

US EPA ARCHIVE DOCUMENT

8.0 CRUDE OIL TANK SLUDGE

Tables 8.1 through 8.4 summarizes the risk results of crude oil tank sludge for onsite land treatment units. The pathway and media tables for the high-end risk for crude oil tank sludge treated in an onsite land treatment unit (close receptor/ long exposure duration) are presented in Tables 8.5 through 8.12. Results for offsite land treatment units are summarized in Tables 8.13 through 8.16. The pathway and media tables for the high-end risk for crude oil tank sludge treated in an offsite land treatment unit (close receptor/ long exposure duration) are presented in Tables 8.17 through 8.24.

**Table 8.1. Individual Risk for Crude Oil Tank Sludge Managed in Onsite Land Treatment Unit
Subsistence Fisher**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	5e-09	2e-09	7e-10	5e-10	1e-09	8e-10	7e-11	9e-09
	Small Area	6e-09	3e-09	1e-09	6e-10	1e-09	1e-09	1e-10	1e-08
	Met Location	8e-10	3e-10	1e-10	8e-11	2e-10	1e-10	1e-11	1e-09
	Quantity	3e-08	1e-08	4e-09	3e-09	6e-09	4e-09	4e-10	5e-08
	Distance to Receptor	7e-09	3e-09	1e-09	7e-10	1e-09	1e-09	1e-10	1e-08
	Maximum Conc.	1e-08	4e-09	2e-09	5e-10	3e-09	2e-09	1e-10	2e-08
	30 yr Exposure	2e-08	7e-09	2e-09	2e-09	4e-09	3e-09	2e-10	3e-08
Small Area	Met Location	1e-09	4e-10	2e-10	1e-10	2e-10	2e-10	2e-11	2e-09
	Quantity	4e-08	2e-08	6e-09	4e-09	8e-09	5e-09	5e-10	7e-08
	Distance to Receptor	1e-08	4e-09	2e-09	1e-09	2e-09	2e-09	2e-10	2e-08
	Maximum Conc.	1e-08	5e-09	3e-09	6e-10	3e-09	3e-09	2e-10	3e-08
	30 yr Exposure	2e-08	9e-09	3e-09	2e-09	4e-09	4e-09	3e-10	4e-08
Met Location	Quantity	5e-09	2e-09	7e-10	4e-10	1e-09	7e-10	7e-11	9e-09
	Distance to Receptor	1e-09	5e-10	3e-10	1e-10	3e-10	3e-10	3e-11	3e-09
	Maximum Conc.	2e-09	6e-10	3e-10	8e-11	4e-10	3e-10	2e-11	3e-09
	30 yr Exposure	3e-09	1e-09	4e-10	3e-10	6e-10	4e-10	4e-11	5e-09
Quantity	Distance to Receptor	4e-08	2e-08	6e-09	4e-09	9e-09	6e-09	6e-10	8e-08
	Maximum Conc.	6e-08	2e-08	1e-08	3e-09	2e-08	1e-08	9e-10	1e-07
	30 yr Exposure	1e-07	4e-08	1e-08	9e-09	2e-08	1e-08	1e-09	2e-07
Distance to Receptor	Maximum Conc.	1e-08	5e-09	3e-09	7e-10	4e-09	3e-09	2e-10	3e-08
	30 yr Exposure	2e-08	9e-09	4e-09	2e-09	5e-09	4e-09	3e-10	4e-08
Maximum Conc.	30 yr Exposure	3e-08	1e-08	6e-09	2e-09	9e-09	7e-09	5e-10	6e-08

**Table 8.2. Individual Risk for Crude Oil Tank Sludge Managed in Onsite Land Treatment Unit
Subsistence Farmer**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	6e-10	1e-08	1e-10	2e-11	4e-10	8e-11	1e-11	1e-08
	Small Area	7e-10	1e-08	1e-10	3e-11	4e-10	9e-11	1e-11	2e-08
	Met Location	6e-10	2e-08	1e-10	2e-11	5e-10	5e-11	8e-12	2e-08
	Quantity	4e-09	7e-08	7e-10	1e-10	2e-09	4e-10	6e-11	7e-08
	Distance to Receptor	2e-09	6e-08	4e-10	6e-11	2e-09	2e-10	3e-11	6e-08
	Maximum Conc.	1e-09	2e-08	3e-10	2e-11	9e-10	2e-10	2e-11	2e-08
	30 yr Exposure	3e-09	5e-08	5e-10	1e-10	2e-09	3e-10	4e-11	6e-08
Small Area	Met Location	8e-10	2e-08	1e-10	2e-11	6e-10	7e-11	1e-11	2e-08
	Quantity	4e-09	8e-08	8e-10	1e-10	2e-09	4e-10	6e-11	8e-08
	Distance to Receptor	3e-09	9e-08	6e-10	9e-11	3e-09	3e-10	4e-11	1e-07
	Maximum Conc.	1e-09	3e-08	4e-10	3e-11	1e-09	2e-10	2e-11	3e-08
	30 yr Exposure	3e-09	6e-08	6e-10	1e-10	2e-09	4e-10	5e-11	7e-08
Met Location	Quantity	4e-09	1e-07	6e-10	9e-11	3e-09	3e-10	5e-11	1e-07
	Distance to Receptor	3e-09	7e-08	4e-10	6e-11	2e-09	2e-10	3e-11	8e-08
	Maximum Conc.	1e-09	3e-08	3e-10	2e-11	1e-09	1e-10	2e-11	3e-08
	30 yr Exposure	3e-09	8e-08	5e-10	7e-11	2e-09	2e-10	3e-11	8e-08
Quantity	Distance to Receptor	1e-08	3e-07	2e-09	4e-10	1e-08	1e-09	2e-10	4e-07
	Maximum Conc.	7e-09	1e-07	2e-09	1e-10	5e-09	1e-09	1e-10	1e-07
	30 yr Exposure	2e-08	3e-07	3e-09	6e-10	9e-09	2e-09	3e-10	3e-07
Distance to Receptor	Maximum Conc.	5e-09	1e-07	1e-09	6e-11	4e-09	5e-10	7e-11	1e-07
	30 yr Exposure	1e-08	3e-07	2e-09	3e-10	7e-09	9e-10	1e-10	3e-07
Maximum Conc.	30 yr Exposure	5e-09	9e-08	1e-09	1e-10	4e-09	9e-10	1e-10	1e-07

**Table 8.3. Individual Risk for Crude Oil Tank Sludge Managed in Onsite Land Treatment Unit
Home Gardener**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	4e-09	7e-09	1e-09	5e-10	1e-09	1e-09	1e-10	1e-08
	Small Area	6e-09	9e-09	2e-09	7e-10	2e-09	2e-09	2e-10	2e-08
	Met Location	7e-10	7e-09	2e-10	7e-11	3e-10	2e-10	2e-11	8e-09
	Quantity	3e-08	4e-08	7e-09	3e-09	6e-09	6e-09	6e-10	8e-08
	Distance to Receptor	7e-09	3e-08	2e-09	7e-10	2e-09	2e-09	2e-10	4e-08
	Maximum Conc.	9e-09	1e-08	3e-09	5e-10	3e-09	3e-09	2e-10	3e-08
	30 yr Exposure	1e-08	2e-08	4e-09	2e-09	3e-09	3e-09	4e-10	5e-08
Small Area	Met Location	1e-09	9e-09	3e-10	9e-11	4e-10	2e-10	3e-11	1e-08
	Quantity	4e-08	5e-08	9e-09	4e-09	9e-09	7e-09	9e-10	1e-07
	Distance to Receptor	1e-08	4e-08	3e-09	1e-09	3e-09	3e-09	3e-10	6e-08
	Maximum Conc.	1e-08	2e-08	4e-09	7e-10	4e-09	4e-09	3e-10	4e-08
	30 yr Exposure	2e-08	3e-08	5e-09	2e-09	5e-09	5e-09	5e-10	6e-08
Met Location	Quantity	4e-09	4e-08	1e-09	4e-10	2e-09	9e-10	1e-10	5e-08
	Distance to Receptor	2e-09	3e-08	5e-10	1e-10	1e-09	4e-10	5e-11	3e-08
	Maximum Conc.	1e-09	1e-08	5e-10	7e-11	8e-10	4e-10	4e-11	2e-08
	30 yr Exposure	2e-09	2e-08	7e-10	2e-10	1e-09	5e-10	6e-11	3e-08
Quantity	Distance to Receptor	4e-08	2e-07	1e-08	4e-09	1e-08	9e-09	1e-09	2e-07
	Maximum Conc.	5e-08	7e-08	2e-08	3e-09	2e-08	1e-08	1e-09	2e-07
	30 yr Exposure	9e-08	1e-07	2e-08	9e-09	2e-08	2e-08	2e-09	3e-07
Distance to Receptor	Maximum Conc.	1e-08	5e-08	5e-09	7e-10	5e-09	4e-09	4e-10	7e-08
	30 yr Exposure	2e-08	9e-08	6e-09	2e-09	7e-09	5e-09	6e-10	1e-07
Maximum Conc.	30 yr Exposure	3e-08	4e-08	1e-08	2e-09	9e-09	9e-09	8e-10	9e-08

**Table 8.4. Individual Risk for Crude Oil Tank Sludge Managed in Onsite Land Treatment Unit
Adult Resident**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	3e-09	2e-09	6e-10	3e-10	6e-10	7e-10	7e-11	6e-09
	Small Area	4e-09	2e-09	9e-10	5e-10	8e-10	1e-09	1e-10	9e-09
	Met Location	4e-10	2e-10	1e-10	5e-11	9e-11	1e-10	1e-11	9e-10
	Quantity	2e-08	9e-09	4e-09	2e-09	3e-09	4e-09	4e-10	4e-08
	Distance to Receptor	4e-09	2e-09	1e-09	5e-10	9e-10	1e-09	1e-10	9e-09
	Maximum Conc.	6e-09	3e-09	2e-09	3e-10	1e-09	2e-09	1e-10	1e-08
	30 yr Exposure	9e-09	5e-09	2e-09	1e-09	2e-09	2e-09	2e-10	2e-08
Small Area	Met Location	6e-10	3e-10	2e-10	7e-11	1e-10	2e-10	2e-11	1e-09
	Quantity	2e-08	1e-08	5e-09	3e-09	5e-09	4e-09	5e-10	5e-08
	Distance to Receptor	7e-09	4e-09	2e-09	9e-10	1e-09	2e-09	2e-10	2e-08
	Maximum Conc.	9e-09	4e-09	3e-09	5e-10	2e-09	2e-09	2e-10	2e-08
	30 yr Exposure	1e-08	8e-09	3e-09	2e-09	3e-09	3e-09	3e-10	3e-08
Met Location	Quantity	3e-09	1e-09	7e-10	3e-10	6e-10	6e-10	6e-11	5e-09
	Distance to Receptor	1e-09	4e-10	3e-10	9e-11	2e-10	2e-10	3e-11	2e-09
	Maximum Conc.	9e-10	4e-10	3e-10	5e-11	2e-10	3e-10	2e-11	2e-09
	30 yr Exposure	1e-09	7e-10	4e-10	2e-10	3e-10	3e-10	4e-11	3e-09
Quantity	Distance to Receptor	3e-08	1e-08	6e-09	3e-09	6e-09	5e-09	6e-10	6e-08
	Maximum Conc.	4e-08	2e-08	1e-08	2e-09	9e-09	9e-09	8e-10	7e-08
	30 yr Exposure	6e-08	3e-08	1e-08	7e-09	1e-08	1e-08	1e-09	1e-07
Distance to Receptor	Maximum Conc.	9e-09	4e-09	3e-09	5e-10	2e-09	3e-09	2e-10	2e-08
	30 yr Exposure	1e-08	8e-09	3e-09	2e-09	3e-09	3e-09	3e-10	3e-08
Maximum Conc.	30 yr Exposure	2e-08	9e-09	6e-09	1e-09	5e-09	5e-09	5e-10	4e-08

**Table 8.5. Media Concentrations for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Long Exposure Duration
Subsistence Fisher**

Constituent	CAS	Soil Conc. (mg/kg)	Fish Conc. (mg/kg)	Combined Air Conc. (ug/m3)
Benzo(a)pyrene	50328	1.32e-02	1.58e-05	6.23e-06
Dibenz(a,h)anthracene	53703	6.42e-03	2.92e-06	8.56e-07
Benz(a)anthracene	56553	1.97e-02	1.19e-06	1.22e-05
Indeno(1,2,3-cd) pyrene	193395	2.91e-02	1.64e-05	4.79e-06
Benzo(b)fluoranthene	205992	1.62e-02	2.34e-05	8.88e-06
Benzo(k)fluoranthene	207089	1.36e-01	4.80e-05	1.99e-05
Chrysene	218019	6.72e-02	2.57e-06	2.40e-05

**Table 8.6. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Long Exposure Duration
Subsistence Fisher**

Constituent	CAS	Soil Ingestion	Fish Ingestion	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	6e-08	4e-08	4e-09	1e-07
Dibenz(a,h)anthracene	53703	3e-08	8e-09	NA	4e-08
Benz(a)anthracene	56553	1e-08	5e-10	NA	1e-08
Indeno(1,2,3-cd) pyrene	193395	7e-09	2e-09	NA	9e-09
Benzo(b)fluoranthene	205992	1e-08	1e-08	NA	2e-08
Benzo(k)fluoranthene	207089	1e-08	2e-09	NA	1e-08
Chrysene	218019	1e-09	3e-11	NA	1e-09
				Total Risk	2e-07

**Table 8.7. Media Concentrations for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Close Receptor
Subsistence Farmer**

Constituent	CAS	Soil Conc. (mg/kg)	Above Ground Veg Conc. (mg/kg)	Below-ground Veg Conc. (mg/kg)	Beef Conc. (mg/kg)	Milk Conc. (mg/kg)	Air Conc. (ug/m3)
Benzo(a)pyrene	50328	3.00e-04	1.56e-05	7.72e-06	NA	NA	3.20e-05
Dibenz(a,h)anthracene	53703	9.60e-05	1.19e-03	1.86e-06	NA	NA	4.42e-06
Benz(a)anthracene	56553	6.64e-04	2.73e-05	2.12e-05	NA	NA	6.30e-05
Indeno(1,2,3-cd) pyrene	193395	4.22e-04	1.29e-05	8.06e-06	NA	NA	2.47e-05
Benzo(b)fluoranthene	205992	4.54e-04	2.13e-04	1.37e-05	NA	NA	4.56e-05
Benzo(k)fluoranthene	207089	3.89e-03	5.83e-05	9.97e-05	NA	NA	1.07e-04
Chrysene	218019	1.99e-03	6.14e-05	6.09e-05	NA	NA	1.24e-04

**Table 8.8. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Close Receptor
Subsistence Farmer**

Constituent	CAS	Soil Ingestion	Fruit and Vegetable Ingestion	Below-ground Vegetable Ingestion	Beef Ingestion	Milk Ingestion	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	4e-10	4e-09	3e-09	NA	NA	7e-09	7e-09
Dibenz(a,h)anthracene	53703	1e-10	3e-07	7e-10	NA	NA	NA	3e-07
Benz(a)anthracene	56553	1e-10	1e-09	1e-09	NA	NA	NA	2e-09
Indeno(1,2,3-cd) pyrene	193395	3e-11	2e-10	2e-10	NA	NA	NA	4e-10
Benzo(b)fluoranthene	205992	1e-10	9e-09	8e-10	NA	NA	NA	1e-08
Benzo(k)fluoranthene	207089	1e-10	3e-10	7e-10	NA	NA	NA	1e-09
Chrysene	218019	1e-11	7e-11	1e-10	NA	NA	NA	2e-10
							Total Risk	4e-07

**Table 8.9. Media Concentrations for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Close Receptor
Home Gardener**

Constituent	CAS	Soil Conc. (mg/kg)	Above Ground Veg Conc. (mg/kg)	Below-ground Veg Conc. (mg/kg)	Air Conc. (ug/m3)
Benzo(a)pyrene	50328	1.32e-02	4.40e-05	7.20e-05	3.20e-05
Dibenz(a,h)anthracene	53703	6.42e-03	1.20e-03	2.63e-05	4.42e-06
Benz(a)anthracene	56553	1.97e-02	1.04e-04	1.41e-04	6.30e-05
Indeno(1,2,3-cd) pyrene	193395	2.91e-02	4.13e-05	1.15e-04	2.47e-05
Benzo(b)fluoranthene	205992	1.62e-02	2.66e-04	1.05e-04	4.56e-05
Benzo(k)fluoranthene	207089	1.36e-01	4.15e-04	9.14e-04	1.07e-04
Chrysene	218019	6.72e-02	2.98e-04	4.59e-04	1.24e-04

**Table 8.10. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Close Receptor
Home Gardener**

Constituent	CAS	Soil Ingestion	Fruit and Vegetable Ingestion Home Gardener	Below-ground Vegetable Ingestion Home Gardener	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	6e-08	4e-09	1e-08	7e-09	7e-08
Dibenz(a,h)anthracene	53703	3e-08	1e-07	4e-09	NA	2e-07
Benz(a)anthracene	56553	1e-08	2e-09	3e-09	NA	2e-08
Indeno(1,2,3-cd) pyrene	193395	7e-09	2e-10	9e-10	NA	8e-09
Benzo(b)fluoranthene	205992	1e-08	4e-09	2e-09	NA	2e-08
Benzo(k)fluoranthene	207089	1e-08	8e-10	3e-09	NA	2e-08
Chrysene	218019	1e-09	1e-10	3e-10	NA	1e-09
					Total Risk	3e-07

**Table 8.11. Media Concentrations for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Long Exposure Duration
Adult Resident**

Constituent	CAS	Soil Conc. (mg/kg)	Air Conc. (ug/m3)
Benzo(a)pyrene	50328	1.32e-02	6.23e-06
Dibenz(a,h)anthracene	53703	6.42e-03	8.56e-07
Benz(a)anthracene	56553	1.97e-02	1.22e-05
Indeno(1,2,3-cd) pyrene	193395	2.91e-02	4.79e-06
Benzo(b)fluoranthene	205992	1.62e-02	8.88e-06
Benzo(k)fluoranthene	207089	1.36e-01	1.99e-05
Chrysene	218019	6.72e-02	2.40e-05

**Table 8.12. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Onsite Land Treatment Unit
Large Quantity/Long Exposure Duration
Adult Resident**

Constituent	CAS	Soil Ingestion	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	6e-08	4e-09	6e-08
Dibenz(a,h)anthracene	53703	3e-08	NA	3e-08
Benz(a)anthracene	56553	1e-08	NA	1e-08
Indeno(1,2,3-cd) pyrene	193395	7e-09	NA	7e-09
Benzo(b)fluoranthene	205992	1e-08	NA	1e-08
Benzo(k)fluoranthene	207089	1e-08	NA	1e-08
Chrysene	218019	1e-09	NA	1e-09
			Total Risk	1e-07

**Table 8.13. Individual Risk for Crude Oil Tank Sludge Managed in Offsite Land Treatment Unit
Subsistence Fisher**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	5e-09	2e-09	5e-10	4e-10	1e-09	8e-10	5e-11	1e-08
	Small Area	2e-08	7e-09	3e-09	2e-09	3e-09	2e-09	2e-10	3e-08
	Met Location	1e-09	4e-10	1e-10	9e-11	2e-10	1e-10	1e-11	2e-09
	Quantity	1e-08	3e-09	1e-09	8e-10	2e-09	1e-09	1e-10	2e-08
	Distance to Receptor	6e-09	2e-09	6e-10	4e-10	1e-09	7e-10	5e-11	1e-08
	Maximum Conc.	1e-08	3e-09	1e-09	4e-10	3e-09	2e-09	1e-10	2e-08
	30 yr Exposure	2e-08	6e-09	2e-09	1e-09	4e-09	2e-09	2e-10	3e-08
Small Area	Met Location	2e-09	1e-09	4e-10	2e-10	5e-10	4e-10	4e-11	5e-09
	Quantity	3e-08	1e-08	4e-09	3e-09	6e-09	4e-09	4e-10	5e-08
	Distance to Receptor	3e-08	1e-08	5e-09	3e-09	5e-09	4e-09	5e-10	5e-08
	Maximum Conc.	3e-08	1e-08	7e-09	2e-09	8e-09	6e-09	5e-10	6e-08
	30 yr Exposure	5e-08	2e-08	9e-09	5e-09	1e-08	8e-09	8e-10	1e-07
Met Location	Quantity	2e-09	7e-10	2e-10	2e-10	4e-10	3e-10	2e-11	3e-09
	Distance to Receptor	1e-09	4e-10	2e-10	1e-10	3e-10	2e-10	2e-11	2e-09
	Maximum Conc.	2e-09	6e-10	3e-10	9e-11	6e-10	4e-10	2e-11	4e-09
	30 yr Exposure	3e-09	1e-09	4e-10	3e-10	7e-10	4e-10	3e-11	6e-09
Quantity	Distance to Receptor	1e-08	3e-09	1e-09	8e-10	2e-09	1e-09	1e-10	2e-08
	Maximum Conc.	2e-08	6e-09	3e-09	8e-10	6e-09	4e-09	2e-10	4e-08
	30 yr Exposure	3e-08	1e-08	3e-09	3e-09	8e-09	4e-09	3e-10	6e-08
Distance to Receptor	Maximum Conc.	1e-08	3e-09	2e-09	4e-10	3e-09	2e-09	1e-10	2e-08
	30 yr Exposure	2e-08	6e-09	2e-09	1e-09	4e-09	2e-09	2e-10	3e-08
Maximum Conc.	30 yr Exposure	4e-08	1e-08	5e-09	1e-09	1e-08	6e-09	4e-10	7e-08

**Table 8.14. Individual Risk for Crude Oil Tank Sludge Managed in Offsite Land Treatment Unit
Subsistence Farmer**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	9e-10	2e-08	2e-10	4e-11	5e-10	1e-10	2e-11	2e-08
	Small Area	1e-09	3e-08	3e-10	5e-11	9e-10	1e-10	2e-11	3e-08
	Met Location	8e-10	2e-08	1e-10	2e-11	6e-10	7e-11	1e-11	2e-08
	Quantity	2e-09	3e-08	4e-10	7e-11	1e-09	2e-10	3e-11	3e-08
	Distance to Receptor	2e-09	5e-08	4e-10	7e-11	1e-09	2e-10	3e-11	5e-08
	Maximum Conc.	2e-09	3e-08	5e-10	4e-11	1e-09	3e-10	4e-11	3e-08
	30 yr Exposure	4e-09	7e-08	8e-10	2e-10	2e-09	6e-10	7e-11	8e-08
Small Area	Met Location	2e-09	4e-08	3e-10	4e-11	1e-09	1e-10	2e-11	5e-08
	Quantity	2e-09	4e-08	4e-10	8e-11	1e-09	2e-10	3e-11	5e-08
	Distance to Receptor	9e-09	2e-07	1e-09	2e-10	6e-09	6e-10	1e-10	2e-07
	Maximum Conc.	3e-09	5e-08	7e-10	5e-11	2e-09	3e-10	4e-11	5e-08
	30 yr Exposure	6e-09	1e-07	1e-09	2e-10	4e-09	6e-10	9e-11	1e-07
Met Location	Quantity	2e-09	4e-08	2e-10	4e-11	1e-09	1e-10	2e-11	4e-08
	Distance to Receptor	2e-09	5e-08	3e-10	5e-11	1e-09	2e-10	2e-11	6e-08
	Maximum Conc.	2e-09	9e-08	6e-10	9e-11	3e-09	3e-10	5e-11	1e-07
	30 yr Exposure	4e-09	9e-08	6e-10	9e-11	3e-09	3e-10	5e-11	1e-07
Quantity	Distance to Receptor	4e-09	9e-08	7e-10	1e-10	3e-09	4e-10	6e-11	1e-07
	Maximum Conc.	4e-09	5e-08	9e-10	7e-11	2e-09	6e-10	7e-11	6e-08
	30 yr Exposure	7e-09	1e-07	2e-09	3e-10	4e-09	1e-09	1e-10	1e-07
Distance to Receptor	Maximum Conc.	5e-09	9e-08	1e-09	7e-11	4e-09	6e-10	7e-11	1e-07
	30 yr Exposure	1e-08	2e-07	2e-09	3e-10	6e-09	1e-09	1e-10	2e-07
Maximum Conc.	30 yr Exposure	8e-09	1e-07	2e-09	2e-10	6e-09	1e-09	2e-10	1e-07

**Table 8.15. Individual Risk for Crude Oil Tank Sludge Managed in Offsite Land Treatment Unit
Home Gardener**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	3e-09	8e-09	8e-10	3e-10	9e-10	9e-10	8e-11	1e-08
	Small Area	2e-08	2e-08	4e-09	2e-09	4e-09	3e-09	4e-10	5e-08
	Met Location	6e-10	9e-09	2e-10	5e-11	3e-10	2e-10	2e-11	1e-08
	Quantity	6e-09	1e-08	2e-09	6e-10	2e-09	2e-09	2e-10	2e-08
	Distance to Receptor	3e-09	2e-08	9e-10	3e-10	1e-09	8e-10	9e-11	3e-08
	Maximum Conc.	7e-09	1e-08	2e-09	3e-10	2e-09	2e-09	2e-10	3e-08
	30 yr Exposure	1e-08	3e-08	3e-09	1e-09	3e-09	3e-09	3e-10	4e-08
Small Area	Met Location	3e-09	2e-08	7e-10	2e-10	1e-09	5e-10	6e-11	2e-08
	Quantity	3e-08	3e-08	7e-09	3e-09	7e-09	5e-09	7e-10	8e-08
	Distance to Receptor	3e-08	1e-07	8e-09	3e-09	9e-09	6e-09	8e-10	2e-07
	Maximum Conc.	4e-08	3e-08	1e-08	2e-09	1e-08	9e-09	9e-10	1e-07
	30 yr Exposure	6e-08	6e-08	1e-08	6e-09	1e-08	1e-08	1e-09	2e-07
Met Location	Quantity	1e-09	2e-08	3e-10	1e-10	6e-10	3e-10	3e-11	2e-08
	Distance to Receptor	1e-09	2e-08	3e-10	8e-11	8e-10	2e-10	3e-11	2e-08
	Maximum Conc.	1e-09	2e-08	5e-10	5e-11	9e-10	4e-10	4e-11	2e-08
	30 yr Exposure	2e-09	3e-08	6e-10	2e-10	1e-09	5e-10	6e-11	3e-08
Quantity	Distance to Receptor	6e-09	4e-08	2e-09	6e-10	2e-09	1e-09	2e-10	5e-08
	Maximum Conc.	1e-08	3e-08	4e-09	6e-10	4e-09	4e-09	3e-10	5e-08
	30 yr Exposure	2e-08	5e-08	5e-09	2e-09	5e-09	5e-09	5e-10	8e-08
Distance to Receptor	Maximum Conc.	7e-09	4e-08	3e-09	3e-10	3e-09	2e-09	2e-10	5e-08
	30 yr Exposure	1e-08	7e-08	3e-09	1e-09	4e-09	3e-09	3e-10	9e-08
Maximum Conc.	30 yr Exposure	2e-08	5e-08	8e-09	1e-09	7e-09	7e-09	6e-10	9e-08

**Table 8.16. Individual Risk for Crude Oil Tank Sludge Managed in Offsite Land Treatment Unit
Adult Resident**

High End Parameters	High End Parameters	Benzo(a) pyrene	Dibenz(a,h) anthracene	Benz(a) anthracene	Indeno (1,2,3-cd) pyrene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Chrysene	Total Carcinogen Risk
None	Central Tendency	2e-09	1e-09	5e-10	3e-10	4e-10	5e-10	5e-11	4e-09
	Small Area	1e-08	6e-09	3e-09	1e-09	2e-09	2e-09	2e-10	2e-08
	Met Location	4e-10	2e-10	1e-10	4e-11	8e-11	1e-10	1e-11	8e-10
	Quantity	4e-09	2e-09	9e-10	5e-10	8e-10	1e-09	9e-11	8e-09
	Distance to Receptor	2e-09	1e-09	5e-10	2e-10	5e-10	5e-10	5e-11	5e-09
	Maximum Conc.	4e-09	2e-09	1e-09	3e-10	1e-09	1e-09	1e-10	9e-09
	30 yr Exposure	7e-09	4e-09	2e-09	8e-10	1e-09	2e-09	2e-10	1e-08
Small Area	Met Location	2e-09	8e-10	4e-10	2e-10	3e-10	3e-10	4e-11	3e-09
	Quantity	2e-08	1e-08	4e-09	2e-09	4e-09	3e-09	4e-10	4e-08
	Distance to Receptor	2e-08	1e-08	5e-09	2e-09	4e-09	4e-09	5e-10	4e-08
	Maximum Conc.	2e-08	1e-08	7e-09	1e-09	6e-09	5e-09	5e-10	5e-08
	30 yr Exposure	4e-08	2e-08	8e-09	5e-09	8e-09	7e-09	8e-10	8e-08
Met Location	Quantity	7e-10	3e-10	2e-10	7e-11	2e-10	2e-10	2e-11	1e-09
	Distance to Receptor	6e-10	2e-10	2e-10	5e-11	1e-10	2e-10	2e-11	1e-09
	Maximum Conc.	8e-10	3e-10	3e-10	4e-11	2e-10	2e-10	2e-11	2e-09
	30 yr Exposure	1e-09	6e-10	3e-10	1e-10	3e-10	3e-10	3e-11	3e-09
Quantity	Distance to Receptor	4e-09	2e-09	1e-09	5e-10	8e-10	9e-10	9e-11	8e-09
	Maximum Conc.	8e-09	4e-09	2e-09	5e-10	2e-09	2e-09	2e-10	2e-08
	30 yr Exposure	1e-08	7e-09	3e-09	2e-09	3e-09	3e-09	3e-10	3e-08
Distance to Receptor	Maximum Conc.	5e-09	2e-09	1e-09	2e-10	1e-09	1e-09	1e-10	1e-08
	30 yr Exposure	7e-09	4e-09	2e-09	8e-10	2e-09	1e-09	2e-10	2e-08
Maximum Conc.	30 yr Exposure	1e-08	7e-09	4e-09	9e-10	4e-09	4e-09	4e-10	3e-08

**Table 8.17. Media Concentrations for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Long Exposure Duration
Subsistence Fisher**

Constituent	CAS	Soil Conc. (mg/kg)	Fish Conc. (mg/kg)	Combined Air Conc. (ug/m3)
Benzo(a)pyrene	50328	8.92e-03	5.08e-06	2.64e-06
Dibenz(a,h)anthracene	53703	4.17e-03	9.30e-07	3.51e-07
Benz(a)anthracene	56553	1.30e-02	3.69e-07	5.13e-06
Indeno(1,2,3-cd) pyrene	193395	1.93e-02	5.30e-06	2.00e-06
Benzo(b)fluoranthene	205992	1.08e-02	7.36e-06	3.74e-06
Benzo(k)fluoranthene	207089	8.04e-02	1.40e-05	7.64e-06
Chrysene	218019	4.30e-02	7.85e-07	9.83e-06

**Table 8.18. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Long Exposure Duration
Subsistence Fisher**

Constituent	CAS	Soil Ingestion	Fish Ingestion	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	4e-08	1e-08	2e-09	5e-08
Dibenz(a,h)anthracene	53703	2e-08	3e-09	NA	2e-08
Benz(a)anthracene	56553	8e-09	1e-10	NA	9e-09
Indeno(1,2,3-cd) pyrene	193395	5e-09	7e-10	NA	5e-09
Benzo(b)fluoranthene	205992	8e-09	3e-09	NA	1e-08
Benzo(k)fluoranthene	207089	7e-09	7e-10	NA	8e-09
Chrysene	218019	8e-10	9e-12	NA	8e-10
				Total Risk	1e-07

**Table 8.19. Media Concentrations for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Close Receptor
Subsistence Farmer**

Constituent	CAS	Soil Conc. (mg/kg)	Above Ground Veg Conc. (mg/kg)	Below-ground Veg Conc. (mg/kg)	Beef Conc. (mg/kg)	Milk Conc. (mg/kg)	Air Conc. (ug/m3)
Benzo(a)pyrene	50328	1.69e-04	1.01e-05	4.35e-06	NA	NA	2.16e-05
Dibenz(a,h)anthracene	53703	4.65e-05	7.78e-04	9.00e-07	NA	NA	2.89e-06
Benz(a)anthracene	56553	3.94e-04	1.72e-05	1.26e-05	NA	NA	4.20e-05
Indeno(1,2,3-cd) pyrene	193395	2.07e-04	8.17e-06	3.94e-06	NA	NA	1.64e-05
Benzo(b)fluoranthene	205992	2.64e-04	1.42e-04	7.96e-06	NA	NA	3.06e-05
Benzo(k)fluoranthene	207089	1.98e-03	3.10e-05	5.07e-05	NA	NA	6.44e-05
Chrysene	218019	1.13e-03	3.69e-05	3.45e-05	NA	NA	8.08e-05

Table 8.20. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Close Receptor
Subsistence Farmer

Constituent	CAS	Soil Ingestion	Fruit and Vegetable Ingestion	Below-ground Vegetable Ingestion	Beef Ingestion	Milk Ingestion	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	2e-10	3e-09	2e-09	NA	NA	5e-09	4e-09
Dibenz(a,h)anthracene	53703	7e-11	2e-07	4e-10	NA	NA	NA	2e-07
Benz(a)anthracene	56553	8e-11	7e-10	7e-10	NA	NA	NA	1e-09
Indeno(1,2,3-cd) pyrene	193395	1e-11	1e-10	8e-11	NA	NA	NA	2e-10
Benzo(b)fluoranthene	205992	6e-11	6e-09	5e-10	NA	NA	NA	6e-09
Benzo(k)fluoranthene	207089	5e-11	2e-10	4e-10	NA	NA	NA	6e-10
Chrysene	218019	6e-12	4e-11	5e-11	NA	NA	NA	1e-10
							Total Risk	2e-07

**Table 8.21. Media Concentrations for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Close Receptor
Home Gardener**

Constituent	CAS	Soil Conc. (mg/kg)	Above Ground Veg Conc. (mg/kg)	Below-ground Veg Conc. (mg/kg)	Air Conc. (ug/m3)
Benzo(a)pyrene	50328	8.92e-03	3.37e-05	5.76e-05	2.16e-05
Dibenz(a,h)anthracene	53703	4.17e-03	7.84e-04	2.04e-05	2.89e-06
Benz(a)anthracene	56553	1.30e-02	7.98e-05	1.10e-04	4.20e-05
Indeno(1,2,3-cd) pyrene	193395	1.93e-02	3.13e-05	9.12e-05	1.64e-05
Benzo(b)fluoranthene	205992	1.08e-02	1.86e-04	8.34e-05	3.06e-05
Benzo(k)fluoranthene	207089	8.04e-02	2.93e-04	6.47e-04	6.44e-05
Chrysene	218019	4.30e-02	2.25e-04	3.51e-04	8.08e-05

**Table 8.22. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Close Receptor
Home Gardener**

Constituent	CAS	Soil Ingestion	Fruit and Vegetable Ingestion Home Gardener	Below-ground Vegetable Ingestion Home Gardener	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	4e-08	3e-09	8e-09	5e-09	5e-08
Dibenz(a,h)anthracene	53703	2e-08	9e-08	3e-09	NA	1e-07
Benz(a)anthracene	56553	8e-09	1e-09	2e-09	NA	1e-08
Indeno(1,2,3-cd) pyrene	193395	5e-09	2e-10	7e-10	NA	5e-09
Benzo(b)fluoranthene	205992	8e-09	3e-09	2e-09	NA	1e-08
Benzo(k)fluoranthene	207089	7e-09	6e-10	2e-09	NA	9e-09
Chrysene	218019	8e-10	1e-10	2e-10	NA	1e-09
					Total Risk	2e-07

**Table 8.23. Media Concentrations for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Long Exposure Duration
Adult Resident**

Constituent	CAS	Soil Conc. (mg/kg)	Air Conc. (ug/m3)
Benzo(a)pyrene	50328	8.92e-03	2.64e-06
Dibenz(a,h)anthracene	53703	4.17e-03	3.51e-07
Benz(a)anthracene	56553	1.30e-02	5.13e-06
Indeno(1,2,3-cd) pyrene	193395	1.93e-02	2.00e-06
Benzo(b)fluoranthene	205992	1.08e-02	3.74e-06
Benzo(k)fluoranthene	207089	8.04e-02	7.64e-06
Chrysene	218019	4.30e-02	9.83e-06

**Table 8.24. Individual Risk by Pathway for Crude Oil Tank Sludge Managed in an Offsite Land Treatment Unit
Small Area/Long Exposure Duration
Adult Resident**

Constituent	CAS	Soil Ingestion	Direct Inhalation	All Oral Pathways Combined
Benzo(a)pyrene	50328	4e-08	2e-09	4e-08
Dibenz(a,h)anthracene	53703	2e-08	NA	2e-08
Benz(a)anthracene	56553	8e-09	NA	8e-09
Indeno(1,2,3-cd) pyrene	193395	5e-09	NA	5e-09
Benzo(b)fluoranthene	205992	8e-09	NA	8e-09
Benzo(k)fluoranthene	207089	7e-09	NA	7e-09
Chrysene	218019	8e-10	NA	8e-10
			Total Risk	8e-08