

EXHIBIT C

**Comments on Health Risk Assessment
Industrial Service Oil Company, Inc.
Prepared by**

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EXECUTIVE SUMMARY

Iris Environmental reviewed the health risk assessment (HRA) prepared by Environmental Audit, Inc. for the Industrial Service Oil Company, Inc. (ISOCI) facility at 1700 South Soto Street, Los Angeles, California (EAI, 2006b). As a part of this review, we evaluated the methods used to estimate emissions of chemicals of potential concern (COPCs) from facility operations. Specifically, the methods used to estimate the speciation profiles of various wastes were examined in detail. These speciation profiles are used to estimate emissions, and therefore risks associated with COPCs. Our evaluation shows that some of these speciation profiles are not clearly documented, cannot be reproduced, and result in an underestimate of likely COPC emissions. As such, the cancer risks estimated in the HRA are likely to be an underestimate of potential inhalation cancer risks. To quantitatively estimate the potential underestimation of cancer risks, the speciation profiles were modified to reflect a more representative and conservative estimate of possible speciation profiles. Use of these speciation profiles leads to an increase in estimated facility-wide total risk for the reasonable maximum exposed adult resident (RMER) from 1.16×10^{-6} to 2.43×10^{-5} , 21 times higher. The increase in risk for other receptors would likely be similar.

1.0 INTRODUCTION

This summary presents a review by Iris Environmental of the health risk assessment (HRA) prepared by Environmental Audit, Inc. for the Industrial Service Oil Company, Inc. (ISOCI) facility at 1700 South Soto Street, Los Angeles, California (EAI, 2006b). The Industrial Service Oil Company has applied for a Resource Conservation and Recovery Act (RCRA) Part B application to operate a hazardous waste treatment, storage, and disposal facility at the site. The HRA was prepared in support of an Environmental Impact Report (EIR) assessing the potential impacts of the planned facility expansion (EAI, 2006a).

The health risk assessment considered three pathways whereby offsite receptors may be exposed to COPCs:

- inhalation of COPCs emitted from combustions sources and the wastewater treatment plant, and volatile organic chemicals (VOCs) emitted from storage tanks, drums, valves and flanges, and transfer operations;
- incidental ingestion of COPCs in soil; and
- ingestion of COPCs in homegrown produce.

For the reasonable maximum exposed adult resident (RMER), the inhalation pathway was determined to account for essentially all (99.6 percent) of the total estimated cancer risk, with benzene responsible for nearly half of the total. The two sources found to contribute most to the total cancer risk were fugitive emissions from Tanks 21 through 27, and fugitive emissions from drums. This review therefore focuses on the assessment of the inhalation pathway, particularly the methods used to estimate evaporative emissions from tanks and drums.

2.0 SPECIATION PROFILES

2.1 Original Profiles

Emission rates (in pounds per year [lb/yr]) of individual VOCs from a specific source were determined by combining the estimated emission rate of total VOCs from the source with the estimated weight fractions of the individual VOCs in the total. The composition of the VOC mixture, comprised of weight fractions of the individual components, is referred to as the speciation profile. Five VOC speciation profiles were developed in the HRA. Each profile has a liquid-phase component and associated vapor-phase component. The volatile component profiles are referred to as: V1, V2, V3, V6, and Drums; the liquid component profiles are referred to as: L1, L2, L3, L6. The appropriate speciation profile was applied to calculate emissions of individual VOCs from each source; note the liquid drum profile was not used to calculate emissions and so is not referenced.

The HRA indicates that speciation profiles were developed from the sampling and analysis of tank headspace vapors. This appears to be true, however, for speciation profiles V1/L1, V2/L2, and V3/L3 only. The vapor speciation profiles V1, V2, and V3 were directly measured by collection and analysis of headspace vapor samples; the corresponding liquid speciation profiles L1, L2, and L3 were derived from the vapor profiles by assuming equilibrium partitioning as described by Henry's Law. (See pages A-3, A-4, and A-5, respectively.) Speciation profiles V6/L6 and Drums, however, were apparently not based on headspace vapor measurements. (See pages A-6 and A-7, respectively.). The methodology used to develop these two speciation profiles is unclear.

2.1.1 Drum Speciation Profile

The HRA indicates (see page 15) that the Drums vapor speciation profile was constructed by "weighting the emissions by vapor pressure and health hazard criteria (*e.g.*, carcinogenic unit risk factor) rather than assuming the emissions are equally distributed. This places greater weight and results in higher emissions of the compounds that are most volatile and most hazardous to health, *e.g.*, benzene, acetaldehyde, acrylonitrile, carbon tetrachloride, chloroform, cyclohexanone, methanol, methylene chloride, methyl chloroform, and vinyl chloride."

The assumed speciation profile (see page A-7), however, does not appear to match this stated methodology. The vapor weight fractions of individual VOCs are ranked neither by Henry's Law Constant, cancer slope factor, nor the product of the two. The footnote to the table indicates that the vapor mole fractions of acrylonitrile, carbon tetrachloride, formaldehyde, and vinyl chloride were assumed to be 0.0001 (0.01 percent) but does not provide a rationale for this nor indicate how vapor mole fractions of the remaining compounds were determined. Moreover, cyclohexanone, methanol, and methylene chloride, and methyl chloroform are not even present in the speciation profile. The lack of a detailed methodology combined with the lack of units for the parameters presented in the profile made reproducing the drum speciation profile impossible.

2.1.2 Speciation Profile V6

The vapor speciation profile V6 is applied to VOC emissions from the fuel-blending tank. The associated liquid speciation profile L6 is applied to fugitive VOC emissions from loading racks and from fuel blending. (See page A-2 for profile/source assignments; see page A-6 for the V6/L6 speciation profile.) The HRA does not provide any information regarding how the V6/L6 profile was developed.

Similar to the drum speciation profile, the footnote to the table indicates that the vapor mole fractions of acrylonitrile, carbon tetrachloride, formaldehyde, and vinyl chloride were assumed to be 0.0001 (0.01 percent) but does not provide a rationale for this nor indicate how vapor mole fractions of the remaining compounds were determined. It is not clear whether the vapor profile was developed first and the liquid profile was derived

from it (as was done for V1/L1, V2/L2, and V3/L3), or vice versa. Accordingly, we could not reproduce the calculations used to develop these numbers.

Finally, we note that the *Notice of Preparation of an Environmental Impact Report* (NOP) prepared by the Department of Toxic Substances Control (DTSC) (see Environmental Impact Report, Appendix A, page 8) indicates the typical benzene weight fraction in waste oil is 0.005 (0.5 percent). The liquid speciation profile L6 (see page A-6), however, specifies a benzene liquid weight fraction of 9.50×10^{-7} , orders of magnitude lower than that specified by DTSC.

2.2 Revised Profiles

The sources of speciation profiles V6 and Drums are not clearly documented, cannot be reproduced, and appear to be a non-conservative estimate of potential speciation profiles. Specifically, the assumed benzene content of the waste oil to be processed in the fuel blending tank is significantly lower than the typical value. Moreover, the assumed mole fractions of benzene and other relatively toxic compounds in drum headspace vapor are low compared to the assumed mole fractions of other VOC compounds. As such, the cancer risks estimated in the HRA are likely to be an underestimate of potential inhalation cancer risks. To quantitatively estimate the potential underestimation of cancer risks, the speciation profiles V6 and Drums are conservatively modified as described below.

2.2.1 Drum Speciation Profile

The Drums profile is revised by assuming equal liquid weight fractions of the individual VOCs, with a total VOC weight fraction of 0.05 (5 percent) as before. The associated vapor speciation profile is derived assuming equilibrium as expressed by Henry's Law. Note this equal distribution was specifically described in the HRA as non-conservative (see page 15); the subsequent risk calculation (see Section 3.0, below), however, indicates that this speciation is significantly more conservative than the original Drums speciation. Revision of the vapor speciation profile results in a greater partial pressure of VOCs in the drum headspace; because the rule-of-thumb methodology employed to estimate the mass of emissions from drums (see page 14) is independent of the VOC pressure, the original mass emission rate of VOCs from the drums is retained.

2.2.2 Speciation Profile V6

The V6 profile is revised by assuming equal liquid weight fractions of the individual VOCs, with a total VOC weight fraction of 0.05 (5 percent) as before. This results in each individual VOC having a liquid weight fraction of 0.0023 (0.23 percent). This assumption of 0.23 percent benzene in the liquid phase is much more consistent with the typical benzene content in waste oil of 0.5 percent, as noted by DTSC in the NOP. The associated vapor speciation profile V6 is derived assuming equilibrium as expressed by Henry's Law. Revision of the vapor speciation profile results in a greater partial pressure

of VOCs in the tank headspace; because the methodology employed to estimate the mass of emissions from storage tanks (see page 14 for reference) assumes mass emissions are proportional to the total VOC vapor pressure, the original mass emission rate of VOCs from the fuel blend tank is scaled by the ratio of the VOC vapor pressures.

3.0 RISK CALCULATIONS

As described above, two of the speciation profiles that were applied in the health risk assessment to calculate emissions of individual VOCs, V6 and Drums, have been conservatively revised. Emission rates of individual VOCs, and associated inhalation cancer risks, from sources to which these profiles were applied are recalculated assuming the revised profiles. Specifically, VOC emissions and cancer risks associated with sources DRUMN and DRUMS (Drums profile) and FUELBLND (V6 profile) are recalculated.

For each source and individual VOC (*e.g.*, benzene from the FUELBLND source), the relationship between emission rate and inhalation cancer risk is unchanged from the original assessment. This parameter – risk per emission rate of individual VOC – is calculated for each VOC in Tables 1 (FUELBLND source) and 3 (combined DRUMN and DRUMS source) from information provided in the original assessment.

Presented in Tables 2 and 4, for the FUELBLND and DRUMN/DRUMS sources, respectively, are the revised speciation profiles, VOC emission rates, and inhalation cancer risks assuming the 22 individual VOCs are present in the liquid phase at equal weight fractions. The recalculated cancer risks associated with the fuel blending tank and drums are summarized below.

Emissions Source	Original Speciation Profile	Revised Speciation Profile
Drums		
Estimated risk	3.97×10^{-7}	6.58×10^{-7}
Estimated risk, percentage of entire facility total	34%	3%
Fuel Blending Tank		
Estimated risk	1.33×10^{-7}	2.30×10^{-5}
Estimated risk, percentage of entire facility total	11%	95%
Entire Facility		
Estimated risk	1.16×10^{-6}	2.43×10^{-5}
Estimated risk, magnitude of increase from original	-	21x

Revised risks have been calculated here for the RMER. The increase in risk to the other receptors considered in the HRA – the reasonable maximum exposed worker, sensitive adult resident, and sensitive child resident – would likely be similar, depending on the distance from each of these receptors to the modified sources (the fuel blending tank and the drums) relative to the distance from the RMER to the modified sources. In other words, the nearer the receptor to the modified sources, the larger the increase in estimated risk.

4.0 SUMMARY AND CONCLUSIONS

Revision of the V6 and Drums speciation profiles results in an increase in estimated inhalation cancer risks from the fuel blending tank and drums. The change in estimated risk from the drums is fairly small, a factor of 1.7. Revision of the V6 profile, however, produces a large increase in the estimate risk from the fuel blending tank, a factor of 173. With the revised V6 and Drums speciation profiles, the fuel blending tank becomes the risk-driver at the facility, as it contributes 95 percent of the total cancer risk from all sources. The change in speciation profiles results in an increase in estimated facility-wide total risk for the RMER from 1.16×10^{-6} to 2.43×10^{-5} , approximately 21 times higher. The increase in risk for the other receptors would likely be similar.

5.0 UNCERTAINTIES

Given the lack of documentation in the HRA of the methods used to determine the speciation profiles, Iris Environmental has made a best guess as to possible, conservative speciation profiles. Note that there is significant uncertainty in any method used to estimate the speciation profile, as the waste mixtures handled by the facility will vary, depending on the waste source. Moreover, we have kept the assumption that only 5% of the waste is COPCs and the remaining 95% is water. Actual wastes may have considerably higher COPC content and this may further increase expected emissions from the site. Note that increasing the fraction of COPC content in the waste may require modification of the methods used to estimate the vapor content above the waste. In particular, we have assumed that the method used in the HRA to estimate the vapor content above the waste is valid for waste mixtures with 5% COPC content. Finally, we have assumed that the vapor pressure used to estimate emissions from the FUELBLND source was based on the V6 speciation profile. If a different vapor pressure was used, assumptions about emission estimates may need to be revised.

6.0 REFERENCES

Environmental Audit, Inc. (EAI). 2006a. *Final Environmental Impact Report for Industrial Service Oil Company, Inc. Hazardous Waste Facility Application*. Volume I. December.

EAI. 2006b. *Final Health Risk Assessment for Industrial Service Oil Company, Inc. Hazardous Waste Facility Application*. December.

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United States Environmental Protection Agency (USEPA) 2004a. *October 20. User's Guide and Background Technical Document for USEPA Region 9's Preliminary Remediation Goals (PRG) Table. Region 9. October 20.*

USEPA (2004b). *Region 9 PRG Table. Region 9. October 20.*

Table 1
Risk per Emission Rate from Source FUELBLND

Compound	MW (g/mol)	Vapor Weight Fraction	SFi (mg/kg/d) ⁻¹	Emission Rate (lb/yr)	SFi*ER	Contrib. to Total Risk	Risk	Risk per Emission Rate (lb/yr) ⁻¹
Acrylonitrile	53.1	0.0037	1.00E+00	2.97E-02	2.97E-02	10.9%	1.45E-08	4.88E-07
Aniline	93.1	0.0001	NA	8.03E-04	0.00E+00	0.0%	0.00E+00	0.00E+00
Benzene	78.1	0.0229	2.70E-02	1.84E-01	4.96E-03	1.8%	2.42E-09	1.32E-08
Carbon tetrachloride	153.8	0.0107	5.25E-02	8.59E-02	4.51E-03	1.7%	2.20E-09	2.56E-08
Chloroethene	62.5	0.0043	3.10E-02	3.45E-02	1.07E-03	0.4%	5.22E-10	1.51E-08
Chloroform	119.4	0.0722	1.90E-02	5.80E-01	1.10E-02	4.0%	5.37E-09	9.26E-09
1,4-Dichlorobenzene	147.0	0.0007	2.20E-02	5.62E-03	1.24E-04	0.0%	6.03E-11	1.07E-08
1,1-Dichloroethane	99.0	0.0707	5.70E-03	5.68E-01	3.24E-03	1.2%	1.58E-09	2.78E-09
1,1-Dichloroethylene	96.9	0.1883	NA	1.51E+00	0.00E+00	0.0%	0.00E+00	0.00E+00
Dichloromethane	84.9	0.1167	1.65E-03	9.37E-01	1.54E-03	0.6%	7.52E-10	8.02E-10
1,1-Dimethylhydrazine	60.1	0.0025	NA	2.01E-02	0.00E+00	0.0%	0.00E+00	0.00E+00
1,4-Dioxane	88.1	0.0101	1.10E-02	8.11E-02	8.92E-04	0.3%	4.35E-10	5.36E-09
Epichlorohydrin	92.5	0.0047	8.00E-02	3.77E-02	3.02E-03	1.1%	1.47E-09	3.90E-08
Ethylbenzene	106.2	0.0030	NA	2.41E-02	0.00E+00	0.0%	0.00E+00	0.00E+00
Ethylene dibromide	187.9	0.0065	2.00E+00	5.22E-02	1.04E-01	38.3%	5.09E-08	9.75E-07
Ethylene dichloride	99.0	0.0247	9.10E-02	1.98E-01	1.80E-02	6.6%	8.80E-09	4.44E-08
Formaldehyde	30.0	0.0021	4.55E-02	1.69E-02	7.67E-04	0.3%	3.74E-10	2.22E-08
Tetrachloroethylene	165.8	0.0090	2.10E-02	7.23E-02	1.52E-03	0.6%	7.40E-10	1.02E-08
Toluene	92.1	0.4084	NA	3.28E+00	0.00E+00	0.0%	0.00E+00	0.00E+00
Trichloroethane	133.4	0.0092	NA	7.39E-02	0.00E+00	0.0%	0.00E+00	0.00E+00
Trichloroethylene	131.4	0.0274	4.00E-01	2.20E-01	8.80E-02	32.3%	4.29E-08	1.95E-07
Xylenes	106.2	0.0020	NA	1.61E-02	0.00E+00	0.0%	0.00E+00	0.00E+00
Total		0.9999		8.03E+00	2.73E-01		1.33E-07	1.66E-08

Notes:

- (1) Total VOC emission rate is taken from page A-2 of EAI (2006b).
- (2) Total inhalation risks are taken from Table 8 of EAI (2006b).
- (3) The vapor weight fraction of each compound is taken from page A-6 of EAI (2006b).
- (2) Inhalation cancer slope factor data are from USEPA (2004b). For non-carcinogens, the cancer slope factor is not applicable (NA).
- (3) Contribution to total risk by each compound is proportional to product of emission rate and cancer slope factor.

Table 2
Risk from Source FUELBLND Assuming Equal Liquid Weight Fractions of all Compounds

Chemical	Liquid Weight Fraction	Henry's Law Constant @ 25 C (atm per m ³ /mol)	Solubility (mg/L)	Molecular Weight (g/mol)	Conc. in Waste (mol/m ³)	Partial Vapor Pressure (atm)	Vapor Mole Fraction (Yi)	Yi*MW	Vapor Weight Fraction	Emission Rate (lb/yr)	Risk per Emission Rate (lb/yr) ⁻¹	Risk
8.03E+02 Total VOC emission rate from Tank 600, lb/yr												
Acrylonitrile	2.27E-03	1.03E-04	7.40E+04	53.1	4.28E+01	4.40E-03	4.40E-03	2.34E-01	1.01E-03	8.08E-01	4.88E-07	3.94E-07
Aniline	2.27E-03	2.02E-06	3.60E+04	93.1	2.44E+01	4.93E-05	4.93E-05	4.59E-03	1.98E-05	1.59E-02	0.00E+00	0.00E+00
Benzene	2.27E-03	5.54E-03	1.79E+03	78.1	2.29E+01	1.27E-01	1.27E-01	9.91E+00	4.27E-02	3.43E+01	1.32E-08	4.52E-07
Carbon tetrachloride	2.27E-03	3.03E-02	7.93E+02	154.0	5.16E+00	1.56E-01	1.56E-01	2.41E+01	1.04E-01	8.34E+01	2.56E-08	2.13E-06
Chloroethene	2.27E-03	2.69E-02	8.80E+03	62.5	3.64E+01	9.79E-01	9.79E-01	6.12E+01	2.64E-01	2.12E+02	1.51E-08	3.20E-06
Chloroform	2.27E-03	3.66E-03	7.92E+03	119.0	1.91E+01	6.99E-02	6.99E-02	8.32E+00	3.59E-02	2.88E+01	9.26E-09	2.67E-07
1,4-Dichlorobenzene	2.27E-03	2.39E-03	7.90E+01	147.0	5.37E-01	1.29E-03	1.29E-03	1.89E-01	8.15E-04	6.55E-01	1.07E-08	7.02E-09
1,1-Dichloroethane	2.27E-03	5.61E-03	5.06E+03	98.9	2.30E+01	1.29E-01	1.29E-01	1.27E+01	5.49E-02	4.41E+01	2.78E-09	1.23E-07
1,1-Dichloroethylene	2.27E-03	2.60E-02	2.25E+03	96.9	2.32E+01	6.04E-01	6.04E-01	5.86E+01	2.53E-01	2.03E+02	0.00E+00	0.00E+00
Dichloromethane	2.27E-03	2.18E-03	1.30E+04	84.9	2.68E+01	5.85E-02	5.85E-02	4.96E+00	2.14E-02	1.72E+01	8.02E-10	1.38E-08
1,1-Dimethylhydrazine	2.27E-03	1.29E-05	1.00E+06	60.1	3.78E+01	4.88E-04	4.88E-04	2.93E-02	1.26E-04	1.02E-01	0.00E+00	0.00E+00
1,4-Dioxane	2.27E-03	4.80E-06	1.00E+06	88.1	2.58E+01	1.24E-04	1.24E-04	1.09E-02	4.70E-05	3.78E-02	5.36E-09	2.03E-10
Epichlorohydrin	2.27E-03	3.19E-05	6.00E+04	92.5	2.46E+01	7.84E-04	7.84E-04	7.25E-02	3.13E-04	2.51E-01	3.90E-08	9.79E-09
Ethylbenzene	2.27E-03	7.86E-03	1.69E+02	106.2	1.59E+00	1.25E-02	1.25E-02	1.33E+00	5.73E-03	4.60E+00	0.00E+00	0.00E+00
Ethylene Dibromide	2.27E-03	7.41E-04	4.18E+03	187.9	1.21E+01	8.97E-03	8.97E-03	1.68E+00	7.26E-03	5.83E+00	9.75E-07	5.69E-06
Ethylene Dichloride	2.27E-03	9.77E-04	8.52E+03	99.0	2.30E+01	2.24E-02	2.24E-02	2.22E+00	9.57E-03	7.68E+00	4.44E-08	3.41E-07
Formaldehyde	2.27E-03	3.37E-07	4.00E+05	30.0	7.57E+01	2.55E-05	2.55E-05	7.66E-04	3.30E-06	2.65E-03	2.22E-08	5.88E-11
Tetrachloroethylene	2.27E-03	1.84E-02	2.00E+02	165.8	1.21E+00	2.21E-02	2.21E-02	3.67E+00	1.58E-02	1.27E+01	1.02E-08	1.30E-07
Toluene	2.27E-03	6.62E-03	5.26E+02	92.1	5.71E+00	3.78E-02	3.78E-02	3.48E+00	1.50E-02	1.21E+01	0.00E+00	0.00E+00
Trichloroethane	2.27E-03	1.72E-02	1.33E+03	133.4	1.00E+01	1.72E-01	1.72E-01	2.29E+01	9.87E-02	7.92E+01	0.00E+00	0.00E+00
Trichloroethylene	2.27E-03	1.03E-02	1.47E+03	131.4	1.12E+01	1.15E-01	1.15E-01	1.51E+01	6.52E-02	5.24E+01	1.95E-07	1.02E-05
Xylenes	2.27E-03	7.34E-03	1.61E+02	106.2	1.52E+00	1.11E-02	1.11E-02	1.18E+00	5.10E-03	4.09E+00	0.00E+00	0.00E+00
Total	5.00E-02					1.00E+00	2.53E+00	2.32E+02	1.00E+00	8.03E+02		2.30E-05

Notes:

- (1) Total VOC emission rate is the original rate (see Table 1), scaled by the ratio of the revised total vapor pressure to the original total vapor pressure.
- (2) Compound liquid weight fractions are assumed equal, and total to 5% of the waste mixture (with 95% as water).
- (3) Compound concentration in waste is limited by solubility where shown in **bold font**.
- (4) Total partial pressure is assumed to equal 1 atm, because the partial of pressure of each component added to greater than 1 atm.

Table 3
Risk per Emission Rate from Sources DRUMN and DRUMS

Compound	MW (g/mol)	Adj. Vapor Weight Fraction	SFi (mg/kg/d) ⁻¹	Emission Rate (lb/yr)	SFi*ER	Risk	Risk per Emission Rate (lb/yr) ⁻¹
20.5	Total VOC emission rate from DrumN and DrumS, lb/yr						
3.97E-07	Total inhalation risk from DrumN and DrumS, unitless						
Acrylonitrile	53.1	0.0041	1.00E+00	8.50E-02	8.50E-02	4.65E-08	5.47E-07
Aniline	93.1	0.0001	NA	2.24E-03	0.00E+00	0.00E+00	0.00E+00
Benzene	78.1	0.0237	2.70E-02	4.85E-01	1.31E-02	7.17E-09	1.48E-08
Carbon tetrachloride	153.8	0.0120	5.25E-02	2.46E-01	1.29E-02	7.07E-09	2.87E-08
Chloroethene	62.5	0.0049	3.10E-02	1.01E-01	3.12E-03	1.71E-09	1.70E-08
Chloroform	119.4	0.0746	1.90E-02	1.53E+00	2.91E-02	1.59E-08	1.04E-08
1,4-Dichlorobenzene	147.0	0.0008	2.20E-02	1.57E-02	3.44E-04	1.88E-10	1.20E-08
1,1-Dichloroethane	99.0	0.0731	5.70E-03	1.50E+00	8.54E-03	4.67E-09	3.12E-09
1,1-Dichloroethylene	96.9	0.1948	NA	3.99E+00	0.00E+00	0.00E+00	0.00E+00
Dichloromethane	84.9	0.1207	1.65E-03	2.48E+00	4.07E-03	2.23E-09	9.00E-10
1,1-Dimethylhydrazine	60.1	0.0026	NA	5.37E-02	0.00E+00	0.00E+00	0.00E+00
1,4-Dioxane	88.1	0.0105	1.10E-02	2.15E-01	2.36E-03	1.29E-09	6.02E-09
Epichlorohydrin	92.5	0.0048	8.00E-02	9.84E-02	7.87E-03	4.31E-09	4.38E-08
Ethylbenzene	106.2	0.0031	NA	6.26E-02	0.00E+00	0.00E+00	0.00E+00
Ethylene dibromide	187.9	0.0067	2.00E+00	1.36E-01	2.73E-01	1.49E-07	1.09E-06
Ethylene dichloride	99.0	0.0255	9.10E-02	5.23E-01	4.76E-02	2.61E-08	4.98E-08
Formaldehyde	30.0	0.0024	4.55E-02	4.92E-02	2.24E-03	1.22E-09	2.49E-08
Tetrachloroethylene	165.8	0.0094	2.10E-02	1.92E-01	4.04E-03	2.21E-09	1.15E-08
Toluene	92.1	0.3863	NA	7.92E+00	0.00E+00	0.00E+00	0.00E+00
Trichloroethane	133.4	0.0096	NA	1.97E-01	0.00E+00	0.00E+00	0.00E+00
Trichloroethylene	131.4	0.0284	4.00E-01	5.81E-01	2.33E-01	1.27E-07	2.19E-07
Xylenes	106.2	0.0021	NA	4.25E-02	0.00E+00	0.00E+00	0.00E+00
Total		1.0000		2.05E+01	7.26E-01	3.97E-07	1.94E-08

Notes:

- (1) Total VOC emission rate is taken from page A-2 of EAI (2006b).
- (2) Total inhalation risks are taken from Table 8 of EAI (2006b).
- (3) The vapor weight fraction of each compound is taken from page A-7 of EAI (2006b).
- (2) Inhalation cancer slope factor data are from USEPA (2004b). For non-carcinogens, the cancer slope factor is not applicable (NA).
- (3) Contribution to total risk by each compound is proportional to product of emission rate and cancer slope factor.

Table 4
Risk from Sources DRUMN and DRUMS Assuming Equal Liquid Weight Fractions of all Compounds

2.05E+01 Total VOC emission rate from DrumN and DrumS, lb/yr												
Chemical	Liquid Weight Fraction	Henry's Law Constant @ 25 C (atm per m ³ /mol)	Solubility (mg/L)	Molecular Weight (g/mol)	Conc. in Waste (mol/m ³)	Partial Vapor Pressure (atm)	Vapor Mole Fraction (Yi)	Yi*MW	Vapor Weight Fraction	Emission Rate (lb/yr)	Risk per Emission Rate (lb/yr) ⁻¹	Risk
Acrylonitrile	2.27E-03	1.03E-04	7.40E+04	53.1	4.28E+01	4.40E-03	1.74E-03	9.22E-02	1.01E-03	2.06E-02	5.47E-07	1.13E-08
Aniline	2.27E-03	2.02E-06	3.60E+04	93.1	2.44E+01	4.93E-05	1.95E-05	1.81E-03	1.98E-05	4.06E-04	0.00E+00	0.00E+00
Benzene	2.27E-03	5.54E-03	1.79E+03	78.1	2.29E+01	1.27E-01	5.01E-02	3.91E+00	4.27E-02	8.76E-01	1.48E-08	1.29E-08
Carbon tetrachloride	2.27E-03	3.03E-02	7.93E+02	154.0	5.16E+00	1.56E-01	6.18E-02	9.51E+00	1.04E-01	2.13E+00	2.87E-08	6.12E-08
Chloroethene	2.27E-03	2.69E-02	8.80E+03	62.5	3.64E+01	9.79E-01	3.87E-01	2.42E+01	2.64E-01	5.41E+00	1.70E-08	9.18E-08
Chloroform	2.27E-03	3.66E-03	7.92E+03	119.0	1.91E+01	6.99E-02	2.76E-02	3.28E+00	3.59E-02	7.35E-01	1.04E-08	7.65E-09
1,4-Dichlorobenzene	2.27E-03	2.39E-03	7.90E+01	147.0	5.37E-01	1.29E-03	5.08E-04	7.47E-02	8.15E-04	1.67E-02	1.20E-08	2.01E-10
1,1-Dichloroethane	2.27E-03	5.61E-03	5.06E+03	98.9	2.30E+01	1.29E-01	5.08E-02	5.03E+00	5.49E-02	1.13E+00	3.12E-09	3.51E-09
1,1-Dichloroethylene	2.27E-03	2.60E-02	2.25E+03	96.9	2.32E+01	6.04E-01	2.39E-01	2.31E+01	2.53E-01	5.18E+00	0.00E+00	0.00E+00
Dichloromethane	2.27E-03	2.18E-03	1.30E+04	84.9	2.68E+01	5.85E-02	2.31E-02	1.96E+00	2.14E-02	4.39E-01	9.00E-10	3.95E-10
1,1-Dimethylhydrazine	2.27E-03	1.29E-05	1.00E+06	60.1	3.78E+01	4.88E-04	1.93E-04	1.16E-02	1.26E-04	2.59E-03	0.00E+00	0.00E+00
1,4-Dioxane	2.27E-03	4.80E-06	1.00E+06	88.1	2.58E+01	1.24E-04	4.89E-05	4.31E-03	4.70E-05	9.64E-04	6.02E-09	5.80E-12
Epichlorohydrin	2.27E-03	3.19E-05	6.00E+04	92.5	2.46E+01	7.84E-04	3.09E-04	2.86E-02	3.13E-04	6.41E-03	4.38E-08	2.81E-10
Ethylbenzene	2.27E-03	7.86E-03	1.69E+02	106.2	1.59E+00	1.25E-02	4.94E-03	5.24E-01	5.73E-03	1.17E-01	0.00E+00	0.00E+00
Ethylene Dibromide	2.27E-03	7.41E-04	4.18E+03	187.9	1.21E+01	8.97E-03	3.54E-03	6.65E-01	7.26E-03	1.49E-01	1.09E-06	1.63E-07
Ethylene Dichloride	2.27E-03	9.77E-04	8.52E+03	99.0	2.30E+01	2.24E-02	8.85E-03	8.76E-01	9.57E-03	1.96E-01	4.98E-08	9.77E-09
Formaldehyde	2.27E-03	3.37E-07	4.00E+05	30.0	7.57E+01	2.55E-05	1.01E-05	3.02E-04	3.30E-06	6.77E-05	2.49E-08	1.69E-12
Tetrachloroethylene	2.27E-03	1.84E-02	2.00E+02	165.8	1.21E+00	2.21E-02	8.74E-03	1.45E+00	1.58E-02	3.24E-01	1.15E-08	3.73E-09
Toluene	2.27E-03	6.62E-03	5.26E+02	92.1	5.71E+00	3.78E-02	1.49E-02	1.38E+00	1.50E-02	3.08E-01	0.00E+00	0.00E+00
Trichloroethane	2.27E-03	1.72E-02	1.33E+03	133.4	1.00E+01	1.72E-01	6.77E-02	9.04E+00	9.87E-02	2.02E+00	0.00E+00	0.00E+00
Trichloroethylene	2.27E-03	1.03E-02	1.47E+03	131.4	1.12E+01	1.15E-01	4.54E-02	5.97E+00	6.52E-02	1.34E+00	2.19E-07	2.93E-07
Xylenes	2.27E-03	7.34E-03	1.61E+02	106.2	1.52E+00	1.11E-02	4.39E-03	4.67E-01	5.10E-03	1.04E-01	0.00E+00	0.00E+00
Total	5.00E-02					2.53E+00	1.00E+00	9.16E+01	1.00E+00	2.05E+01		6.58E-07

Notes:

- (1) Total VOC emission rate is the original rate (see Table 3).
- (2) Compound liquid weight fractions are assumed equal, and total to 5% of the waste mixture (with 95% as water).
- (3) Compound concentration in waste is limited by solubility where shown in **bold font**.