1.0	0.4	1,000,000	2,200	0.2	0.14	0.81	0.49	1.8
Lowest Risk & Persistence		0.000001	16	27,375	365	6	200	1.0	0.07	1,000,000	2,200	0.2	0.14	0.81	0.0864	10
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	0.000001	16	27,375	365	6	200	1.0	0.051	1,000,000	2,200	0.2	0.03	0.80	0.064	18
Toluene	108-88-3								not available							
1,1,1 Trichloroethane	71-55-6								not available							
Trichloroethylene	79-01-6	0.000001	16	27,375	365	6	200	1.0	0.011	1,000,000	2,200	0.2	0.03	0.80	0.014	84
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 Factor is the oral slope factors from EPA's IRIS database, except for tetrachloroethylene, trichlorothylene and vinyl chloride which are from HEAST.
(2) Dermal CPF = Oral CPF/ GI abs conversion factor. The GI abs. factor is chemical specific. See equation 740-5 for defaults and 1/25/99 memo for chemical specific factors used here.
(3) Calculated using equation 740-5 and default assumptions.

Table 6: Method B Calculations for Noncarcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion + Dermal Contact																
Parameter	CAS No.	Hazard Index (unitless)	Avg. Body Weight (kg)	Averaging Time (days)	Exposure Frequency (days/yr)	Exposure Duration (years)	Oral Ref. Dose (1) (mg/kg-day)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Unit Conv. Factor (mg/kg)	G.I. Conv. Factor (unitless)	Dermal Rfd (2) (mg/kg-day)	Surface Area (cm^2)	Adherence Factor (mg/cm^2)	Dermal Abs. Fraction (unitless)	Method B Noncarc(2) (mg/kg)
Arsenic	7440-38-2	1	16	2,190	365	6	0.0003	200	1	1,000,000	0.95	0.00029	2,200	0.2	0.03	22
Benzene	71-43-2	1	16	2,190	365	6	0.003	200	1	1,000,000	0.80	0.0024	2,200	0.2	0.0005	
Cadmium	7440-43-9	1	16	2,190	365	6	0.001	200	1	1,000,000	0.025	0.000025	2,200	0.2	0.001	74
T Chromium	7440-47-3						not available									
Chromium III	16065-83-1	1	16	2,190	365	6	1.5	200	1	1,000,000	0.013	0.020	2,200	0.2	0.01	44,571
Chromium VI	18540-29-9	1	16	2,190	365	6	0.003	200	1	1,000,000	0.025	0.000075	2,200	0.2	0.01	128
DDT	50-29-3	1	16	2,190	365	6	0.0005	200	1	1,000,000	0.70	0.00035	2,200	0.2	0.03	37
Ethylbenzene	100-41-4	1	16	2,190	365	6	0.1	200	1	1,000,000	0.80	0.080	2,200	0.2	0.03	7,390
Ethylene dibromide (EDB)	106-93-4						not available									
Lead	7439-92-1						not available									
Lindane	58-89-9	1	16	2,190	365	6	0.0003	200	1	1,000,000	0.50	0.00015	2,200	0.2	0.04	20
Methylene chloride	75-09-2	1	16	2,190	365	6	0.06	200	1	1,000,000	0.80	0.048	2,200	0.2	0.0005	4,793
Mercury (inorganic)	7439-97-6	1	16	2,190	365	6	0.0003	200	1	1,000,000	0.07	0.000021	2,200	0.2	0.01	18
MTBE	1634-04-4						not available									
Naphthalene	91-20-3	1	16	2,190	365	6	0.02	200	1	1,000,000	0.89	0.018	2,200	0.2	0.13	1,211
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 EPA's IRIS database except for benzene which is from EPA's NCEA.
(2) Dermal RfD = Oral RfD X GI abs. conversion factor. The GI abs. factor is chemical specific. See equation 740-4 for defaults and 1/25/99 memo for chemical specific factors used here.
(3) Calculated using equation 740-4 and default assumptions.

Table 6: Method B Calculations for Noncarcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion + Dermal Contact

Parameter	CAS No.	Hazard Index (unitless)	Avg. Body Weight (kg)	Averaging Time (days)	Exposure Frequency (unitless)	Exposure Duration (years)	Oral Ref. Dose (1) (mg/kg-day)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Unit Conv. Factor (mg/kg)	G.I. Conv. Factor (unitless)	Dermal Rfd (2) (mg/kg-day)	Surface Area (mg/cm^2)	Adherence Factor (mg/cm^2)	Dermal Abs. Fraction (unitless)	Method B Noncarc(2) (mg/kg)
PCB mixtures	1336-36-3						not available									
High Risk & Persistence							not available									
Low Risk & Persistence							not available									
Lowest Risk & Persistence							not available									
Aroclor 1016	12674-11-2	1	16	2,190	365	6	0.00007	200	1	1,000,000	0.81	0.000057	2,200	0.2	0.14	4.1
Arochlor 1248	12672-29-6						not available									
Arochlor 1254	11097-69-1	1	16	2,190	365	6	0.00002	200	1	1,000,000	0.81	0.000016	2,200	0.2	0.14	1.2
Arochlor 1260							not available									
Tetrachloroethylene (PCE)	127-18-4	1	16	2,190	365	6	0.01	200	1	1,000,000	0.80	0.0080	2,200	0.2	0.03	739
Toluene	108-88-3	1	16	2,190	365	6	0.2	200	1	1,000,000	0.80	0.16	2,200	0.2	0.03	14,781
1,1,1 Trichloroethane	71-55-6	1	16	2,190	365	6	0.9	200	1	1,000,000	0.80	0.72	2,200	0.2	0.0005	71,901
Trichloroethylene	79-01-6						not available									
Xylenes	1330-20-7	1	16	2,190	365	6	2.0	200	1	1,000,000	0.80	1.6	2,200	0.2	0.03	147,806
m-Xylene	108-38-3						not available									
o-xylene	95-47-6						not available									
p-xylene							not available									

(1) Source of oral RfDs is EPA's IRIS database except for benzene which is from EPA's NCEA.
(2) Dermal RfD = Oral RfD X GI abs. conversion factor. This factor is chemical specific. See equation 740-4.
(3) Calculated using equation 740-4 and default assumptions.

Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results											
	CAS No.	Gd H_2O C/U Level (mg/l) (1)	Bulk Density (g/cc) (2)	Soil Water (cc/cc) (2)	Soil Air (cc/cc) (2)	H' (cc/cc) (3)	Koc (ml/g) (3)	foc (%) (4)	Kd (cc/g) (5)	Dilution Factor (dimensionless)	Soil C/U Level (mg/kg) (6)
Arsenic	7440-38-2	0.005	1.5	0.3	0.13	0	-	-	29	20	2.92
Benzene	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
DDT	50-29-3	0.0003	1.5	0.3	0.13	0.000332	677,934	0.1%	678	20	4.07
Ethyl Benzene	100-41-4	0.7	1.5	0.3	0.13	0.323	204	0.1%	0.204	20	6.05
Ethylene dibromide (EDB)	106-93-4	0.00001	1.5	0.3	0.13	0.0336	66	0.1%	0.066	20	0.000054
Lead	7439-92-1	0.015	1.5	0.3	0.13	0	-	-	10000	20	3000
Lindane	58-89-9	0.0002	1.5	0.3	0.13	0.000574	1,352	0.1%	1.4	20	0.0062
Methylene Chloride	75-09-2	0.005	1.5	0.3	0.13	0.0898	10	0.1%	0.010	20	0.022
Mercury (inorganic)	7439-97-6	0.002	1.5	0.3	0.13	0.467	-	-	52	20	2.09
MTBE	1634-04-4	0.02	1.5	0.3	0.13	0.018	11	0.1%	0.011	20	0.085
Naphthalene	91-20-3	0.16	1.5	0.3	0.13	0.0198	1,191	0.1%	1.191	20	4.46
cPAH Mixtures	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
Benzo[a]pyrene	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
Indeno[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

Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results	CAS No.	Gd H_2O C/U Level (mg/l) (1)	Bulk Density (g/cc) (2)	Soil Water (cc/cc) (2)	Soil Air (cc/cc) (2)	H' (cc/cc) (3)	Koc (ml/g) (3)	foc (%) (4)	Kd (cc/g) (5)	Dilution Factor (dimensionless)	Soil C/U Level (mg/kg) (6)
PCB Mixtures	1336-36-3										
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
Tetrachloroethylene (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 Trichloroethane	71-55-6	0.2	1.5	0.3	0.13	0.705	135	0.1%	0.135	20	1.58
Trichloroethylene	79-01-6	0.005	1.5	0.3	0.13	0.422	94	0.1%	0.094	20	0.033
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		1.0	1.5	0.3	0.13	0.314	311	0.1%	0.311	20	10.76

(1) Ground water cleanup level used for calculation. From proposed table 720-1 except for Cr III used 0.1 mg/l and for PAHs used Method B value for B(a)P.
If the Method A ground water cleanup level for B(a)P of 0.1 ug/l is used, the soil cleanup level becomes 1.94 mg/kg for B(a)P.
(2) From equation 747-1. Based on Soil Screening Guidance: Technical Background Document. EPA/540/R-95/12B. May, 1996
(3) Source: Soil Screening Guidance: Technical Background Document. EPA/540/R-95/12B. May, 1996. Exceptions are:
EDB values from ATSDR Toxicological Profile (TP 91/13);
MTBE from USGS final draft report on fuel oxygenates (March, 1996)
Arochlor values for Henry's constant and solubility limit from ATSDR Toxlicological Profile (Dec, 1998); Arochlor Koc from EPA 1994 draft of soil screening guidance
Values for total xylenes are a weighted average of m,o & p xylene based on gasoline composition data from TPH Criterial Working Group--Volume 2 (May 1998).
That is: m = 51% of total xylene; o = 28% of total xylene; and , p = 21% of total xylene.
H' for all metals except mercury assumed = zero. Mercury H' from EPA Soil Screening Guidance.
(4) Based on review of data available from the literature and WA State sites.
(5) From equation 747-2 for organics. For metals, based on review of data available from the literature and WA State sites.
(6) Calculated using equation 747-1 (3-phase model) with model defaults (as shown in this table) and ground water cleanup level shown in this table.

Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results												
	CAS No.	Pore Water Concentration (mg/l) (7)	Solubility (mg/l) (3)	NAPL in Soil? (8)	Csat (mg/kg) (9)	Pore Water Concentration (mg/l) (7)	Water Mass (mg/kg) (10)	Vapor Concentration (mg/m^3) (11)	Vapor Mass (mg/kg) (12)	Soil Concentration (mg/kg) (13)	Soil Mass (mg/kg) (14)	Sum Mass (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	1.0	-	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	17	0.0060	0.0012	0.0020	1.73E-07	4.07	4.07	4.07
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	0.020	9.0	0.00078	0.0010	0.0010	0.022
Mercury (inorganic)	7439-97-6	0.040	-	n/a	-	0.040	0.008	19	0.0016	2.08	2.08	2.09
MTBE	1634-04-4	0.40	50,000	No	10,628	0.40	0.080	7.2	0.00062	0.0044	0.0044	0.085
Naphthalene	91-20-3	3.2	31	No	43	3.2	0.64	63	0.0055	3.81	3.81	4.46
cPAH Mixtures	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]pyrene	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	53-70-3	0.00024	0.00249	No	4.5	0.00024	0.000048	1.45E-07	1.25E-11	0.43	0.43	0.43
Indeno[1,2,3-cd]pyrene	207-08-9	0.00024	0.000022	Yes	0.076	0.00024	0.000048	1.57E-05	1.36E-09	0.83	0.83	0.83

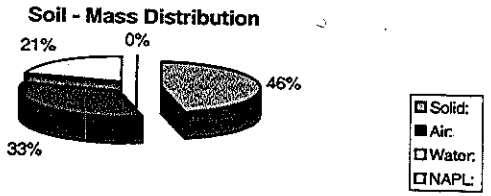
Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results												
	CAS No.	Pore Water Concentration (mg/l) (7)	Solubility (mg/l) (3)	NAPL in Soil? (8)	Csat (mg/kg) (9)	Pore Water Concentration (mg/l) (7)	Water Mass (mg/kg) (10)	Vapor Concentration (mg/m^3) (11)	Vapor Mass (mg/kg) (12)	Soil Concentration (mg/kg) (13)	Soil Mass (mg/kg) (14)	Sum Mass (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
Tetrachloroethylene (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 Trichloroethane	71-55-6	4.0	1,330	No	527	4.0	0.80	2820	0.24	0.54	0.54	1.58
Trichloroethylene	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 = ground water cleanup level X dilution factor
(8) There is NAPL in the soil if the pore water concentration exceeds the solubility limit.
(9) C sat is the soil concentration above which there is NAPL in the soil. It is calculated by substituting the solubility limit for the [ground water cleanup level X DF] in equation 747-1.
(10) Water mass = [Pore water concentration X soil water fraction] / soil bulk density. This is the mass of contaminant in the water phase.
(11) Vapor concentration = Pore water concentration X Henry's Constant X 1000.
(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 = Pore water concentration X Kd
(14) Soil mass = [Pore water concentration X Kd X soil bulk density] / soil bulk density. This is the mass of contaminant in the soil phase.
(15) Sum mass = water mass + vapor mass + soil mass. This value equals the soil cleanup level.

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 ppm	Predicted G.W. ug/l
Aliphatics	**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
Aromatics		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

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

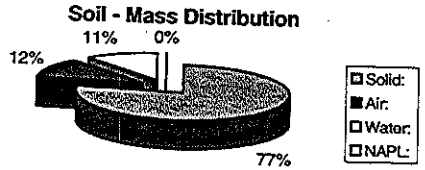
Volumetric NAPL Content, QNAPL :	NAPL phase is not existing!
NAPL Saturation (%), QNAPL/n:	N/A
Type of model used for computation:	3-Phase Model
Computation completed?	Yes!
TPH Distribution @ 4-phase in soil pore system:	
Total Mass distributed in Water Phase:	20.89% in Solid: 46.11%
Total Mass distributed 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 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%



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**ARCO 5**		
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
Aromatics		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

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**

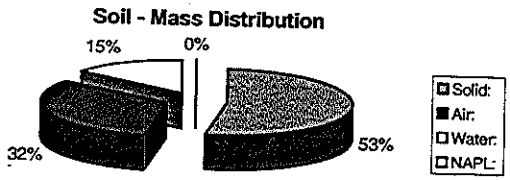
Volumetric NAPL Content, QNAPL :	NAPL phase is not existing!
NAPL Saturation (%), QNAPL/n:	N/A
Type of model used for computation:	3-Phase Model
Computation completed?	Yes!
TPH Distribution @ 4-phase in soil pore system:	
Total Mass distributed in Water Phase: 11.05%	in Solid: 77.18%
Total Mass distributed 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 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

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



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**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
Aromatics		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

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 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:	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 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%

Soil - Mass Distribution

	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**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
Aromatics			
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

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 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: 8.90% in Solid: 78.72%

Total Mass distributed in Air Phase: 12.37% in NAPL: NONE

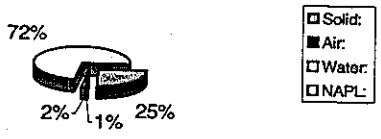
Soil Concentration = 22.00

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 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%

Soil - Mass Distribution



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**BP #24**		
EC >5-6	0.0000%	0.00	0.0
EC >6-8	0.0601%	0.06	0.2
EC >8-10	10.4590%	10.98	2.8
EC >10-12	31.3676%	32.94	0.6
EC >12-16	0.0000%	0.00	0.0
EC >16-21	0.0000%	0.00	0.0
Aromatics		0.00	
Benzene	0.0000%	0.000	0.0
Toluene	0.0000%	0.00	0.0
Ethylbenzene	0.0012%	0.00	0.1
Xylenes	0.0098%	0.01	0.7
EC >8-10	3.7452%	3.93	70.8
EC >10-12	21.2490%	22.31	205.9
EC >12-16	31.2770%	32.84	88.2
EC >16-21	0.0000%	0.00	0.0
EC >21-35	0.0000%	0.00	0.0
Naphthalene	1.8311%	1.92	30.1
MTBE	0.0000%	0.00	0.0
Total	100.0000%	105.00	399.3

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	
NAPL Saturation (%), QNAPL/n:	0.03%	
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 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

DEPARTMENT OF ECOLOGY

February 9, 2001

TO: Interested Persons

FROM: Pete Kmet, Senior Environmental Engineer PKmet
Toxics Cleanup Program

SUBJECT: Calculations for Table 745-1; Method A **Industrial Soil** Cleanup Levels For Industrial Properties

Attached are several spreadsheets providing background information leading to the Method A soil cleanup levels in Table 745-1. These tables include:

Table 1: A **"quick summary"** illustrating the current Method A soil cleanup levels, proposed Method A soil cleanup levels, and a brief explanation of the reasoning for the new Method A values. The values that are proposed to be changed are highlighted with boxes.

Table 2: A **detailed compilation** of the information considered in the development of the Method A soil cleanup levels. This includes: The Method C direct contact values for soil ingestion and soil ingestion plus dermal (skin) absorption (for both carcinogenic effects and noncarcinogenic effects), the Method C soil leaching values using the 100 X ground water rule and the proposed 3 phase model, the proposed terrestrial ecological evaluation values, values from other laws, the practical quantitation limit, natural background, and other relevant information.

Table 3: Describes the assumptions and equation used to calculate the Method C values assuming **soil ingestion** (for carcinogens).

Table 4: Describes the assumptions and equation used to calculate the Method C values assuming **soil ingestion** (for noncarcinogens).

Table 5: Describes the assumptions and equation used to calculate the Method C values assuming **concurrent soil ingestion plus dermal** (skin) absorption (for carcinogens).

Table 6: Describes the assumptions and equation used to calculate the Method C values assuming **concurrent soil ingestion plus dermal (skin) absorption** (for noncarcinogens).

Table 7: Describes the assumptions and equations used to calculate soil concentrations protective of drinking water using the proposed **3 phase leaching model.**

Tables 8-12 **4-Phase model results** summary sheets for 2 brands of fresh **gasoline** and these same gasolines using various weathered compositions.

Table 1: Quick Summary – Basis for Method A, Table 745-1, Industrial Land Use Soil Values

Hazardous Substance	CAS Number	Current Method A Cleanup Level mg/kg	Proposed Standard mg/kg	Basis for 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 water--based on both 3 and 4 phase models.
Benzo(a)Pyrene	50-32-8	none	2	Protection of drinking water--3 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 water--3 phase model.
Chromium III	16065-83-1		2000	Protection of drinking water--3 phase model.
DDT	50-29-3	5	4	Protection of drinking water--3 phase model.
Ethylbenzene	100-41-4	20	6	Protection of drinking water--3 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 water--3 phase model.
Mercury (inorganic)	7439-97-6	1	2	Protection of drinking water--3 phase model.
MTBE	1634-04-4	none	0.1	Protection of drinking water--3 phase model.
Naphthalenes	91-20-3	none	5	Protection of drinking water--3 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 water--3 phase model.
Toluene	108-88-3	40	7	Protection of drinking water--3 phase model.
1,1,1 Trichloroethane	71-55-6	20	2	Protection of drinking water--3 phase model.
Trichloroethylene	79-01-5	0.5	0.03	Protection of drinking water--3 phase model.
Xylenes	1330-20-7	20	9	Protection of drinking water--3 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 water--4 phase model, assuming weathered gasoline composition.
GRO w/o benzene		100	100 (5)	Protection of drinking water--4 phase model, assuming highly weathered gasoline composition.
Diesel Range Organics		200	2000	Protection of drinking water--residual saturation
Heavy Oils		200	2000	Protection of drinking water--residual saturation for diesel.
Electrical Insulating Mineral Oil		200 (4)	4000	Protection of drinking water--residual saturation

(1) Based on background value in table 740-1. Ecology intends to review and, if appropriate, update this value in a future rulemaking.
(2) This can also be used as the total toxic equivalents for all cPAHs. See WAC 173-340-708(8).
(3) Ecology decision not to change at this time. Ecology intends to review and, if appropriate, update this value in a future rulemaking.
(4) Ecology has also issued a fact sheet (#95-157-TCP) allowing the use of 2000 mg/kg at electrical substations and switchyards.
(5) To use this value no benzene must be present in the soil and the total of ethyl benzene, toluene & xylene must be less than 1% of the gasoline mixture.

Table 2: Summary Table for Method A Industrial Soil Cleanup Values in Table 745-1.

Method A Soil Cleanup Levels -for Industrial Land Uses										
Hazardous Substance	CAS Number	Current Method A Cleanup Level mg/kg (1)	Ingestion Carcinogen mg/kg (2)	Ingestion Noncarc. mg/kg (3)	Dermal + Ingestion Carcinogen mg/kg (4)	Dermal + Ingestion Noncarc. mg/kg (5)	Leaching 3-Phase M odel mg/kg (6)	100 X Ground water C/U level mg/kg (7)	Vapor mg/kg (8)	Other mg/kg (9)
Arsenic	7440-38-2	200.0	88.0	1,050	39	466	2.9	0.5		
Benzene	71-43-2	0.5	4,526	10,500	2,627		0.028	0.5		0.1
Benzo(a)Pyrene	50-32-8	none	18		4.3		0.23/1.9	0.01		
Cadmium	7440-43-9	10.0		3,500		1,460	0.69	0.5		
Chromium (total)	7440-47-3	500.0								
Chromium VI	18540-29-9			10,500		1,226	19	5		500
Chromium III	16065-83-1			pure		352,726	2,000	10		
DDT	50-29-3	5.0	386	1,750	158	715	4.1	0.03		
Ethylbenzene	100-41-4	20.0		350,000		148,655	6.1	70		
Ethylene dibromide (EDB)	106-93-4	0.001	1.5		0.66		0.00005	0.001		
Lead	7439-92-1	1000.0	1,000 (10)				3,000	1.5		
Lindane	58-89-9	20.0	101	1,050	33	341	0.0062	0.02		
Methylene chloride	75-09-2	0.5	17,500	210,000	10,157	121,878	0.022	0.5		
Mercury (inorganic)	7439-97-6	1.0		1,050		252	2.1	0.2		
MTBE	1634-04-4	none					0.085	2		
Naphthalene	91-20-3	none		70,000		16,613	4.5	16		
PAHs (carcinogenic)(11)		20.0	18		4.3		0.23	0.01		
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 745-1.
(4) Calculated using equation 745-5. For comparison only. Not used in setting cleanup levels since defaults not changed for other pathways.
(5) 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 747-1 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 level. Except for Cr III used 100 ppb and cPAH used current Method A value.
(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.
(12) PCB values based on various arochlors and IRIS values for PCB mixtures.

Table 2: Summary Table for Method A Industrial Soil Cleanup Values in Table 745-1.

Method A Soil Cleanup Levels -for Industrial Land Uses										
Hazardous Substance	CAS Number	Current Method A Cleanup Level mg/kg (1)	Ingestion Noncarc. mg/kg (2)	Dermal + Ingestion Noncarc. mg/kg (3)	Leaching Using 4-phase Model mg/kg (4)	Residual Saturation mg/kg (5)	100 X Ground water C/U level mg/kg (6)	Vapor mg/kg (7)		
TPH (total)	14280-30-9									
Gasoline range organics	6842-59-6	100								
GRO with benzene			210,000	150,000	1 / 23 to 28	1,000	80	unknown		
GRO without benzene					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	No upper limit	4,000	100	Not volatile		

(1) From WAC 173-340-740 Table 2 [1/26/96 revision].
(2) Calculated using surrogates. See 1/29/99 Steve Robb memo.
(3) Calculated using surrogates and equation 740-4. See 1/29/99 Steve Robb memo.
(4) Calculated using 4 phase model. For GRO with benzene, 1st value assumes fresh gas (3% benzene); 2nd values assume weathered gas (~0.1% benzene)
For GRO without benzene, assumes no benzene present in gasoline mixture and that ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture.
For diesel, heavy oils and mineral oil, "no upper limit" means HI of 1 never exceeded. This is true only if the soil is above the water table.
(5) Residual saturation for coarse soils from Coen and Mercer for gas and diesel and BPA study for mineral oil.
(6) Calculated using 1991 method of 100 X table 720-1 proposed ground water cleanup level.
(7) Gasoline vapors not calculated. The current Method A value of 100 ppm thought to be protective for vapor pathway. Diesel vapors based on qualitative observations at sites by PLIA.
(8) Based on diesel composition.
(9) Ecology has also issued a fact sheet (#95-157-TCP) allowing the use of 2000 mg/kg at electrical substations and switchyards.

Table 2: Summary Table for Method A Industrial Soil Cleanup Values in Table 745-1.

Method A Soil Cleanup Levels -for Industrial Land Uses										
Hazardous Substance	Ecological Simplified Evaluation mg/kg (1)	Ecological Indicator Concentration mg/kg (2)	Most Stringent Non-Eco Path mg/kg	Controlling Non-Eco Pathway	ARARs mg/kg	PQL mg/kg (3)	Background mg/kg (4)	Current Method A mg/kg	Proposed Standard mg/kg	Basis for Standard
Arsenic	20	7	2.9	Leaching		1 (SW7060)	7 & 20	200.0	20	Leaching, adjusted for background (5)
Benzene			0.1	Leaching		0.005 (SW8260)		0.5	0.1	Protection of drinking water--4 phase model
Benzo(a)Pyrene	300	12	1.9	Leaching		0.05 (SW8270)		none	2	Protection of drinking water--3 phase model (6)
Cadmium	36	14	0.69	Leaching		2 (SW6010A)	1	10.0	2	Leaching, adjusted for PQL (7)
Chromium (total)	135	67				2 (SW6010A)	42	500.0		
Chromium VI			19	Leaching		1 (SW3060A)			19	Protection of drinking water--3 phase model
Chromium III			2,000	Leaching		2 (SW6010A)			2000	Protection of drinking water--3 phase model
DDT	1	0.75	4.1	Leaching		0.05 (SW8081)		5.0	4	Protection of drinking water--3 phase model
Ethylbenzene			6.1	Leaching		0.005 (SW8260)		20.0	6	Protection of drinking water--3 phase model
Ethylene dibromide (EDB)			0.00005	Leaching		0.005 (SW8260)		0.001	0.001	Leaching, adjusted for PQL
Lead	220	118	1,000	Ingestion		5.0 (SW6010A)	17	1000.0	1000	Ingestion (8)
Lindane	10	6	0.0062	Leaching		0.01 (SW8081)		20.0	0.01	Leaching, adjusted for PQL
Methylene chloride			0.022	Leaching		0.005 (SW8260)		0.5	0.02	Protection of drinking water--3 phase model
Mercury (inorganic)	9	5.5	2.1	Leaching		0.1 (SW7471)	0.07	1.0	2	Protection of drinking water--3 phase model
MTBE			0.085	Leaching		0.005 (SW8260)		none	0.1	Protection of drinking water--3 phase model
Naphthalenes			4.5	Leaching		0.5 (SW8260)		none	5	Protection of drinking water--3 phase model (10)
PAHs (carcinogenic)	300	12	1.9	Leaching		0.05 (SW8270)		20.0	none	Replaced with benzo(a)pyrene.
PCB Mixtures	2	0.65	0.2	Leaching	10	0.04 (SW8082)		10.0	10	ARAR (9)
Tetrachloroethylene			0.053	Leaching		0.005 (SW8260)		0.5	0.05	Protection of drinking water--3 phase model
Toluene			7.3	Leaching		0.005 (SW8260)		40.0	7	Protection of drinking water--3 phase model
1,1,1 Trichloroethane			1.6	Leaching		0.005 (SW8260)		20.0	2	Protection of drinking water--3 phase model
Trichloroethylene			0.033	Leaching		0.005 (SW8260)		0.5	0.03	Protection of drinking water--3 phase model
Xylenes			9.1	Leaching		0.015 (SW8260)		20.0	9	Protection of drinking water--3 phase model

(1) Value from Table 749-2 for industrial land use. For reference only, not used in developing Method A values.
(2) Wildlife protection value from Table 749-3. For reference only, not used in developing Method A values.
(3) From Manchester Lab
(4) For arsenic, 1st value from upper 90% for WA State, documented in report #94-115 and 2nd value from a 1989 report by PTI Environmental Services. All others upper 90% in WA State from report # 94-115.
(5) Based on background value in table 740-1. Ecology intends to review and, if appropriate, update this value in a future rulemaking.
(6) This can also be used as the total toxic equivalents for all cPAHs. See WAC 173-340-708(8).
(7) For cadmium, there are two possible PQLs: 0.1 PPM using SW7131 and 2 PPM using SW6010A. The later has been used since this is the more commonly used test method.
(8) Ecology decision not to change current rule value at this time. Ecology intends to review and, if appropriate, update this value in a future rulemaking.
(9) Cleanup level is sum of all PCBs. ARAR is for low occupancy areas with a cap, from 40 CFR Part 761.61 (EPA rule governing disposal and cleanup of PCB contaminated facilities under TSCA).
(10) This is a total of all naphthalene, 1-Methyl naphthalene & 2-Methyl Naphthalene. Also, use SW 8270C to measure all three types of naphthalene.

Table 2: Summary Table for Method A Industrial Soil Cleanup Values in Table 745-1.

Method A Soil Cleanup Levels -for Industrial Land Uses										
Hazardous Substance	Ecological Simplified Evaluation mg/kg (1)	Ecological Indicator Concentration mg/kg (2)	Most Stringent Non-Eco Path mg/kg	Controlling Non-Eco Pathway	ARARs mg/kg	PQL mg/kg (3)	Background mg/kg	Current Method A mg/kg	Proposed Standard mg/kg	Basis for 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)		200 (7)	4000	Residual Saturation

(1) Value from Table 749-2 for unrestricted land use. For reference only, not used in developing Method A values.
(2) Most stringent indicator value from Table 749-3. For reference only, not used in developing Method A values.
(3) From Manchester Lab.
(4) Based on 4-phase model results for weathered gasoline with 0.1% benzene, a typical value for gasoline contaminated sites.
(5) Based on 4-phase model results for weathered gasoline assuming no benzene present in soil and that ethyl benzene, toluene & xylene are less than 1% of the gasoline mixture.
(6) Based on diesel composition.
(7) Ecology has also issued a fact sheet (#95-157-TCP) allowing the use of 2000 mg/kg at electrical substations and switchyards.

Table 3: Soil Ingestion -- Method C Industrial Soil Calculations for Carcinogens

Risk Calculations--Carcinogenic Effects of Soil Ingestio														
Parameter	CAS No.	Risk	Avg. Body Weight	Lifetime	Unit Conv. Factor	Cancer Potency Factor	G.I. Abs. Fraction	Soil Ing. Rate	Duration of Exposure	Frequency of Contact	Method B Carcinogen	ARAR (3)	Risk @ ARAR(4)
		(unitless)	(kg)	(years)	(ug/mg)	(kg-day/mg)	(unitless)	(mg/day)	(years)	(unitless)	(mg/kg)	(mg/kg)	(unitless)
Arsenic (5)	7440-38-2	0.00001	70	75	1,000,000	1.5	1.0	50	20	0.4	88		
Benzene	71-43-2	0.00001	70	75	1,000,000	0.029	1.0	50	20	0.4	4,526		
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	75	1,000,000	0.34	1.0	50	20	0.4	386		
Ethylbenzene	100-41-4					not available							
Ethylene dibromide (EDB)	106-93-4	0.00001	70	75	1,000,000	85	1.0	50	20	0.4	1.5		
Lead	7439-92-1					not available							
Lindane	58-89-9	0.00001	70	75	1,000,000	1.3	1.0	50	20	0.4	101		
Methylene chloride	75-09-2	0.00001	70	75	1,000,000	0.0075	1.0	50	20	0.4	17,500		
Mercury (inorganic)	7439-97-6					not available							
MTBE	1634-04-4					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	75	1,000,000	7.3	1.0	50	20	0.4	18		
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 Cancer Potency Factor is the oral slope factors fromEPA's IRIS database, except for Lindane which is from HEAST.
(2) Value calculated using equation 745-2 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement.
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that risk not exceed 1 X 10-5 [i.e. >10].
(5) The MTCA CLARC tables currently use a GI absorbtion fraction of 0.4. That number is no longer thought to be valid and 1.0 is used here.

Table 3: Soil Ingestion – Method C Industrial Soil Calculations for Carcinogens

Risk Calculations--Carcinogenic Effects of Soil Ingestio													
Parameter	CAS No.	Risk	Avg. Body Weight	Lifetime	Unit Conv. Factor	Cancer Potency Factor	G.I. Abs. Fraction	Soil Ing. Rate	Duration of Exposure	Frequency of Contact	Method B Carcinogen	ARAR (3)	Risk @ 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												
High Risk & Persistence		0.00001	70	75	1,000,000	2.0	1.0	50	20	0.4		1.0	
Low Risk & Persistence		0.00001	70	75	1,000,000	0.4	1.0	50	20	0.4	66	1.0	0.02
Lowest Risk & Persistence		0.00001	70	75	1,000,000	0.07	1.0	50	20	0.4	328	1.0	0.003
Aroclor 1016	12674-11-2					not available					1,875	1.0	0.001
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					not available							
1,1,1 Trichloroethane	71-55-6					not available							
Trichloroethylene	79-01-6	0.00001	70	75	1,000,000	0.011	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							

(1) Source of Cancer Potency Factor is the oral slope factors from EPA's IRIS database, except for tetrachloroethylene, trichlorothylene and vinyl chloride which are from HEAST.
(2) Value calculated using equation 745-2 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement. Source for PCBs is 40 CFR Part 761.61(a)(4)(i)(A).
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that risk not exceed 1 X 10-5 [i.e. >10].

Table 4: Soil Ingestion -- Method C Industrial Soil Calculations for Noncarcinogens

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion											
Parameter	CAS No.	Reference Dose (1) (mg/kg-day)	Avg. Body Weight (kg)	Unit Conv. Factor (ug/mg)	Hazard Quotient (unitless)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Frequency of Contact (unitless)	Method B Noncarc(2) (mg/kg)	ARAR (3) (mg/kg)	HQ @ ARAR (4) (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	0.003	70	1,000,000	1	50	1.0	0.4	10,500		
DDT	50-29-3	0.0005	70	1,000,000	1	50	1.0	0.4	1,750		
Ethylbenzene	100-41-4	0.1	70	1,000,000	1	50	1.0	0.4	350,000		
Ethylene dibromide (EDB)	106-93-4	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	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 RfDs is EPA's IRIS database except for benzene which is from EPA's NCEA.
(2) Value calculated using equation 740-1 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement.
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that HQ not exceed 1.0.
(5) The MTCA CLARC tables currently use a GI absorbtion fraction of 0.4. That number is no longer thought to be valid and 1.0 is used here.

Table 4: Soil Ingestion – Method C Industrial Soil Calculations for Noncarcinogens

Risk Calculations–Noncarcinogenic Effects of Soil Ingestion											
Parameter	CAS No.	Reference Dose (1) (mg/kg-day)	Avg. Body Weight (kg)	Unit Conv. Factor (ug/mg)	Hazard Quotient (unitless)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Frequency of Contact (unitless)	Method B Noncarc(2) (mg/kg)	ARAR (3) (mg/kg)	HQ @ ARAR (4) (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 IRIS database except for 1,1,1, TCE which is from HEAST.
(2) Value calculated using equation 740-1 and default assumptions in that equation.
(3) Applicable, relevant and appropriate requirement. Source for PCBs is 40 CFR Part 761.61(a)(4)(i)(A).
(4) ARAR divided by Method B value in column K. Bolded values indicate ARAR exceeds MTCA requirement that HQ not exceed 1.0.

Table 5: Method C Industrial Calculations for Carcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations–Carcinogenic Effects of Soil Ingestion + Dermal Contac																
Parameter	CAS No.	Risk	Avg. Body Weight	Averaging Time	Exposure Frequency	Exposure Duration	Soil Ing. Rate	G.I. Abs. Fraction	Oral CPF (1)	Unit Conv. Factor	Surface Area	Adherence Factor	Dermal Abs. Fraction	G.I. Conv. Factor	Dermal CPF (2)	Method B (3) 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)
Arsenic	7440-38-2	0.00001	70	27,375	250	20	50	1.0	1.5	1,000,000	2,500	0.2	0.03	0.95	1.6	38.84
Benzene	71-43-2	0.00001	70	27,375	250	20	50	1.0	0.029	1,000,000	2,500	0.2	0.0005	0.80	0.036	2,627
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							
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
Mercury (inorganic)	7439-97-6								not available							
MTBE	1634-04-4								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	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 Cancer Potency Factor is the oral slope factors fromEPA's IRIS database, except for Lindane which is from HEAST.
(2) Dermal CPF = Oral CPF/ GI abs conversion factor. The GI abs. factor is chemical specific. See equation 745-5 for defaults and 1/25/99 memo for chemical specific factors used here.
(3) Calculated using equation 745-5 and default assumptions.

Table 5: Method C Industrial Calculations for Carcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations–Carcinogenic Effects of Soil Ingestion + Dermal Contac																	
Parameter	CAS No.	Risk	Avg. Body Weight	Averaging Time	Exposure Frequency	Exposure Duration	Soil Ing. Rate	G.I. Abs. Fraction	Oral CPF (1)	Unit Conv. Factor	Surface Area	Adherence Factor	Dermal Abs. Fraction	G.I. Conv. Factor	Dermal CPF (2)	Method B (3) 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								not available							
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 Factor is the oral slope factors from EPA's IRIS database, except for tetrachloroethylene, trichlorothylene and vinyl chloride which are from HEAST.
(2) Dermal CPF = Oral CPF/ GI abs conversion factor. The GI abs. factor is chemical specific. See equation 745-5 for defaults and 1/25/99 memo for chemical specific factors used here.
(3) Calculated using equation 745-5 and default assumptions.

Table 6: Method C Industrial Calculations for Noncarcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion + Dermal Contact

Parameter	CAS No.	Hazard Index (unitless)	Avg. Body Weight (kg)	Averaging Time (days)	Exposure Frequency (days/yr)	Exposure Duration (years)	Oral Ref. Dose (1) (mg/kg-day)	Soil Ing. Rate (mg/day)	G.I. Abs. Fraction (unitless)	Unit Conv. Factor (mg/kg)	G.I. Conv. Factor (unitless)	Dermal Rfd (2) (mg/kg-day)	Surface Area (cm^2)	Adherence Factor (mg/cm^2)	Dermal Abs. Fraction (unitless)	Method B Noncarc(2) (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	1	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	0.1	50	1	1,000,000	0.80	0.080	2,500	0.2	0.03	148,655
Ethylene dibromide (EDB)	106-93-4						not available									
Lead	7439-92-1						not available									
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 EPA's IRIS database except for benzene which is from EPA's NCEA.
(2) Dermal RfD = Oral RfD X GI abs. conversion factor. The GI abs. factor is chemical specific. See equation 745-4 for defaults and 1/25/99 memo for chemical specific factors used here.
(3) Calculated using equation 745-4 and default assumptions.

Table 6: Method C Industrial Calculations for Noncarcinogens for Soil Ingestion plus Dermal Contact

Risk Calculations--Noncarcinogenic Effects of Soil Ingestion + Dermal Contact																
Parameter	CAS No.	Hazard Index	Avg. Body Weight	Averaging Time	Exposure Frequency	Exposure Duration	Oral Ref. Dose (1)	Soil Ing. Rate	G.I. Abs. Fraction	Unit Conv. Factor	G.I. Conv. Factor	Dermal Rfd (2)	Surface Area	Adherence Factor	Dermal Abs. Fraction	Method B 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						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						not available									
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									
o-xylene	95-47-6						not available									
p-xylene							not available									
(1) Source of oral RfDs is EPA's IRIS database except for benzene which is from EPA's NCEA.																
(2) Dermal RfD = Oral RfD X GI abs. conversion factor. This factor is chemical specific. See equation 745-4.																
(3) Calculated using equation 745-4 and default assumptions.																

Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results	CAS No.	Gd H_2O C/U Level (mg/l) (1)	Bulk Density (g/cc) (2)	Soil Water (cc/cc) (2)	Soil Air (cc/cc) (2)	H' (cc/cc) (3)	Koc (ml/g) (3)	foc (%) (4)	Kd (cc/g) (5)	Dilution Factor (dimensionless)	Soil C/U Level (mg/kg) (6)
Arsenic	7440-38-2	0.005	1.5	0.3	0.13	0	-	-	29	20	2.92
Benzene	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
DDT	50-29-3	0.0003	1.5	0.3	0.13	0.000332	386,977	0.1%	387	20	2.32
Ethyl Benzene	100-41-4	0.7	1.5	0.3	0.13	0.323	204	0.1%	0.204	20	6.05
Ethylene dibromide (EDB)	106-93-4	0.00001	1.5	0.3	0.13	0.0336	66	0.1%	0.066	20	0.000054
Lead	7439-92-1	0.015	1.5	0.3	0.13	0	-	-	10000	20	3000
Lindane	58-89-9	0.0002	1.5	0.3	0.13	0.000574	1,352	0.1%	1.4	20	0.0062
Methylene Chloride	75-09-2	0.005	1.5	0.3	0.13	0.0898	10	0.1%	0.010	20	0.022
Mercury (inorganic)	7439-97-6	0.002	1.5	0.3	0.13	0.467	-	-	52	20	2.09
MTBE	1634-04-4	0.02	1.5	0.3	0.13	0.018	11	0.1%	0.011	20	0.085
Naphthalene	91-20-3	0.16	1.5	0.3	0.13	0.0198	1,191	0.1%	1.191	20	4.46
cPAH 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
Benzo[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
Indeno[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

Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results											
	CAS No.	Gd H_2O C/U Level (mg/l) (1)	Bulk Density (g/cc) (2)	Soil Water (cc/cc) (2)	Soil Air (cc/cc) (2)	H' (cc/cc) (3)	Koc (ml/g) (3)	foc (%) (4)	Kd (cc/g) (5)	Dilution Factor (dimensionless)	Soil C/U Level (mg/kg) (6)
PCB Mixtures	1336-36-3										
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	0.422	94	0.1%	0.094	20	0.033
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		1.0	1.5	0.3	0.13	0.314	311	0.1%	0.311	20	10.76

(1) Ground water cleanup level used for calculation. From proposed table 720-1 except for Cr III used 0.1 mg/l and for PAHs used Method B value for B(a)P.
If the Method A ground water cleanup level for B(a)P of 0.1 ug/l is used, the soil cleanup level becomes 1.94 mg/kg for B(a)P.
(2) From equation 747-1. Based on Soil Screening Guidance: Technical Background Document. EPA/540/R-95/12B. May, 1996
(3) Source: Soil Screening Guidance: Technical Background Document. EPA/540/R-95/12B. May, 1996. Exceptions are:
EDB values from ATSDR Toxicological Profile (TP 91/13);
MTBE from USGS final draft report on fuel oxygenates (March, 1996)
Arochlor values for Henry's constant and solubility limit from ATSDR Toxlicological Profile (Dec, 1998); Arochlor Koc from EPA 1994 draft of soil screening guidance
Values for total xylenes are a weighted average of m,o & p xylene based on gasoline composition data from TPH Criterial Working Group--Volume 2 (May 1998).
That is: m = 51% of total xylene; o = 28% of total xylene; and , p = 21% of total xylene.
H' for all metals except mercury assumed = zero. H' for mercury from EPA Soil Screening Guidance.
DDT value for Koc based on 1994 Draft Soil Screening Guidance. If 1996 guidance is used, Koc = 677,934 and soil cleanup level equals 4.07 mg/kg.
(4) Based on review of data available from the literature and WA State sites.
(5) From equation 747-2 for organics. For metals, based on review of data available from the literature and WA State sites.
(6) Calculated using equation 747-1 (3-phase model) with model defaults (as shown in this table) and ground water cleanup level shown in this table.

Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results												
	CAS No.	Pore Water Concentration (mg/l) (7)	Solubility (mg/l) (3)	NAPL in Soil? (8)	Csat (mg/kg) (9)	Pore Water Concentration (mg/l) (7)	Water Mass (mg/kg) (10)	Vapor Concentration (mg/m^3) (11)	Vapor Mass (mg/kg) (12)	Soil Concentration (mg/kg) (13)	Soil Mass (mg/kg) (14)	Sum Mass (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	1.0	-	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	0.020	9.0	0.00078	0.0010	0.0010	0.022
Mercury (inorganic)	7439-97-6	0.040	-	n/a	-	0.040	0.008	19	0.0016	2.08	2.08	2.09
MTBE	1634-04-4	0.40	50,000	No	10,628	0.40	0.080	7.2	0.00062	0.0044	0.0044	0.085
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	53-70-3	0.00024	0.00249	No	4.5	0.00024	0.000048	1.45E-07	1.25E-11	0.43	0.43	0.43
Indeno[1,2,3-cd]pyrene	207-08-9	0.00024	0.000022	Yes	0.076	0.00024	0.000048	1.57E-05	1.36E-09	0.83	0.83	0.83

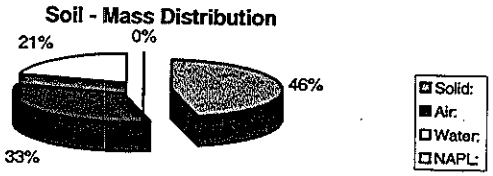
Table 7: 3-Phase Modeling Assumptions and Results

3-Phase Model Results												
	CAS No.	Pore Water Concentration (mg/l) (7)	Solubility (mg/l) (3)	NAPL in Soil? (8)	Csat (mg/kg) (9)	Pore Water Concentration (mg/l) (7)	Water Mass (mg/kg) (10)	Vapor Concentration (mg/m^3) (11)	Vapor Mass (mg/kg) (12)	Soil Concentration (mg/kg) (13)	Soil Mass (mg/kg) (14)	Sum Mass (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 = ground water cleanup level X dilution factor
(8) There is NAPL in the soil if the pore water concentration exceeds the solubility limit.
(9) C sat is the soil concentration above which there is NAPL in the soil. It is calculated by substituting the solubility limit for the [ground water cleanup level X DF] in equation 747-1.
(10) Water mass = [Pore water concentration X soil water fraction] / soil bulk density. This is the mass of contaminant in the water phase.
(11) Vapor concentration = Pore water concentration X Henry's Constant X 1000.
(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 = Pore water concentration X Kd
(14) Soil mass = [Pore water concentration X Kd X soil bulk density] / soil bulk density. This is the mass of contaminant in the soil phase.
(15) Sum mass = water mass + vapor mass + soil mass. This value equals the soil cleanup level.

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 ppm	Predicted G.W. ug/l
Aliphatics	**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
Aromatics		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

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

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:	20.89% in Solid: 46.11%
Total Mass distributed in Air Phase:	33.00% in NAPL: NONE

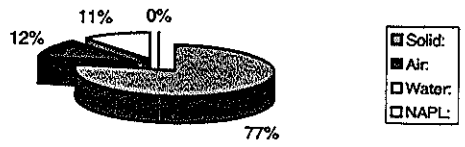
Soil Concentration = 0.90

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 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%

Soil - Mass Distribution



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**ARCO 5**		
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
Aromatics		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

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**

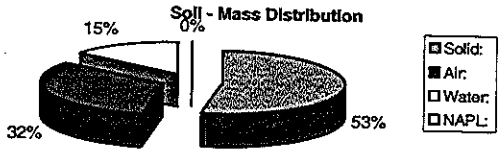
Volumetric NAPL Content, QNAPL :	NAPL phase is not existing!	
NAPL Saturation (%), QNAPL/n:	N/A	
Type of model used for computation:	3-Phase Model	
Computation completed?	Yes!	
TPH Distribution @ 4-phase in soil pore system:		
Total Mass distributed in Water Phase:	11.05%	in Solid: 77.18%
Total Mass 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 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

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



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**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
Aromatics		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

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 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: 14.75% in Solid: 52.87%
Total Mass distributed in Air Phase: 32.38% in NAPL: NONE

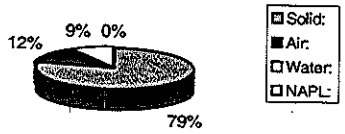
Soil Concentration = 1.00

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 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%

Soil - Mass Distribution



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
Aliphatics	**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
Aromatics			
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

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 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: 8.90% in Solid: 78.72%

Total Mass distributed in Air Phase: 12.37% in NAPL: NONE

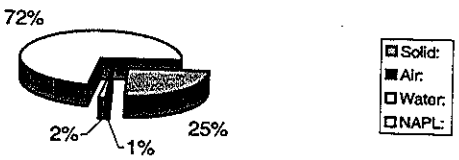
Soil Concentration = 22.00

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 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%

Soil - Mass Distribution



	Equilibrium Composition %	Protective Soil ppm	Predicted G.W. ug/l
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
Aromatics		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	
NAPL Saturation (%), QNAPL/n:	0.03%	
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 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