

US EPA ARCHIVE DOCUMENT

## **APPENDIX E**

### **BASELINE MODELING RESULTS**

**Table E.1 Two Parameter High-End Analysis Results for On-Site Landfills**

Waste Stream	Constituent	HBN Total <sup>1</sup> (mg/L)	1995 Back. Docu.	Mean TCLP (mg/l)	Revised Receptor Well Conc. (mg/L)	Two High-End Parameters from Sensitivity Analysis		Revised Results <sup>2</sup> in Response to Comments	Revised Results <sup>2</sup> w/Indirect Risk <sup>1</sup>	Two High-End Parameters from TC Capped Sensitivity Analysis		TC Rule Capped Revised Conc. <sup>3</sup>	TC Capped Revised Total Risk <sup>3</sup>
CSO sludge	Benzene #	6.23E-03	0.6	5.90E-02	1.9E-02	X-Well	Waste Vol.	1.9	3.1	NA	NA	NA	NA
Hydrotreating Catalyst <sup>4</sup>	Benzene #	6.23E-03	28.6	7.89E+00	0.51	Waste Conc.	X-Well	51.3	82.4	X-Well	Infiltration	2.5E-02	4.1
	Nickel	1.00E+00	0.1	1.46E+02	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Arsenic #	3.00E-04	20.1	1.10E+00	1.9E-02	Waste Vol.	Waste Conc.	63.3	63.3	NA	NA	NA	NA
	Toluene	1.00E+01	2.2E-02	7.68E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur complex sludge <sup>5</sup>	Benzene #	6.23E-03	1.6E-03	2.60E-02	2.2E-05	NA	NA	2.2E-03	3.5E-03	NA	NA	NA	NA
	Arsenic #	3.00E-04	0.1	1.38E-01	3.3E-05	NA	NA	0.1	0.1	NA	NA	NA	NA
Off-spec products and fines <sup>6</sup>	Benz(a)anthracene #	2.00E-05	0.3	1.30E-02	4.2E-04	Waste Vol.	X-Well	21.2	21.2	NA	NA	NA	NA
	Benzo(a)pyrene #	6.00E-05	0.0E+00	1.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA
Off-spec products and fines <sup>7</sup>	Benz(a)anthracene #	2.00E-05	0.3	1.30E-02	6.72E-05	Infiltration	TCLP	3.4	3.4	NA	NA	NA	NA
Hydrotreating catalyst <sup>4</sup>	Benzene #	6.23E-03	20.1	1.49E+00	0.25	X-well	Waste Vol.	25.4	40.8	Infiltration	X-Well	3.2E-02	5.1
	Arsenic #	3.00E-04	67.0	1.37E+01	1.2E-01	X-Well	Waste Vol.	413.3	413.3	X-Well	Waste Vol.	7.7E-03	25.7
	Nickel	1.00E+00	0.1	2.82E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unleaded gasoline tank sl. <sup>5</sup>	Benzene #	6.23E-03	0.6	7.52E-01	1.1E-02	NA	NA	1.1	1.7	NA	NA	7.4E-02	11.9
	Nickel	1.00E+00	6.4E-04	2.92E+01	1.3E-03	NA	NA	1.3E-03	1.3E-03	NA	NA	NA	NA
FCC catalyst and fines	Nickel	1.00E+00	0.5	2.20E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA
SCOT catalyst	Cadmium	3.00E-02	NA	8.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vanadium	4.00E-01	NA	1.18E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFalkylation sludge	Benzene #	6.23E-03	0.8	7.60E-02	3.6E-02	Infiltration	X-Well	3.6	5.8	NA	NA	NA	NA
	Nickel	1.00E+00	3.2E-03	2.80E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA

- Risk results are presented as HBN exceedance or HBN/well conc. This ratio corresponds to a  $1 \times 10^{-6}$  risk. The HBN value for Benzene is 0.01 mg/l, which corresponds to a direct risk from drinking 1.4 l/day of water ( $1.0 \times 10^{-4}$  risk per 1mg/l benzene). The total risk also includes an indirect risk from showering ( $6.05 \times 10^{-5}$  risk per 1mg/l benzene).
  - With the noted exceptions (see 5 below) the revised analysis consists of a Two Parameter Sensitivity Analysis.
  - Input leaching rates were capped on TC Regulatory levels for maximum allowable TCLP values for disposal in Subtitle D landfills (0.5 mg/l for benzene, and 5.0 mg/l for arsenic)
  - For hydrotreating and hydrotreating, all waste quantities, except those managed in Subtitle C landfills, were modeled including reclaimed waste.
  - Sensitivity analyses were not performed on these waste streams. Revised results were calculated using the two-high end parameters from the 1995 sensitivity analysis and 20-year 50 perc. waste volumes were used rather than derived waste volumes.
  - "J" value assumed to represent mean or expected TCLP value (see section 2.3.5)
  - "J" value assumed to represent maximum or high-end TCLP value (see section 2.3.5)
- NA : Modeling results not available or not applicable.

**Table E.2 Monte Carlo Baseline Modeling Results for On-Site Landfills**

Waste Stream	Constituent	HBN Total <sup>1</sup> (mg/L)	90th Percentile				95th Percentile				99th Percentile						
			Rec. Well Conc. (mg/L)	Total Risk	TC Capped Well concentration	TC Capped Direct Risk <sup>3</sup>	TC Capped Total Risk <sup>3</sup>	Rec. Well Conc. (mg/L)	Total Risk	TC Capped Well concentration	TC Capped Direct Risk <sup>3</sup>	TC Capped Total Risk <sup>3</sup>	Rec. Well Conc. (mg/L)	Total Risk	TC Capped Well concentration	TC Capped Direct Risk <sup>3</sup>	TC Capped Total Risk <sup>3</sup>
CSO sludge	Benzene #	6.23E-03	5.00E-04	0.1	5.0E-04	0.1	0.1	1.58E-03	0.3	1.6E-03	0.2	0.3	6.34E-03	<b>1.0</b>	6.3E-03	0.6	<b>1.0</b>
Hydrotreating Catalyst <sup>4</sup>	Benzene #	6.23E-03	8.30E-03	<b>1.3</b>	4.9E-03	0.5	0.8	4.77E-02	<b>7.7</b>	2.2E-02	<b>2.2</b>	<b>3.5</b>	5.38E-01	<b>86.5</b>	1.1E-01	<b>11.0</b>	<b>17.7</b>
	Nickel	1.00E+00	5.43E-02	5.4E-02	NA	NA	NA	4.95E-01	0.5	NA	NA	NA	1.16E+01	<b>11.6</b>	NA	NA	NA
	Arsenic #	3.00E-04	4.57E-04	<b>1.5</b>	NA	NA	NA	2.15E-03	<b>7.2</b>	NA	NA	NA	1.24E-02	<b>41.2</b>	NA	NA	NA
	Toluene	1.00E+01	8.22E-03	8.2E-04	NA	NA	NA	3.61E-02	3.6E-03	NA	NA	NA	7.26E-01	7.3E-02	NA	NA	NA
Sulfur complex sludge	Benzene #	6.23E-03	8.93E-05	1.4E-02	NA	NA	NA	6.21E-04	0.1	NA	NA	NA	4.39E-03	0.7	NA	NA	NA
	Arsenic #	3.00E-04	4.10E-06	1.4E-02	NA	NA	NA	4.36E-05	0.1	NA	NA	NA	1.57E-03	<b>5.2</b>	NA	NA	NA
Off-spec products and fines <sup>6</sup>	Benz(a)anthracene #	2.00E-05	7.51E-08	3.8E-03	NA	NA	NA	2.74E-06	0.1	NA	NA	NA	8.42E-05	<b>4.2</b>	NA	NA	NA
	Benzo(a)pyrene #	6.00E-05	1.36E-12	2.3E-08	NA	NA	NA	1.26E-10	2.1E-06	NA	NA	NA	9.38E-07	1.6E-02	NA	NA	NA
Off-spec products and fines <sup>7</sup>	Benz(a)anthracene #	2.00E-05	6.98E-08	3.5E-03	NA	NA	NA	2.68E-06	0.1	NA	NA	NA	8.22E-05	<b>4.1</b>	NA	NA	NA
Hydrotreating catalyst <sup>4</sup>	Benzene #	6.23E-03	1.64E-02	<b>2.6</b>	1.2E-02	<b>1.2</b>	<b>2.0</b>	4.75E-02	<b>7.6</b>	3.6E-02	<b>3.6</b>	<b>5.8</b>	4.78E-01	<b>76.8</b>	0.1	<b>12.0</b>	<b>19.3</b>
	Arsenic #	3.00E-04	8.43E-03	<b>28.1</b>	8.1E-03	<b>27.1</b>	<b>27.1</b>	3.35E-02	<b>111.7</b>	3.3E-02	<b>109.0</b>	<b>109.0</b>	2.71E-01	<b>904.7</b>	0.2	<b>830.3</b>	<b>830.3</b>
	Nickel	1.00E+00	2.49E-02	2.5E-02	NA	NA	NA	3.36E-01	0.3	NA	NA	NA	7.07E+00	<b>7.1</b>	NA	NA	NA
Unleaded gasoline tank sludge	Benzene #	6.23E-03	6.84E-04	0.1	6.6E-04	0.1	0.1	3.84E-03	0.6	3.8E-03	0.4	0.6	2.43E-02	<b>3.9</b>	2.4E-02	<b>2.4</b>	<b>3.8</b>
	Nickel	1.00E+00	5.24E-05	5.2E-05	NA	NA	NA	7.68E-04	7.7E-04	NA	NA	NA	3.01E-02	3.0E-02	NA	NA	NA
FCC catalyst and fines	Nickel	1.00E+00	5.45E-03	5.5E-03	NA	NA	NA	6.56E-02	6.6E-02	NA	NA	NA	1.18E+00	<b>1.2</b>	NA	NA	NA
SCOT catalyst	Cadmium	3.00E-02	5.90E-06	2.0E-04	NA	NA	NA	4.86E-05	1.6E-03	NA	NA	NA	1.06E-03	3.5E-02	NA	NA	NA
	Vanadium	4.00E-01	3.68E-13	9.2E-13	NA	NA	NA	7.36E-11	1.8E-10	NA	NA	NA	5.76E-09	1.4E-08	NA	NA	NA
HFalkylation sludge	Benzene #	6.23E-03	2.79E-04	4.5E-02	2.8E-04	2.8E-02	4.5E-02	1.49E-03	0.2	1.5E-03	0.1	0.2	8.68E-03	<b>1.4</b>	8.7E-03	0.9	<b>1.4</b>
	Nickel	1.00E+00	2.82E-05	2.8E-05	NA	NA	NA	1.03E-03	1.0E-03	NA	NA	NA	3.06E-02	3.1E-02	NA	NA	NA

- Risk results are presented as HBN exceedance or HBN/well conc. This ratio corresponds to a 1 x 10<sup>-6</sup> risk. The HBN value for Benzene is 0.01 mg/l, which corresponds to a direct risk from drinking 1.4 l/day of water (1.0 x 10<sup>-4</sup> risk per 1mg/l benzene). The total risk also includes an indirect risk from showering (6.05 x 10<sup>-5</sup> risk per 1mg/l benzene).
  - With the noted exceptions (see 5 below) the revised analysis consists of a Two Parameter Sensitivity Analysis.
  - Input leaching rates were capped on TC Regulatory levels for maximum allowable TCLP values for disposal in Subtitle D landfills ( 0.5 mg/l for benzene, and 5.0 mg/l for arsenic)
  - For hydrotreating and hydrotreating, all waste quantities, except those managed in Subtitle C landfills, were modeled including reclaimed waste.
  - Sensitivity analyses were not performed on these waste streams. Revised results were calculated using the two-high end parameters from the 1995 sensitivity analysis and 20-year 50 perc. waste volumes were used rather than derived waste volumes.
  - "J" value assumed to represent mean or expected TCLP value (see section 2.3.5)
  - "J" value assumed to represent maximum or high-end TCLP value (see section 2.3.5)
- NA : Modeling results not available or not applicable.

**Table E.3 Two Parameter High-End Analysis Results for Off-Site Landfills**

Waste Stream	Constituent	HBN Total <sup>1</sup> (mg/L)	1995 Back. Docu.	Mean TCLP (mg/l)	Revised Receptor Well Conc. (mg/L)	Two High-End Parameters from Sensitivity Analysis		Revised Results <sup>2</sup> in Response to Comments	Revised Results <sup>2</sup> w/Indirect Risk <sup>1</sup>	Two High-End Parameters from TC Capped Sensitivity Analysis		TC Rule Capped Revised Conc. <sup>3</sup>	TC Capped Revised Total Risk <sup>3</sup>
						Area	Waste Vol.			Area	Waste Vol.		
CSO sludge	Benzene #	6.23E-03	0.6	5.90E-02	1.55E-02	Area	Waste Vol.	1.6	2.5	NA	NA	NA	NA
Crude Oil Tank Sludge	Benzene #	6.23E-03	0.5	6.98E-01	1.71E-01	Area	Waste Vol.	17.1	27.5	Area	Waste Vol.	1.3E-01	21.5
Hydrotreating Catalyst <sup>4</sup>	Benzene #	6.23E-03	35.7	7.89E+00	3.38E-01	Y-Well	TCLP	33.8	54.3	Area	Waste Vol.	8.9E-02	14.2
	Nickel	1.00E+00	0.2	1.46E+02	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Arsenic *	3.00E-04	31.6	1.10E+00	2.11E-02	Waste Conc.	Y-Well	70.3	70.3	NA	NA	NA	NA
	Toluene	1.00E+01	3.7E-02	7.68E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sulfur complex sludge <sup>5</sup>	Benzene #	6.23E-03	1.6E-02	2.60E-02	1.99E-05	NA	NA	2.0E-03	3.2E-03	NA	NA	NA	NA
	Arsenic *	3.00E-04	0.5	1.38E-01	3.01E-05	NA	NA	0.1	0.1	NA	NA	NA	NA
Off-spec products and fines <sup>6</sup>	Benz(a)anthracene *	2.00E-05	13.5	1.30E-02	3.85E-04	Y-Well	Infiltration	19.3	19.3	NA	NA	NA	NA
	Benzo(a)pyrene *	6.00E-05	2.0E-04	1.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA
Off-spec products and fines <sup>7</sup>	Benz(a)anthracene *	2.00E-05	13.5	1.30E-02	9.29E-05	Infiltration	TCLP	4.6	4.6	NA	NA	NA	NA
Hydrorefining catalyst <sup>4</sup>	Benzene #	6.23E-03	34.6	1.49E+00	2.26E-01	Area	Waste Vol.	22.6	36.3	Area	Waste Vol.	1.2E-01	19.1
	Arsenic *	3.00E-04	126.7	1.37E+01	2.04E-01	Y-Well	Waste Vol.	680.0	680.0	Y-Well	Waste Vol.	1.2E-01	393.3
	Nickel	1.00E+00	0.2	2.82E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Unleaded gasoline tank sl. <sup>5</sup>	Benzene #	6.23E-03	4.1	7.52E-01	2.90E-02	NA	NA	2.9	4.7	NA	NA	1.9E-02	3.0
	Nickel	1.00E+00	4.3E-03	2.92E+01	NA	NA	NA	NA	NA	NA	NA	NA	NA
FCC catalyst and fines	Nickel	1.00E+00	NA	2.20E+00	NA	NA	NA	NA	NA			NA	NA
SCOT catalyst	Cadmium	3.00E-02	8.9E-03	8.00E-02	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vanadium	4.00E-01	NA	1.18E+00	NA	NA	NA	NA	NA	NA	NA	NA	NA
HFalkylation sludge	Benzene #	6.23E-03	3.1	7.60E-02	3.98E-02	Area	TCLP	4.0	6.4	NA	NA	NA	NA
	3/4-Methylphenol	3.00E-01	0.4	2.80E-01	NA	NA	NA	NA	NA	NA	NA	NA	NA

- Risk results are presented as HBN exceedance or HBN/well conc. This ratio corresponds to a  $1 \times 10^{-6}$  risk. The HBN value for Benzene is 0.01 mg/l, which corresponds to a direct risk from drinking 1.4 l/day of water ( $1.0 \times 10^{-4}$  risk per 1mg/l benzene). The total risk also includes an indirect risk from showering ( $6.05 \times 10^5$  risk per 1mg/l benzene).
  - With the noted exceptions (see 5 below) the revised analysis consists of a Two Parameter Sensitivity Analysis.
  - Input leaching rates were capped on TC Regulatory levels for maximum allowable TCLP values for disposal in Subtitle D landfills (0.5 mg/l for benzene, and 5.0 mg/l for arsenic)
  - For hydrotreating and hydrorefining, all waste quantities, except those managed in Subtitle C landfills, were modeled including reclaimed waste.
  - Sensitivity analyses were not performed on these waste streams. Revised results were calculated using the two-high end parameters from the 1995 sensitivity analysis and 20-year 50 perc. waste volumes were used rather than derived waste volumes.
  - "J" value assumed to represent mean or expected TCLP value (see section 2.3.5)
  - "J" value assumed to represent maximum or high-end TCLP value (see section 2.3.5)
- NA : Modeling results not available or not applicable.

**Table E.4 Monte Carlo Baseline Modeling Results for Off-Site Landfills**

Waste Stream	Constituent	HBN Total <sup>1</sup> (mg/L)	90th Percentile					95th Percentile					99th Percentile				
			Rec. Well Conc. (mg/L)	Total Risk	TC Capped Well concentration	TC Capped Direct Risk <sup>3</sup>	TC Capped Total Risk <sup>3</sup>	Rec. Well Conc. (mg/L)	Total Risk	TC Capped Well concentration	TC Capped Direct Risk <sup>3</sup>	TC Capped Total Risk <sup>3</sup>	Rec. Well Conc. (mg/L)	Total Risk	TC Capped Well concentration	TC Capped Direct Risk <sup>3</sup>	TC Capped Total Risk <sup>3</sup>
CSO sludge	Benzene #	6.23E-03	1.76E-03	0.3	1.8E-03	0.2	0.3	6.84E-03	1.1	6.8E-03	0.7	1.1	2.14E-02	3.4	2.1E-02	2.1	3.4
Crude Oil Tank Sludge	Benzene #	6.23E-03	5.03E-03	0.8	3.9E-03	0.4	0.6	2.78E-02	4.5	2.1E-02	2.1	3.3	2.71E-01	43.5	0.1	13.7	22.0
Hydrotreating Catalyst <sup>4</sup>	Benzene #	6.23E-03	1.37E-02	2.2	7.3E-03	0.7	1.2	6.61E-02	10.6	2.7E-02	2.7	4.4	6.74E-01	108.3	0.1	12.7	20.3
	Nickel	1.00E+00	1.77E-01	1.8E-01	NA	NA	NA	1.33E+00	1.3	NA	NA	NA	1.83E+01	18.3	NA	NA	NA
	Arsenic *	3.00E-04	7.59E-04	2.5	NA	NA	NA	2.88E-03	9.6	NA	NA	NA	1.70E-02	56.5	NA	NA	NA
	Toluene	1.00E+01	1.16E-02	1.2E-03	NA	NA	NA	4.75E-02	4.8E-03	NA	NA	NA	6.16E-01	0.1	NA	NA	NA
Sulfur complex sludge	Benzene #	6.23E-03	4.41E-05	7.1E-03	NA	NA	NA	2.95E-04	4.7E-02	NA	NA	NA	4.64E-03	0.7	NA	NA	NA
	Arsenic *	3.00E-04	4.19E-06	1.4E-02	NA	NA	NA	4.65E-05	0.2	NA	NA	NA	1.48E-03	4.9	NA	NA	NA
Off-spec products and fines <sup>6</sup>	Benz(a)anthracene *	2.00E-05	1.34E-05	0.7	NA	NA	NA	1.09E-04	5.4	NA	NA	NA	1.48E-03	73.8	NA	NA	NA
	Benzo(a)pyrene *	6.00E-05	6.18E-07	1.0E-02	NA	NA	NA	9.43E-06	0.2	NA	NA	NA	2.48E-04	4.1	NA	NA	NA
Off-spec products and fines <sup>7</sup>	Benz(a)anthracene *	2.00E-05	1.17E-05	0.6	NA	NA	NA	8.86E-05	4.4	NA	NA	NA	1.05E-03	52.6	NA	NA	NA
Hydrotreating catalyst <sup>4</sup>	Benzene #	6.23E-03	2.06E-02	3.3	1.6E-02	1.6	2.6	5.14E-02	8.3	4.0E-02	4.0	6.3	5.30E-01	85.1	1.3E-01	12.8	20.5
	Arsenic *	3.00E-04	9.78E-03	32.6	9.4E-03	31.3	31.3	3.75E-02	124.9	3.7E-02	123.0	123.0	3.10E-01	1034.0	2.8E-01	936.7	936.7
	Nickel	1.00E+00	3.08E-02	3.1E-02	NA	NA	NA	3.58E-01	0.4	NA	NA	NA	6.36E+00	6.4	NA	NA	NA
Unleaded gasoline tank sl.	Benzene #	6.23E-03	1.99E-03	0.3	1.3E-03	0.1	0.2	1.09E-02	1.7	6.5E-03	0.6	1.0	8.22E-02	13.2	5.0E-02	5.0	8.0
	Nickel	1.00E+00	8.05E-05	8.0E-05	NA	NA	NA	2.01E-03	2.0E-03	NA	NA	NA	8.74E-02	0.1	NA	NA	NA
FCC catalyst and fines	Nickel	1.00E+00	4.69E-03	4.7E-03	NA	NA	NA	4.42E-02	4.4E-02	NA	NA	NA	5.57E-01	0.6	NA	NA	NA
SCOT catalyst	Cadmium	3.00E-02	2.75E-08	9.2E-07	NA	NA	NA	6.53E-06	2.2E-04	NA	NA	NA	4.27E-04	0.0	NA	NA	NA
	Vanadium	4.00E-01	4.41E-15	1.1E-14	NA	NA	NA	1.05E-11	2.6E-11	NA	NA	NA	3.92E-09	0.0	NA	NA	NA
HFalkylation sludge	Benzene #	6.23E-03	4.33E-03	0.7	4.3E-03	0.4	0.7	9.86E-03	1.6	9.9E-03	1.0	1.6	2.99E-02	4.8	3.0E-02	3.0	4.8
	3/4-Methylphenol	3.00E-01	4.70E-03	1.6E-02	NA	NA	NA	1.05E-02	3.5E-02	NA	NA	NA	3.09E-02	0.1	NA	NA	NA

- Risk results are presented as HBN exceedance or HBN/well conc. This ratio corresponds to a  $1 \times 10^{-6}$  risk. The HBN value for Benzene is 0.01 mg/l, which corresponds to a direct risk from drinking 1.4 l/day of water ( $1.0 \times 10^{-4}$  risk per 1mg/l benzene). The total risk also includes an indirect risk from showering ( $6.05 \times 10^{-5}$  risk per 1mg/l benzene).
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