

Table 3. Alberta Tier 1 Hydrocarbon Guidelines for Fine Surface Soil

<i>Land Use</i>	<i>Exposure Pathway</i>	<i>Benzene</i> <i>(mg/kg)</i>	<i>Toluene</i> <i>(mg/kg)</i>	<i>Ethyl- benzene</i> <i>(mg/kg)</i>	<i>Xylenes</i> <i>(mg/kg)</i>	<i>B(a)P</i> <i>(mg/kg)</i>	<i>F1</i> <i>(mg/kg)</i>	<i>F2</i> <i>(mg/kg)</i>	<i>F3</i> <i>(mg/kg)</i>	<i>F4</i> <i>(mg/kg)</i>
Natural Area	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	14	300	450	1,200	F3	260	900	800	5,600
	Soil Ingestion (Wildlife)	93	5,200	3,400	14,000	F3	11,000	10,000	17,000	11,000
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>
	Protection of Groundwater for Wildlife *	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>
Agricultural	Human Soil Ingestion	1,200	22,000	10,000	RES	4.9	<u>15,000</u>	<u>8,000</u>	<u>18,000</u>	<u>25,000</u>
	Human Dermal Contact	2,700	RES	RES	RES	4.3	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation (basement) ¹	1.9	4,600	2,000	500	NA	<u>940</u>	<u>5,200</u>	<u>NA</u>	<u>NA</u>
	Human Vapour Inhalation (slab-on-grade) ¹	1.9	4,600	2,000	500	NA	<u>940</u>	<u>5,200</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	14	300	450	1,200	F3	260	900	800	5,600
	Soil Ingestion (Livestock)	33	1,800	1,200	4,900	F3	4,000	3,700	6,000	4,000
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>
Protection of Groundwater for Livestock	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>	
Residential	Human Soil Ingestion	1,200	22,000	10,000	RES	4.9	<u>15,000</u>	<u>8,000</u>	<u>18,000</u>	<u>25,000</u>
	Human Dermal Contact	2,700	RES	RES	RES	4.3	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation (basement)	1.9	4,600	2,000	500	NA	<u>940</u>	<u>5,200</u>	<u>NA</u>	<u>NA</u>
	Human Vapour Inhalation (slab-on-grade)	1.9	4,600	2,000	500	NA	<u>940</u>	<u>5,200</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	14	300	450	1,200	F3	260	900	800	5,600
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>
Commercial	Human Soil Ingestion	4,400	RES	RES	RES	18	<u>RES</u>	<u>29,000</u>	<u>RES</u>	<u>RES</u>
	Human Dermal Contact	9,700	RES	RES	RES	16	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation	9	22,000	9,700	2,400	NA	<u>4,600</u>	<u>25,000</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	38	450	690	1,500	F3	660	1,500	2,500	6,600
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>
Industrial	Human Soil Ingestion	4,400	RES	RES	RES	18	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Dermal Contact	9,700	RES	RES	RES	16	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation	9	22,000	9,700	2,400	NA	<u>4,600</u>	<u>25,000</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	38	450	690	1,500	F3	660	1,500	2,500	6,600
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	<u>TBD</u>	<u>TBD</u>	<u>NA</u>	<u>NA</u>

Guidelines apply for all substances. Pathways apply as per Sections 2.6, 4 and 5 of this document.

Notes:

1. this pathway can be excluded within 15 m of an oilfield wellhead;

bold = lowest value for each chemical and land use;

underlined = PHC guidelines adopted without change from CCME (2000);

* the potable groundwater, aquatic life, and groundwater for wildlife

pathways may not apply at a given site: see text for details;

BaP = benzo(a)pyrene;

all values are presented to two significant figures

RES = calculated value exceeds 30,000 mg/kg;

NA = not applicable;

TBD = to be determined;

F3 = ecological endpoints for B(a)P are included in the guideline for F3; and,

F1 to F4 = petroleum hydrocarbon fractions as defined by CCME (2000).

Table 4. Alberta Tier 1 Hydrocarbon Guidelines for Coarse Surface Soil

Land Use	Exposure Pathway	Benzene	Toluene	Ethylbenzene	Xylenes	B(a)P	F1	F2	F3	F4
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Natural Area	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	8.3	24	91	90	F3	130	450	400	2,800
	Soil Ingestion (Wildlife)	93	5,200	3,400	14,000	F3	11,000	10,000	17,000	11,000
	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Protection of Groundwater for Wildlife *	5.3	5,400	RES	RES	F3	16,000	15,000	NA	NA
Agricultural	Human Soil Ingestion	1,200	22,000	10,000	RES	4.9	<u>15,000</u>	<u>8,000</u>	<u>18,000</u>	<u>25,000</u>
	Human Dermal Contact	2,700	RES	RES	RES	4.3	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation (basement) ¹	0.077	200	88	22	NA	<u>50</u>	<u>240</u>	<u>NA</u>	<u>NA</u>
	Human Vapour Inhalation (slab-on-grade) ¹	0.048	120	54	14	NA	<u>30</u>	<u>150</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	8.3	24	91	90	F3	130	450	400	2,800
	Soil Ingestion (Livestock)	33	1,800	1,200	4,900	F3	4,000	3,700	6,000	4,000
	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
Residential	Protection of Groundwater for Livestock	2.2	2,200	16,000	25,000	F3	11,000	8,600	NA	NA
	Human Soil Ingestion	1,200	22,000	10,000	RES	4.9	<u>15,000</u>	<u>8,000</u>	<u>18,000</u>	<u>25,000</u>
	Human Dermal Contact	2,700	RES	RES	RES	4.3	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation (basement)	0.077	200	88	22	NA	<u>50</u>	<u>240</u>	<u>NA</u>	<u>NA</u>
	Human Vapour Inhalation (slab-on-grade)	0.048	120	54	14	NA	<u>30</u>	<u>150</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	8.3	24	91	90	F3	130	450	400	2,800
Commercial	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Human Soil Ingestion	4,400	RES	RES	RES	18	<u>RES</u>	<u>29,000</u>	<u>RES</u>	<u>RES</u>
	Human Dermal Contact	9,700	RES	RES	RES	16	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation	0.55	1,400	630	160	NA	310	<u>1,700</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
Industrial	Soil Contact (Plants and Invertebrates)	13	71	200	130	F3	330	760	1,700	3,300
	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Human Soil Ingestion	4,400	RES	RES	RES	18	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Dermal Contact	9,700	RES	RES	RES	16	<u>RES</u>	<u>RES</u>	<u>RES</u>	<u>RES</u>
	Human Vapour Inhalation	0.55	1,400	630	160	NA	310	<u>1,700</u>	<u>NA</u>	<u>NA</u>
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
Industrial	Soil Contact (Plants and Invertebrates)	13	71	200	130	F3	330	760	1,700	3,300
	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA

Guidelines apply for all substances. Pathways apply as per Sections 2.6, 4 and 5 of this document.

Notes:

1. this pathway can be excluded within 15 m of an oilfield wellhead;

bold = lowest value for each chemical and land use;

underlined = PHC guidelines adopted without change from CCME (2000);

* the potable groundwater, aquatic life, and groundwater for wildlife

pathways may not apply at a given site: see text for details;

BaP = benzo(a)pyrene;

all values are presented to two significant figures

RES = calculated value exceeds 30,000 mg/kg;

NA = not applicable;

TBD = to be determined; and,

F3 = ecological endpoints for B(a)P are included in the guideline for F3; and,

F1 to F4 = petroleum hydrocarbon fractions as defined by CCME (2000).

**Table 5. Alberta Hydrocarbon Guidelines for Fine Subsoil
Applicable below 1.5 m depth within 15 m radius of wellhead***

Land Use	Exposure Pathway	Benzene	Toluene	Ethyl- benzene	Xylenes	B(a)P	F1	F2	F3	F4
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Natural Area ¹	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	28	300	450	1,200	F3	<u>750</u>	<u>2,200</u>	<u>3,500</u>	<u>10,000</u>
	Soil Ingestion (Wildlife)	NA	NA	NA	NA	F3	NA	NA	NA	NA
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	TBD	TBD	NA	NA
	Protection of Groundwater for Wildlife *	RES	RES	RES	RES	F3	TBD	TBD	NA	NA
Agricultural ¹	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation (basement) ²	1.9	4,600	2,000	500	NA	<u>940</u>	<u>5,200</u>	NA	NA
	Human Vapour Inhalation (slab-on-grade) ²	1.9	4,800	2,100	520	NA	<u>990</u>	<u>5,500</u>	NA	NA
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	28	300	450	1,200	F3	<u>750</u>	<u>2,200</u>	<u>3,500</u>	<u>10,000</u>
	Soil Ingestion (Livestock)	NA	NA	NA	NA	F3	NA	NA	NA	NA
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	TBD	TBD	NA	NA
	Protection of Groundwater for Livestock	RES	RES	RES	RES	F3	TBD	TBD	NA	NA
Residential	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation (basement)	1.9	4,600	2,000	500	NA	<u>940</u>	<u>5,200</u>	NA	NA
	Human Vapour Inhalation (slab-on-grade)	1.9	4,800	2,100	520	NA	<u>990</u>	<u>5,500</u>	NA	NA
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	28	300	450	1,200	F3	<u>750</u>	<u>2,200</u>	<u>3,500</u>	<u>10,000</u>
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	TBD	TBD	NA	NA
Commercial	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation	9	23,000	9,800	2,500	NA	<u>4,800</u>	<u>26,000</u>	NA	NA
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	77	450	690	1,500	F3	<u>1,000</u>	<u>3,000</u>	<u>5,000</u>	<u>10,000</u>
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	TBD	TBD	NA	NA
Industrial	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation	9	23,000	9,800	2,500	NA	<u>4,800</u>	<u>26,000</u>	NA	NA
	Protection of Potable Groundwater *	0.073	0.86	0.19	25	NA	1,900	2,600	NA	NA
	Soil Contact (Plants and Invertebrates)	77	450	690	1,500	F3	<u>1,000</u>	<u>3,000</u>	<u>5,000</u>	<u>10,000</u>
	Protection of Groundwater for Aquatic Life *	RES	RES	RES	RES	F3	TBD	TBD	NA	NA

Guidelines apply for all substances. Pathways apply as per Sections 2.6, 4 and 5 of this document.

Notes: 1. subsoil guidelines are available at Tier 1 within 15 m of wellhead in natural area and agricultural; otherwise Tier 2B management is required.

2. this pathway can be excluded within 15 m of an oilfield wellhead;

bold = lowest value for each chemical and land use;

underlined = PHC guidelines adopted without change from CCME (2000);

* the potable groundwater, aquatic life, and groundwater for wildlife;

pathways may not apply at a given site: see text for details;

all values are presented to two significant figures

RES = calculated value exceeds 30,000 mg/kg;

NA = not applicable;

TBD = to be determined; and

BaP = benzo(a)pyrene

F3 = ecological endpoints for B(a)P are included in F3; and,

F1 to F4 = petroleum hydrocarbon fractions defined by CCME (2000c)

Table 6. Alberta Hydrocarbon Guidelines for Coarse Subsoil
Applicable below 1.5 m depth within 15 m radius of wellhead

Land Use	Exposure Pathway	Benzene	Toluene	Ethyl- benzene	Xylenes	B(a)P	F1	F2	F3	F4
		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Natural Area ¹	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	17	48	180	180	F3	350	1,500	2,500	10,000
	Soil Ingestion (Wildlife)	NA	NA	NA	NA	F3	NA	NA	NA	NA
	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Protection of Groundwater for Wildlife *	5.3	5,400	RES	RES	F3	16,000	15,000	NA	NA
Agricultural ¹	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation (basement) ²	0.077	200	88	22	NA	50	240	NA	NA
	Human Vapour Inhalation (slab-on-grade) ²	0.054	140	61	15	NA	40	190	NA	NA
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	17	48	180	180	F3	350	1,500	2,500	10,000
	Soil Ingestion (Livestock)	NA	NA	NA	NA	F3	NA	NA	NA	NA
	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Protection of Groundwater for Livestock	2.2	2,200	16,000	25,000	F3	11,000	8,600	NA	NA
Residential	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation (basement)	0.077	200	88	22	NA	50	240	NA	NA
	Human Vapour Inhalation (slab-on-grade)	0.054	140	61	15	NA	40	190	NA	NA
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	17	48	180	180	F3	350	1,500	2,500	10,000
Commercial	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation	0.58	1,500	660	170	NA	340	1,800	NA	NA
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	25	140	390	260	F3	700	2,000	3,500	10,000
Industrial	Protection of Groundwater for Aquatic Life *	1.6	0.16	79	59	F3	360	230	NA	NA
	Human Soil Ingestion	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Dermal Contact	NA	NA	NA	NA	NA	RES	RES	RES	RES
	Human Vapour Inhalation	0.58	1,500	660	170	NA	340	1,800	NA	NA
	Protection of Potable Groundwater *	0.13	1.6	0.36	49	NA	3,700	5,100	NA	NA
	Soil Contact (Plants and Invertebrates)	25	140	390	260	F3	700	2,000	3,500	10,000

Guidelines apply for all substances. Pathways apply as per Sections 2.6, 4 and 5 of this document.

Notes: 1. subsoil guidelines are available at Tier 1 within 15 m of wellhead in natural area and agricultural; otherwise Tier 2B management is required.

2. this pathway can be excluded within 15 m of an oilfield wellhead;

bold = lowest value for each chemical and land use;

underlined = PHC guidelines adopted without change from CCME (2000);

* the potable groundwater, aquatic life, and groundwater for wildlife;

pathways may not apply at a given site: see text for details;

all values are presented to two significant figures

RES = calculated value exceeds 30,000 mg/kg;

NA = not applicable;

TBD = to be determined; and

BaP = benzo(a)pyrene

F3 = ecological endpoints for B(a)P are included in F3; and,

F1 to F4 = petroleum hydrocarbon fractions defined by CCME (2000c)

F1 to F4 = petroleum hydrocarbon fractions as defined by CCME (2000).

Table 7. Alberta Hydrocarbon Guidelines for Groundwater

Criteria	Benzene (mg/L)	Toluene (mg/L)	Ethylbenzene (mg/L)	Xylenes (mg/L)	B(a)P (mg/L)	F1 (mg/L)	F2 (mg/L)
All Soils							
Human Drinking Water	0.005	0.024	0.0024	0.3	0.00001	4.6	2.1
Livestock Watering	0.51	29	19	76	NA	62	57
All Soils; Piezometers <10 m from Surface Water Body							
Freshwater Aquatic Life	0.370	0.002	0.090	0.180	NA	ND	ND
Wildlife Watering	1.2	69	45	180	NA	150	140
Coarse Soils; Piezometers >10 m from Surface Water Body							
Freshwater Aquatic Life	0.53	0.021	4.8	3.3	NA	NG	NG
Wildlife Watering	1.8	NG	NG	NG	NA	NG	NG
Fine Soils; Piezometers >10 m from Surface Water Body							
Freshwater Aquatic Life	NG	NG	NG	NG	NA	NG	NG
Wildlife Watering	NG	NG	NG	NG	NA	NG	NG

Notes:

NG = no guideline required for this pathway – limited by solubility from ever exceeding surface water criterion at 10 m offset;

NA = not applicable;

ND = not determined, due to uncertainties with the critical body residue method of determining aquatic toxicity; and,

see Volume 2 of this project for further explanation of values in this Table.