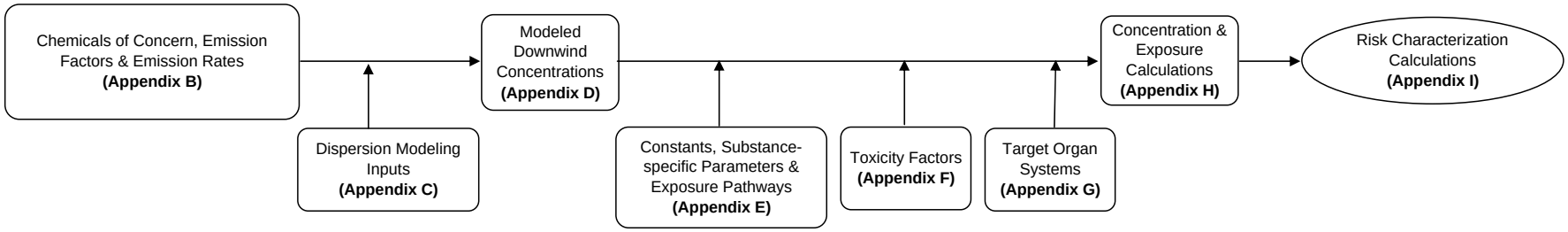
Appendix A

Appendix Organization and Sample Calculations

A-1 Appendix Organization Flowchart
A-2 Sample Calculation

NAWS China Lake OB/OD HRA

Flowchart for Organization of Appendices for the August 2007 Final Deliverable



Notes:

Electronic files used to print the contents of the appendices are listed on the following page

Please read the README file to open the electronic files in the right order

NAWS China Lake OB/OD HRA

Flowchart for Organization of Appendices for the August 2007 Final Deliverable

Section		Title	File Name
Appendix A		**Appendix Organization and Sample Calculations**	
	A-1	**Appendix Organization Flowchart**	070702_NAWSCL_HRA_AppendixFlowchart_jeh-cnr.xls
	A-2	**Sample Calculation**	-
Appendix B		**Chemicals of Concern, Emission Factors, and Emission Rates**	
	B-1	**Energetic Treatment Emissions**	
	B-1.1	Formulae Used	Formulae Used.xls
	B-1.2	Emission Factors	050329_NAWS_OBOD_HRA_Emissions_jad.xls
	B-1.3	Annual & Hourly Emission Rates	050329_NAWS_OBOD_HRA_Emissions_jad.xls
	B-2	**Other Emissions**	
	B-2.1	Formulae Used	Formulae Used.xls
	B-2.2	Constituent Concentrations in Soil and Ash	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
	B-2.3	Crater Emissions	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
	B-2.4	Ash Handling Emissions and Reference Material	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
	B-2.5	Grading Emissions and Reference Material	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
	B-2.6	Wind Erosion Emissions and Reference Material	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
	B-2.7	Diesel Combustion Emissions and Reference Material	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
	B-2.8	Wood Combustion Emissions and Reference Material	050402_NAWS_OBOD_HRA_IndirEmis_jad.xls
Appendix C		**Dispersion Modeling Inputs**	
	C-1	**Greenpoint Meteorological Station Windroses**	
	C-2	**Receptor Data**	
	C-3	**Source Data**	
Appendix D		**Modeled Downwind Concentrations**	
	D-1	**Modeling X/Q Results**	050405_NAWS_Concentration_jad.xls
	D-2	**ISCST3 and OBODM Model Output Files (Electronic Files on CD)**	Modeling Files FOLDER
Appendix E		**Constants, Substance-specific Parameters, and Applicable Exposure Pathways**	
	E-1	**Soil Concentration and Exposure by Media Equation Constants**	050405_NAWS_OBOD_Param_jad.xls
	E-2	**Substance-specific Parameters**	050405_NAWS_OBOD_Param_jad.xls
	E-3	**Applicable Exposure Pathways**	050405_NAWS_OBOD_Param_jad.xls
Appendix F		**Toxicity Factors**	
	F-1	**Cancer Toxicity Factors**	050328_NAWS_OBOD_HRA_TOXLST_V3-3_jad.xls
	F-2	**Chronic Noncancer Toxicity Factors**	050328_NAWS_OBOD_HRA_TOXLST_V3-3_jad.xls
	F-3	**Acute Noncancer Toxicity Factors**	050328_NAWS_OBOD_HRA_TOXLST_V3-3_jad.xls
	F-4	**Toxicity Factor References**	Table 5-1.xls
Appendix G		**Applicable Target Organ Systems**	
	G-1	**Chronic Noncancer**	050331_NAWS_OBOD_Target_jad.xls
	G-2	**Acute Noncancer**	050331_NAWS_OBOD_Target_jad.xls
Appendix H		**Concentration and Exposure Calculations for OB & OD** ***(Concentration and Exposure by OB followed by Concentration and Exposure by OD for each family)***	
	H-1	**Formulae Used**	Formulae Used.xls
	H-2	**Energetic Families**	
	H-2.1	Family A1	050405_NAWS_OBOD_Concentration_jad_A1.xls
	H-2.2	Family A2	050405_NAWS_OBOD_Concentration_jad_A2.xls
	H-2.3	Family B1	050405_NAWS_OBOD_Concentration_jad_B1.xls
	H-2.4	Family B2	050405_NAWS_OBOD_Concentration_jad_B2.xls
	H-2.5	Family B3	050405_NAWS_OBOD_Concentration_jad_B3.xls
	H-2.6	Family C1	050405_NAWS_OBOD_Concentration_jad_C1.xls
	H-2.7	Family IAw	050405_NAWS_OBOD_Concentration_jad_IAw.xls
	H-2.8	Family IAwo	050405_NAWS_OBOD_Concentration_jad_IAwo.xls
	H-2.9	Family IBw	050405_NAWS_OBOD_Concentration_jad_IBw.xls
	H-2.10	Family IBwo	050405_NAWS_OBOD_Concentration_jad_IBwo.xls
	H-2.11	Family ICw	050405_NAWS_OBOD_Concentration_jad_ICw.xls
	H-2.12	Family ICwo	050405_NAWS_OBOD_Concentration_jad_ICwo.xls
	H-2.13	Family IIA	050405_NAWS_OBOD_Concentration_jad_IIA.xls
	H-2.14	Family IIB	050405_NAWS_OBOD_Concentration_jad_IIB.xls
	H-2.15	Family IIC	050405_NAWS_OBOD_Concentration_jad_IIC.xls
	H-2.16	Family IID	050405_NAWS_OBOD_Concentration_jad_IID.xls
	H-2.17	Family IIE	050405_NAWS_OBOD_Concentration_jad_IIE.xls
	H-2.18	Family IIF	050405_NAWS_OBOD_Concentration_jad_IIF.xls
	H-2.19	Family M	050405_NAWS_OBOD_Concentration_jad_M.xls
	H-2.20	Family P	050405_NAWS_OBOD_Concentration_jad_P.xls
	H-2.21	Family W	050405_NAWS_OBOD_Concentration_jad_W.xls
	H-3	**Other Categories**	
	H-3.1	Crater	050405_NAWS_Concentration_jad.xls
	H-3.2	Ash Handling	050405_NAWS_Concentration_jad.xls

NAWS China Lake OB/OD HRA

Flowchart for Organization of Appendices for the August 2007 Final Deliverable

Section		Title	File Name
	H-3.3	Grading	050405_NAWS_Concentration_jad.xls
	H-3.4	Wind Erosion	050405_NAWS_Concentration_jad.xls
	H-3.5	Diesel Combustion	050405_NAWS_Concentration_jad.xls
	H-3.6	Wood Combustion	050405_NAWS_Concentration_jad.xls
Appendix I		**Risk Characterization Calculations for OB & OD** ***(Cancer Risk by OB and OD followed by Chronic Noncancer Hazard Index by OB and OD and Acute Noncancer Hazard Index by OB and OD for each family)***	
	I-1	**Formulae Used**	
	I-2	**Energetic Families**	
	I-2.1	Family A1	050405_NAWS_OBOD_RiskCalc_jad_A1.xls
	I-2.2	Family A2	050405_NAWS_OBOD_RiskCalc_jad_A2.xls
	I-2.3	Family B1	050405_NAWS_OBOD_RiskCalc_jad_B1.xls
	I-2.4	Family B2	050405_NAWS_OBOD_RiskCalc_jad_B2.xls
	I-2.5	Family B3	050405_NAWS_OBOD_RiskCalc_jad_B3.xls
	I-2.6	Family C1	050405_NAWS_OBOD_RiskCalc_jad_C1.xls
	I-2.7	Family IAw	050405_NAWS_OBOD_RiskCalc_jad_IAw.xls
	I-2.8	Family IAwo	050405_NAWS_OBOD_RiskCalc_jad_IAwo.xls
	I-2.9	Family IBw	050405_NAWS_OBOD_RiskCalc_jad_IBw.xls
	I-2.10	Family IBwo	050405_NAWS_OBOD_RiskCalc_jad_IBwo.xls
	I-2.11	Family ICw	050405_NAWS_OBOD_RiskCalc_jad_ICw.xls
	I-2.12	Family ICwo	050405_NAWS_OBOD_RiskCalc_jad_ICwo.xls
	I-2.13	Family IIA	050405_NAWS_OBOD_RiskCalc_jad_IIA.xls
	I-2.14	Family IIB	050405_NAWS_OBOD_RiskCalc_jad_IIB.xls
	I-2.15	Family IIC	050405_NAWS_OBOD_RiskCalc_jad_IIC.xls
	I-2.16	Family IID	050405_NAWS_OBOD_RiskCalc_jad_IID.xls
	I-2.17	Family IIE	050405_NAWS_OBOD_RiskCalc_jad_IIE.xls
	I-2.18	Family IIF	050405_NAWS_OBOD_RiskCalc_jad_IIF.xls
	I-2.19	Family M	050405_NAWS_OBOD_RiskCalc_jad_M.xls
	I-2.20	Family P	050405_NAWS_OBOD_RiskCalc_jad_P.xls
	I-2.21	Family W	050405_NAWS_OBOD_RiskCalc_jad_W.xls
	I-3	**Other Categories**	
	I-3.1	Crater	050410_NAWS_OBOD_RiskCalc_Crater_jad.xls
	I-3.2	Ash Handling	050410_NAWS_OBOD_RiskCalc_Ash_jad.xls
	I-3.3	Grading	050410_NAWS_OBOD_RiskCalc_Grading_jad.xls
	I-3.4	Wind Erosion	050410_NAWS_OBOD_RiskCalc_Dust_jad.xls
	I-3.5	Diesel Combustion	050410_NAWS_OBOD_RiskCalc_Diesel_jad.xls
	I-3.6	Wood Combustion	050410_NAWS_OBOD_RiskCalc_Wood_jad.xls
	I-4	**Lead**	

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Job No. 29869482 Project NAWS China Lake OBOD HRA Sheet 1 of 6

Subject Sample Calculations - Risk Calculation Procedure

By James Heumann Date 12-4-06 Checked By [illegible] Date 12-15-06

OBJECTIVE: Demonstrate risk calculation procedure for benzo(a)pyrene (BaP) as an emission from OB treatment of IIA.

CALCULATIONS:

EMISSION RATE OF BaP

BaP emission factor = 8.10×10^{-8} g/g = 8.10×10^{-8} lb/lb

Event treatment limit = 1,000 lbs

Annual treatment limit = 365,000 lbs

∴ Annual BaP emission rate

$$= 8.10 \times 10^{-8} \frac{\text{lb BaP}}{\text{lb IIA}} \times 365{,}000 \text{ lbs IIA}$$

$$= 0.029565 \frac{\text{lbs BaP}}{\text{yr}} \times \left(\frac{454 \text{ g}}{\text{lb}} \times \frac{1 \text{ yr}}{8760 \text{ hr}} \times \frac{1 \text{ hr}}{3600 \text{ s}} \right)$$

$$= 4.256 \times 10^{-7} \text{ g/s BaP}$$

∴ Hourly BaP emission rate

$$= 8.10 \times 10^{-8} \frac{\text{lb BaP}}{\text{lb IIA}} \times 1{,}000 \text{ lbs IIA}$$

$$= 8.1 \times 10^{-5} \frac{\text{lb BaP}}{\text{hr}} \times \left(\frac{454 \text{ g}}{\text{lb}} \times \frac{1 \text{ hr}}{3600 \text{ s}} \right)$$

$$= 1.0215 \times 10^{-5} \text{ g/s BaP}$$

Normalized Concentration

⇒ from "Modeling X/Q Results" in Appendix C,

Maximum Annual Frequency-Weighted $\frac{X}{Q}$ = 7.49×10^{-3} µg/m³/g/s

Maximum 1-hr Average $\frac{X}{Q}$ = 1.94×10^{-1} µg/m³/g/s

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Job No. 29869482 Project NAWS China Lake OBOD HRA Sheet 2 of 6

Subject Sample Calculations - Risk Calculation Procedure

By James Heumann Date 12-4-06 Checked By [illegible] Date 12-15-06

Applicable Pathways

For BaP (a PAH), from Table 5-1 of the OEHHA Guidelines (OEHHA, 2003), the following pathways may apply:

- inhalation
- soil ingestion
- dermal aborption
- meat, dairy, and egg ingestion
- fish ingestion
- plant ingestion (exposed & leafy)
- water ingestion

For NAWS China Lake, water ingestion is not considered a viable exposure route since there are no exposed sources of drinking water in the immediate vicinity. Fish ingestion is also not considered as a viable population exposure route since there is no significant source of fish that supports the local diet. Meat, dairy, and egg ingestion are also not considered as viable exposure routes since a significant amount of farm activity does not exist in the immediate vicinity. Lastly, plant ingestion is also not considered a viable exposure route since a significant amount of vegetation farming does not exist in the immediate vicinity.

Concentration By Media (chronic or annual exposure)

Air

$$GLC = ER_{ANN} \times X/Q$$

$$= 4.256 \times 10^{-7}\ g/s\ BaP \times 7.49 \times 10^{-3}\ \mu g/m^3/g/s$$

$$GLC_{ANN} = 3.188 \times 10^{-9}\ \mu g/m^3$$

Soil (for soil ingestion and dermal absorption pathway)

$$C_s = Dep \times X / (K_s \times SD \times BD \times T_t)$$

$$Dep = GLC \times Dep\text{-}rate \times 86400\ s/d$$

$$= (3.188 \times 10^{-9}\ \mu g/m^3)(0.05\ m/s)(86400\ s/d)$$

$$= 1.377 \times 10^{-5}\ \mu g/m^2/d$$

$$X = [\{e^{-K_s \times T_f} - e^{-K_s \times T_0}\}/K_s] + T_t$$

$$= [\{e^{-(.00122/d)(25{,}550\,d)} - e^{-(.00122/d)(0\,d)}\}/0.00122\,d^{-1}] + 25{,}550\,d$$

$$= [(2.9013 \times 10^{-14} - 1)/0.00122/d] + 25{,}550\,d$$

$$X = 24730.33\ d$$

$SD = 0.01\ m$
$BD = 1{,}333\ kg/m^3$
$T_t = 25{,}550\ d$
$Dep\text{-}rate = 0.05\ m/s$ (uncontrolled source)

$K_s = 0.693/t_{1/2}$
$= 0.693/5.70 \times 10^2$
$K_s = 0.00122/d$
$T_0 = 0\ d$
$T_f = 25{,}550\ d$

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Job No. 29869482 Project NAWS China Lake OBOD HRA Sheet 3 of 6

Subject Sample Calculations – Risk Calculation Procedure

By James Heumann Date 12-4-06 Checked By [illegible] Date 12-15-06

$$C_s = 1.377 \times 10^{-5}\ mg/m^2/d \times 24730.33\ d \Big/ \left[(0.00122\ d^{-1})(0.01\ m)(1{,}333\ kg/m^3)(25{,}550\ d)\right]$$

$$= 8.196 \times 10^{-4}\ mg/kg$$

For nursing mother in mother's milk pathway

$$x = \left[\left(e^{-(.00122\ d^{-1})(9{,}190\ d)} - e^{-0}\right)/.00122\ d\right] + 9{,}490\ d$$

$$= 8670.34\ d$$

$$\therefore C_s = 1.377 \times 10^{-5}\ mg/m^2/d \times 8{,}670.34\ d \Big/ \left[(.00122\ d^{-1})(.01\ m)(1{,}333\ kg/m^3) \times (25{,}550\ d)\right]$$

$$= 2.87 \times 10^{-4}$$ → used to calculate dose for child in mother's milk pathway only

* For produce and meat pathways, SD = 0.15 m

$$\therefore C_s = 8.196 \times 10^{-4}\ mg/kg \times \frac{0.01}{0.15}$$

$$= 5.464 \times 10^{-5}\ mg/kg$$

For nursing mother in mother's milk pathway,

$$C_s = 2.87 \times 10^{-4} \times \frac{0.01}{0.15}$$

$$C_s = 1.91 \times 10^{-5}\ mg/kg$$ → used to calculate dose for child in mother's milk pathway only

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Job No. 29869482 Project NAWS China Lake OBOD HRA Sheet 4 of 6

Subject Sample Calculations - Risk Calculation Procedure

By James Heumann Date 12-4-06 Checked By [illegible] Date 12-15-06

Exposure by Media (Chronic or Annual Exposure)

Inhalation Exposure

$$Dose_{inh} = C_{air} \times DBR \times A \times EF \times ED \times 10^{-6} / AT \qquad Eq\ 5.4.1A$$

$$= \left[3.188 \times 10^{-9}\ \mu g/m^3 \times 393\ l/kg \cdot d \times 1 \times 350\ d/yr \times 70\ yr \times 10^{-6}\right] / 25{,}550\ d$$

$$Dose_{inh} = 1.2 \times 10^{-12}\ mg/kg \cdot d$$

DBR = 393 l/kg·d
A = 1
EF = 350 d/yr
ED = 70 yr
AT = 25,550 d
$10^{-6} \Rightarrow \mu g \rightarrow mg$
$l \rightarrow m^3$

Dermal Exposure

$$Dose_{derm} = C_s \times SA \times SL \times EF \times ABS \times 10^{-9} \times ED / BW \times AT \qquad Eq\ 5.4.2A$$

$$= \left[(8.196 \times 10^{-4}\ mg/kg)(5{,}500\ cm^2)(1.0\ mg/cm^2 \cdot d)(350\ d/yr) \times (0.13)(10^{-9})(70\ yr)\right] / (63\ kg \times 25{,}550\ d)$$

$$Dose_{derm} = 8.92 \times 10^{-12}\ mg/kg \cdot d$$

SA = 5,500 cm²
SL = 1.0 mg/cm²·d
EF = 350 d/yr
ABS = 0.13
ED = 70 yr
BW = 63 kg
AT = 25,550 d
$10^{-9} \Rightarrow \mu g \rightarrow kg$

Soil Ingestion Exposure

$$Dose_{soil} = C_s \times GRAF \times SIR \times EF \times ED \times 10^{-9} / AT$$

$$= \left[(8.196 \times 10^{-4}\ mg/kg)(1.0)(1.7\ mg/kg \cdot d)(350\ d/yr) \times (70\ yr \times 10^{-9})\right] / 25{,}550\ d$$

$$Dose_{soil} = 1.34 \times 10^{-12}\ mg/kg \cdot d$$

GRAF = 1.0
SIR = 1.7 mg/kg·d
EF = 350 d/yr
ED = 70 yr
AT = 25,550 d
$10^{-9} \Rightarrow \left(\frac{mg}{\mu g}\right)\left(\frac{kg}{mg}\right)$

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Job No. 29869482 Project NAWS China Lake OBOD HRA Sheet 5 of 6

Subject Sample Calculations – Risk Calculation Procedure

By James Heermann Date 12-4-06 Checked By [illegible] Date 12-13-06

Risk Index Calculations

Cancer Risk

Inhalation Cancer Risk = $Dose_{inh} \times CPF_{inh}$

$$= \left(1.2 \times 10^{-12} \frac{mg}{kg \cdot d}\right)\left[3.90 \times 10^{0} \left(mg/kg \cdot d\right)^{-1}\right]$$

$$= 4.68 \times 10^{-12}$$

Dermal Absorption Cancer Risk = $Dose_{derm} \times CPF_{oral}$

$$= \left(8.92 \times 10^{-12} \frac{mg}{kg \cdot d}\right)\left[1.2 \times 10^{1} \left(\frac{mg}{kg \cdot d}\right)^{-1}\right]$$

$$= 1.07 \times 10^{-10}$$

Soil Ingestion Cancer Risk = $Dose_{soil} \times CPF_{oral}$

$$= \left(1.34 \times 10^{-12} \frac{mg}{kg \cdot d}\right)\left[1.2 \times 10^{1} \left(\frac{mg}{kg \cdot d}\right)^{-1}\right]$$

$$= 1.61 \times 10^{-11}$$

Total Cancer Risk = $\sum$(Inhalation, Dermal, Soil) Cancer Risk

$$= 4.68 \times 10^{-12} + 1.07 \times 10^{-10} + 1.61 \times 10^{-11}$$

$$\boxed{\text{Total Cancer Risk} = 1.28 \times 10^{-10}}$$

Chronic Noncancer Risk

BaP does not have a chronic noncancer REL identified; therefore the chronic hazard quotient is zero.

$$\boxed{HQ_{chronic} = 0}$$

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Job No. 29869482 Project NAWS China Lake OBOD HRA Sheet 6 of 6

Subject Sample Calculations – Risk Calculation Procedure

By James Heumann Date 12-4-06 Checked By [illegible] Date 12-15-06

Acute Noncancer Risk

BaP does have an acute REL; however, a target organ (TO) system is not identified by OEHHA, and secondarily, a TO system is not discernible through a RAIS/NIOSH search. An "other" TO system has therefore been assigned since an acute REL is evaluated for in this HRA.

$$\text{Acute Hazard Quotient} = \frac{C_{air,hr}}{\text{Acute REL}} = \frac{\chi/Q_{hr} \times Q_{hr}}{\text{Acute REL}}$$

$$= \frac{\left(1.94\times10^{-1}\ \frac{mg}{m^3}/g/s\right)\left(1.0215\times10^{-5}\ \frac{g}{s}\right)}{1\times10^{3}\ mg/m^3}$$

$$\boxed{HQ_{Acute} = 1.98\times10^{-9}}$$

Appendix B

Chemicals of Concern, Emission Factors, and Emission Rates

B-1 Energetic Treatment Emissions

- B-1.1 Formulae Used
- B-1.2 Emission Factors
- B-1.3 Annual & Hourly Emission Rates

B-2 Other Emissions

- B-2.1 Formulae Used
- B-2.2 Constituent Concentrations in Soil and Ash
- B-2.3 Crater Emissions
- B-2.4 Ash Handling Emissions and Reference Material
- B-2.5 Grading Emissions and Reference Material
- B-2.6 Wind Erosion Emissions and Reference Material
- B-2.7 Diesel Combustion Emissions and Reference Material
- B-2.8 Wood Combustion Emissions and Reference Material

NAWS China Lake OBOD HRA Update
Formulae Used - Energetic Emission Rates

Quantity	Formula
Energetic COC Annual Emission Rate (lbs/yr)	(COC Emission Factor, g/g EW[1]) x (Energetic Treatment Amount, lbs/yr)
Energetic COC Hourly Emission Rate (lbs/hr)	(COC Emission Factor, g/g EW[1]) x (Energetic Treatment Amount, lbs/hr)

Note:

[1]Emission factor is g/g (EW + W) for families M and W

NAWS China Lake OBOD HRA Update
OB Emission Factors

Chemical	CAS #	Emission Factor by Family																	
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)
Acenaphthene	83329	5.00E-07		5.00E-07	5.00E-07		5.00E-07		5.00E-07	5.00E-07	5.00E-07	5.00E-07							
Acenaphthylene	208968	5.00E-07		5.00E-07	5.00E-07		5.00E-07		5.00E-07	5.00E-07	5.00E-07	5.00E-07							
Acetaldehyde	75070															1.34E-06	1.34E-06		
Acetone	67641												1.40E-05			3.71E-06	3.71E-06	1.40E-05	
Acetonitrile	75058																		
Acetophenone	98862																		
Acetylaminofluorene, 2-	53963																		
Acrolein	107028												2.10E-06			5.51E-06	5.51E-06	2.10E-06	
Acrylonitrile	107131															9.06E-06	9.06E-06		
Allyl chloride	107051																		
Aluminum	7429905									1.10E-02	1.10E-02		2.70E-02		1.70E-02		2.70E-02	2.70E-02	1.90E-01
Aminobiphenyl, 4-	92671																		
Ammonia	7664417	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04
Aniline	62533																		
Anthracene	120127																		
Antimony and Compounds	7440360																		
Arsenic	7440382																		
Azobenzene	103333																		
Barium	7440393							5.50E-05											2.40E-04
Benzaldehyde	100527												6.00E-05					6.00E-05	1.10E-04
Benzene	71432	1.00E-05	6.70E-05		1.00E-05	6.70E-05		1.20E-04	3.20E-06	5.70E-05	5.70E-05		1.40E-05	9.70E-05	7.20E-06	8.10E-04	8.10E-04	1.40E-05	1.10E-04
Benzidine	92875	3.00E-08			3.00E-08			3.10E-07	3.00E-08										
Benzo(A)Anthracene	56553							1.40E-07	1.40E-07										
Benzo(A)pyrene	50328							8.10E-08											
Benzo(b)fluoranthene	205992																		
Benzo(k)fluoranthene	207089																		
Benzo[g,h,i]perylene	191242																		
Benzofuran, 2,3-	271896																		1.10E-07
Benzoic acid	65850																		1.10E-04
Benzyl alcohol	100516												9.30E-06					9.30E-06	1.10E-04
Benzyl chloride	100447																		
Beryllium	7440417																		
Biphenyl, 1,1-	92524																		1.10E-04
Bis(2-chloroethyl)ether	111444																		
Bis(2-chloroisopropyl)ether	39638329																		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		3.00E-04			3.00E-04													
Bromodichloromethane	75274									7.10E-07	7.10E-07		6.80E-06					6.80E-06	
Bromoform (tribromomethane)	75252									4.20E-07	4.20E-07		6.80E-06					6.80E-06	
Bromomethane	74839									7.10E-07	7.10E-07								
Butadiene-1,3	106990		6.70E-06			6.70E-06		5.10E-06					2.80E-06	1.70E-06	1.50E-06	2.10E-05	2.10E-05	2.80E-06	1.10E-04
Butanol, 1-	71363																		7.70E-03
Butyl benzyl phthalate	85687		3.00E-04			3.00E-04													
Butylacrylate	141322																		
Butylbenzene, n-	104518	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06				1.10E-04
Butylbenzene, T-	98066	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06				1.10E-04
Cadmium	7440439																		
Carbazole	86748	3.00E-08			3.00E-08			3.10E-07	3.00E-08										
Carbon Monoxide	630080	1.40E-02	1.40E-02	1.30E-04	1.40E-02	1.40E-02	1.30E-04	1.10E-01	2.70E-03	4.20E-03	4.20E-03	1.40E-04	7.10E-03	5.50E-02	5.20E-03	3.10E-02	3.10E-02	7.10E-03	5.30E-02
Carbon tetrachloride	56235									1.10E-06	1.10E-06								
Chlorine	7782505									4.60E-03	4.60E-03	9.20E-03	4.60E-03					4.60E-03	
Chloroacetophenone, 2-	532274																		
Chloroaniline, 4-	106478																		
Chlorobenzene	108907																		
Chloroethane (Ethyl chloride)	75003																		
Chloroform	67663									4.20E-07	4.20E-07		6.80E-06					6.80E-06	
Chloromethane (Methyl chloride)	74873									7.10E-07	7.10E-07								
Chloronaphthalene	91587																		
Chlorophenol, 2-	95578																		
Chlorotoluene, o-	95498																		
Chromium (hex.)	18540299																		
Chromium III	16065831																		
Chrysene	218019																		
Cobalt	7440484																		
Copper	7440508									5.50E-05	5.50E-05		5.40E-07					5.40E-07	9.48E-04
Cumene (Isopropylbenzene)	98828		5.20E-07			5.20E-07									7.30E-07	3.00E-07	3.00E-07		1.10E-04

NAWS China Lake OBOD HRA Update
OB Emission Factors

Chemical	CAS #	Emission Factor by Family																	
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)
Cyclohexane	110827							6.90E-07						1.60E-06		7.50E-06	7.50E-06		1.10E-04
Dibenz[a,h]anthracene	53703							1.40E-07	1.40E-07										
Dibenzofuran	132649							1.20E-07						1.90E-07		2.00E-06	2.00E-06		1.10E-07
Dibromochloromethane	124481									4.20E-07	4.20E-07		6.20E-03					6.20E-03	
Dichlorobenzene, 1,2-	95501																		
Dichlorobenzene, 1,3-	541731																		
Dichlorobenzene, 1,4-	106467																		
Dichlorobenzidine, 3,3-	91941																		
Dichlorodifluoromethane	75718									1.10E-06	1.10E-06		6.20E-03					6.20E-03	
Dichloroethane, 1,1-	75343																		
Dichloroethane, 1,2-	107062																		
Dichloroethylene (cis), 1,2-	156592																		
Dichloroethylene (trans), 1,2-	156605																		
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354																		
Dichlorophenol, 2,4-	120832																		
Dichloropropane, 1,2-	78875																		
Dichloropropene, 1,3-	542756																		
Diethyl ether (Ethyl ether)	60297																		1.10E-07
Diethyl phthalate	84662		3.00E-04			3.00E-04										1.50E-03	1.50E-03		
Dimethyl Phthalate	131113																		
Dimethylbenz(a)anthracene, 7,12-	57976							1.40E-07	1.40E-07										
Dimethylbenzidine, 3,3'-	119937	3.00E-08			3.00E-08			3.10E-07	3.00E-08										1.10E-04
Dimethylphenol, 2,4-	105679																		1.10E-04
Dinitrobenzene, 1,3-	99650																		
Dinitrophenol, 2,4-	51285																		
Dinitropyrene, 1,6-	42397648																		
Dinitrotoluene, 2,4-	121142	3.00E-08			3.00E-08			1.60E-07						4.50E-07		2.10E-07	2.10E-07		5.90E-07
Dinitrotoluene, 2,6-	606202	3.00E-08			3.00E-08			1.40E-07						2.40E-08		4.10E-08	4.10E-08		8.00E-08
Di-n-octyl phthalate	117840		3.00E-04			3.00E-04													
Dioxane, 1,4-	123911																		1.10E-07
Diphenylamine	122394	3.00E-08			3.00E-08			3.10E-07	3.00E-08										
Ethylbenzene	100414	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06	3.80E-05	3.80E-05		1.10E-04
Ethylene	74851	7.80E-06	3.30E-04		7.80E-06	3.30E-04		2.90E-04	6.50E-06				4.80E-05	3.10E-05	3.20E-05	3.90E-04	3.90E-04	4.80E-05	7.70E-03
Fluoranthene	206440																		
Fluorene	86737																		
Fluorotrichloromethane (Trichlorofluoromethane)	75694									1.10E-06	1.10E-06								
Formaldehyde	50000																		
Furan (Epoxy-1,3-butadiene, 4-)	110009																		1.10E-07
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394															4.10E-12	4.10E-12		
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897																		
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469															2.34E-12	2.34E-12		
Hexachlorobenzene	118741																		
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683																		
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269															1.09E-12	1.09E-12		
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449																		
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219																		
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345															9.26E-13	9.26E-13		
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286																		
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857																		
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743																		
Hexachloroethane	67721																		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	8.40E-04	8.40E-04	8.40E-04	8.40E-04	8.40E-04	8.40E-04	1.20E-05	3.00E-08	3.00E-08	3.00E-08	3.00E-08	7.40E-03	9.60E-06	5.00E-08	7.40E-03	7.40E-03	7.40E-03	
Hexane, n-	110543	1.90E-05	1.50E-06		1.90E-05	1.50E-06		3.50E-06						9.30E-07	5.50E-07	1.90E-05	1.90E-05		7.70E-03
Hydrogen chloride	7647010									2.10E-01	2.10E-01	2.20E-01	3.80E-03					3.80E-03	
Hydrogen Cyanide	74908											6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04
Indeno[1,2,3-cd]pyrene	193395																		
Iron	7439896																		9.48E-04
Isophorone	78591		5.20E-07			5.20E-07		2.80E-06						5.10E-06	1.00E-05				1.10E-04
Isoprene	9003310		6.70E-06			6.70E-06		5.10E-06					2.80E-06	1.70E-06	1.50E-06			2.80E-06	7.70E-03
Lead	7439921							1.30E-02											1.30E-02
Methylcholanthrene, 3-	56495																		
Methylcyclohexane	108872		5.20E-07			5.20E-07		2.80E-06						5.10E-06	1.00E-05	5.30E-06	5.30E-06		7.70E-03
Methylene chloride	75092									6.00E-07	6.00E-07		6.20E-03					6.20E-03	
Methylethyl ketone	78933																		7.70E-03
Methylnaphthalene, 2-	91576	5.00E-07		5.00E-07	5.00E-07		5.00E-07		5.00E-07	5.00E-07	5.00E-07	5.00E-07	1.70E-05					1.70E-05	
Methylphenol, 2-	95487																		1.10E-04

NAWS China Lake OBOD HRA Update
OB Emission Factors

Chemical	CAS #	Emission Factor by Family																	
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		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)
Methylphenol, 3-	108394																		1.10E-04
Methylphenol, 4-	106445																		1.10E-04
Methyltertbutyl ether (MTBE)	1634044																		1.10E-07
Molybdenum	7439987																		
Naphthalene	91203	5.00E-07		5.00E-07	5.00E-07		5.00E-07	5.40E-07	5.00E-07	5.00E-07	5.00E-07	5.00E-07	6.30E-05	1.80E-06		1.40E-06	1.40E-06	6.30E-05	6.30E-07
Nickel and compounds	7440020																		
Nitric Oxide	10102439	2.40E-03	1.50E-02	5.20E-03	2.40E-03	1.50E-02	5.20E-03	2.40E-02	6.30E-03	2.10E-03	2.10E-03	4.00E-03	4.00E-03	1.80E-02	9.90E-03	1.20E-02	1.20E-02	4.00E-03	9.00E-04
Nitroacenaphthene, 5-	602879																		
Nitroaniline, 2-	88744												6.30E-06					6.30E-06	
Nitrobenzene	98953																		
Nitrochrysene, 6-	7496028																		
Nitrogen Dioxide	10102440	5.20E-04	1.70E-03	2.10E-03	5.20E-04	1.70E-03	2.10E-03	2.80E-03	4.70E-04	1.00E-03	1.00E-03	2.40E-03	2.40E-03	2.50E-03	4.50E-05	1.70E-02	1.70E-02	2.40E-03	1.10E-03
Nitroglycerin	55630	3.00E-08	5.00E-08	3.00E-08	3.00E-08	5.00E-08	3.00E-08	5.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08			5.00E-08	5.00E-08	3.00E-08	
Nitroguanidine	556887	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08
Nitrophenol, 4-	100027																		
Nitropropane, 2-	79469												1.10E-05					1.10E-05	
Nitropyrene, 1-	5522430																		
Nitrosodiethylamine, N-	55185																		
Nitrosodimethylamine, N-	62759																		
Nitrosodi-n-butylamine, N-	924163																		
Nitrosodi-n-propylamine, N-	621647																		
Nitrosodiphenylamine, N-	86306																		
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956																		
Nitrosopiperidine, N-	100754																		
Nitrosopyrrolidine, N-	930552																		
Nitrotoluene, o-	88722																		
Nitrotoluene, p-	99990																		
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020															3.23E-12	3.23E-12		
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879															6.64E-12	6.64E-12		
Pentachlorobenzene	608935																		
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416																		
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314																		
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764																		
Pentachloronitrobenzene	82688																		
Pentachlorophenol	87865																		
Phenanthrene	85018																		
Phenol	108952																		
Propanol, 2-	67630																		7.70E-03
Propylbenzene, n-	103651	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06				1.10E-04
Propylene (Propene)	115071	2.00E-06	6.00E-05		2.00E-06	6.00E-05		5.10E-05	1.10E-06	1.70E-06	1.70E-06		1.60E-05	7.20E-06	9.40E-06	7.30E-05	7.30E-05	1.60E-05	7.70E-03
Pyrene	129000																		7.70E-03
Pyridine	110861																		1.10E-04
Styrene	100425		9.40E-06			9.40E-06		3.60E-06					1.80E-06	1.50E-06		1.70E-03	1.70E-03	1.80E-06	1.10E-04
Sulfur Dioxide	7446095													2.60E-04					2.60E-04
Tetrachlorobenzene, 1,2,4,5-	95943																		
Tetrachlorodibenzofuran, 2,3,7,8-	51207319																		
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016																		
Tetrachloroethane, 1,1,2,2-	79345																		
Tetrachloroethylene (PCE)	127184																		
Tetrachlorophenol, 2,3,4,6-	58902																		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458															5.00E-08	5.00E-08		
Thallium and compounds	7446186																		
Toluene	108883	1.80E-06	1.70E-05		1.80E-06	1.70E-05		3.00E-05	3.40E-06					6.70E-06	3.30E-06	2.50E-04	2.50E-04		1.10E-04
Toluidine, o- (Methylaniline, 2-)	95534	1.80E-06	1.70E-05		1.80E-06	1.70E-05		3.00E-05	3.40E-06										
Total HpCDD	35822469															5.34E-12	5.34E-12		
Total HpCDF	67562394															6.13E-12	6.13E-12		
Total HxCDD	19408743																		
Total HxCDF	57117449															5.08E-12	5.08E-12		
Total PeCDD	40321764																		
Total PeCDF	57117314															2.98E-12	2.98E-12		
Total TCDD	1746016																		
Total TCDF	51207319															3.52E-12	3.52E-12		
Trichlorobenzene, 1,2,4-	120821																		
Trichloroethane, 1,1,1- (Methyl chloroform)	71556												1.70E-05					1.70E-05	
Trichloroethane, 1,1,2-	79005												1.70E-05					1.70E-05	
Trichloroethylene (TCE)	79016																		

NAWS China Lake OBOD HRA Update
OB Emission Factors

Chemical	CAS #	Emission Factor by Family																	
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		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)
Trichlorophenol, 2,4,5-	95954																		
Trichlorophenol,2,4,6-	88062																		
Trimethylbenzene, 1,2,4-	95636																		1.10E-04
Trimethylbenzene, 1,3,5-	108678																		1.10E-04
Trimethylpentane, 2,2,4-	540841		7.70E-07			7.70E-07		9.50E-06						2.90E-06	7.30E-07				7.70E-03
Trinitrobenzene, 1,3,5-	99354	3.00E-08			3.00E-08									5.90E-08		4.40E-08	4.40E-08		1.80E-08
Trinitrotoluene, 2,4,6- (TNT)	118967	3.00E-08			3.00E-08									2.50E-07	5.00E-08				
Vanadium & Compounds	7440622																		
Vinyl acetate	108054																		7.70E-03
Vinyl Chloride	75014									1.50E-06	1.50E-06								
Xylene, m-	108383																		1.10E-04
Xylene, o-	95476																		1.10E-04
Xylene, p-	106423																		1.10E-04
Xylenes	1330207															8.37E-07	8.37E-07		1.10E-04
Zinc	7440666									2.75E-05	2.75E-05								5.04E-04
Surrogates with EFs																			
Aminopyridine, 4-	504245																		
Bis(2-chloro-1-methylethyl)ether	108601																		
Bis(chloromethyl)ether	542881																		
Chloronitrobenzene, o-	88733																		
Chloropicrin (trichloronitromethane)	76062												1.10E-05					1.10E-05	
Diaminotoluene, 2,4-	95807																		
Diazomethane	334883																		
Dibutyl phthalate	84742		3.00E-04			3.00E-04													
Dimethylamine	124403	3.00E-08			3.00E-08			3.10E-07	3.00E-08				1.10E-05					1.10E-05	1.10E-05
Dimethylcarbamoyl chloride	79447																		
Dimethylhydrazine, 1,2-	540738																		
Dinitrobenzene, 1,2-	528290																		
Dinitrobenzene, 1,4-	100254																		
Dinitro-o-cresol, 4,6-	534521																		
Ethoxyethanol, 2-	110805																		
Ethyleneimine (Aziridine)	151564															9.06E-06	9.06E-06		
Glutaraldehyde	111308															1.34E-06	1.34E-06		
Malononitrile	109773																		
Manganese	7439965																		9.48E-04
Methacrylonitrile	126987															9.06E-06	9.06E-06		
Methanol	67561																		
Perchlorate	7601903									7.10E-07	7.10E-07								
Phosgene	75445									7.10E-07	7.10E-07								
Phosphorus (white)	7723140																		
Selenium	7782492																		
Silica, Crystalline	1175																		
Sulfuric acid	7664939													2.60E-04					
Urethane (Ethyl carbamate)	51796												5.40E-05					5.40E-05	5.40E-05
Metals in Casings																			
Aluminum	7429905																		
Antimony and Compounds	7440360																		
Barium	7440393																		
Cadmium	7440439																		
Chromium III	16065831																		
Chromium VI	18540299																		
Copper	7440508																		
Iron	7439896																		
Lead	7439921																		
Manganese	7439965																		
Molybdenum	7439987																		
Nickel	7440020																		
Strontium	7440246																		
Zinc	7440666																		

OD Emission Factors

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		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW+W)	(g/g EW+W)
Acenaphthene	83329	5.00E-07		5.00E-07	5.00E-07		5.00E-07		5.00E-07	5.00E-07	5.00E-07	5.00E-07										
Acenaphthylene	208968	5.00E-07		5.00E-07	5.00E-07		5.00E-07		5.00E-07	5.00E-07	5.00E-07	5.00E-07										
Acetaldehyde	75070															1.34E-06	1.34E-06					
Acetone	67641												1.40E-05			3.71E-06	3.71E-06	1.40E-05			8.68E-03	8.68E-03
Acetonitrile	75058																					
Acetophenone	98862																				1.80E-06	1.80E-06
Acetylaminofluorene, 2-	53963																					
Acrolein	107028												2.10E-06			5.51E-06	5.51E-06	2.10E-06			7.15E-06	7.15E-06
Acrylonitrile	107131															9.06E-06	9.06E-06					
Allyl chloride	107051																			1.80E-05		
Aluminum	7429905									1.10E-02	1.10E-02		2.70E-02		1.70E-02		2.70E-02	2.70E-02	1.90E-01	1.90E-02	1.90E-01	1.90E-01
Aminobiphenyl, 4-	92671																					
Ammonia	7664417	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04	6.87E-04		
Aniline	62533																					
Anthracene	120127																					
Antimony and Compounds	7440360																					
Arsenic	7440382																					
Azobenzene	103333																					
Barium	7440393							5.50E-05											2.40E-04	2.40E-04		
Benzaldehyde	100527												6.00E-05					6.00E-05	1.10E-04			
Benzene	71432	1.00E-05	6.70E-05		1.00E-05	6.70E-05		1.20E-04	3.20E-06	5.70E-05	5.70E-05		1.40E-05	9.70E-05	7.20E-06	8.10E-04	8.10E-04	1.40E-05	1.10E-04	4.50E-05	1.17E-05	1.17E-05
Benzidine	92875	3.00E-08			3.00E-08			3.10E-07	3.00E-08													
Benzo(A)Anthracene	56553							1.40E-07	1.40E-07													
Benzo(A)pyrene	50328							8.10E-08														
Benzo(b)fluoranthene	205992																					
Benzo(k)fluoranthene	207089																					
Benzo[g,h,i]perylene	191242																					
Benzofuran, 2,3-	271896																		1.10E-07			
Benzoic acid	65850																		1.10E-04			
Benzyl alcohol	100516												9.30E-06					9.30E-06	1.10E-04			
Benzyl chloride	100447																					
Beryllium	7440417																					
Biphenyl, 1,1-	92524																		1.10E-04			
Bis(2-chloroethyl)ether	111444																			3.10E-06		
Bis(2-chloroisopropyl)ether	39638329																			3.10E-06		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		3.00E-04			3.00E-04														4.00E-04		
Bromodichloromethane	75274									7.10E-07	7.10E-07		6.80E-06					6.80E-06				
Bromoform (tribromomethane)	75252									4.20E-07	4.20E-07		6.80E-06					6.80E-06				
Bromomethane	74839									7.10E-07	7.10E-07									1.70E-06		
Butadiene-1,3	106990		6.70E-06			6.70E-06		5.10E-06					2.80E-06	1.70E-06	1.50E-06	2.10E-05	2.10E-05	2.80E-06	1.10E-04	1.20E-05		
Butanol, 1-	71363																		7.70E-03			
Butyl benzyl phthalate	85687		3.00E-04			3.00E-04														4.00E-04		
Butylacrylate	141322																					
Butylbenzene, n-	104518	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06				1.10E-04	2.40E-06		
Butylbenzene, T-	98066	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06				1.10E-04	2.40E-06		
Cadmium	7440439																			1.10E-03		
Carbazole	86748	3.00E-08			3.00E-08			3.10E-07	3.00E-08													
Carbon Monoxide	630080	1.40E-02	1.40E-02	1.30E-04	1.40E-02	1.40E-02	1.30E-04	1.10E-01	2.70E-03	4.20E-03	4.20E-03	1.40E-04	7.10E-03	5.50E-02	5.20E-03	3.10E-02	3.10E-02	7.10E-03	5.30E-02	2.20E-02		
Carbon tetrachloride	56235									1.10E-06	1.10E-06											
Chlorine	7782505									4.60E-03	4.60E-03	9.20E-03	4.60E-03					4.60E-03		1.59E-04	1.59E-04	1.59E-04
Chloroacetophenone, 2-	532274																					
Chloroaniline, 4-	106478																					
Chlorobenzene	108907																					
Chloroethane (Ethyl chloride)	75003																			3.10E-06		
Chloroform	67663									4.20E-07	4.20E-07		6.80E-06					6.80E-06				
Chloromethane (Methyl chloride)	74873									7.10E-07	7.10E-07									1.70E-06		
Chloronaphthalene	91587																					
Chlorophenol, 2-	95578																					
Chlorotoluene, o-	95498																					
Chromium (hex.)	18540299																			2.67E-05		
Chromium III	16065831																			1.33E-04		
Chrysene	218019																					
Cobalt	7440484																					
Copper	7440508									5.50E-05	5.50E-05		5.40E-07					5.40E-07	9.48E-04	1.20E-03	9.48E-04	9.48E-04
Cumene (Isopropylbenzene)	98828		5.20E-07			5.20E-07									7.30E-07	3.00E-07	3.00E-07		1.10E-04	9.20E-07		
Cyclohexane	110827							6.90E-07						1.60E-06		7.50E-06	7.50E-06		1.10E-04	5.60E-07		
Dibenz[a,h]anthracene	53703							1.40E-07	1.40E-07													
Dibenzofuran	132649							1.20E-07						1.90E-07		2.00E-06	2.00E-06		1.10E-07			
Dibromochloromethane	124481									4.20E-07	4.20E-07		6.20E-03					6.20E-03				
Dichlorobenzene, 1,2-	95501																					
Dichlorobenzene, 1,3-	541731																					
Dichlorobenzene, 1,4-	106467																					

OD Emission Factors

Chemical	CAS #	Emission Factor by Family																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW+W)	(g/g EW+W)
Dichlorobenzidine, 3,3-	91941																					
Dichlorodifluoromethane	75718									1.10E-06	1.10E-06		6.20E-03					6.20E-03				
Dichloroethane, 1,1-	75343																					
Dichloroethane, 1,2-	107062																					
Dichloroethylene (cis), 1,2-	156592																					
Dichloroethylene (trans), 1,2-	156605																					
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354																					
Dichlorophenol, 2,4-	120832																					
Dichloropropane, 1,2-	78875																					
Dichloropropene, 1,3-	542756																					
Diethyl ether (Ethyl ether)	60297																		1.10E-07			
Diethyl phthalate	84662		3.00E-04			3.00E-04										1.50E-03	1.50E-03			4.00E-04		
Dimethyl Phthalate	131113																					
Dimethylbenz(a)anthracene, 7,12-	57976							1.40E-07	1.40E-07													
Dimethylbenzidine, 3,3'-	119937	3.00E-08			3.00E-08			3.10E-07	3.00E-08										1.10E-04			
Dimethylphenol, 2,4-	105679																		1.10E-04			
Dinitrobenzene, 1,3-	99650																					
Dinitrophenol, 2,4-	51285																					
Dinitropyrene, 1,6-	42397648																					
Dinitrotoluene, 2,4-	121142	3.00E-08			3.00E-08			1.60E-07						4.50E-07		2.10E-07	2.10E-07		5.90E-07			
Dinitrotoluene, 2,6-	606202	3.00E-08			3.00E-08			1.40E-07						2.40E-08		4.10E-08	4.10E-08		8.00E-08			
Di-n-octyl phthalate	117840		3.00E-04			3.00E-04														4.00E-04		
Dioxane, 1,4-	123911																		1.10E-07			
Diphenylamine	122394	3.00E-08			3.00E-08			3.10E-07	3.00E-08													
Ethylbenzene	100414	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06	3.80E-05	3.80E-05		1.10E-04	2.40E-06	2.05E-05	2.05E-05
Ethylene	74851	7.80E-06	3.30E-04		7.80E-06	3.30E-04		2.90E-04	6.50E-06				4.80E-05	3.10E-05	3.20E-05	3.90E-04	3.90E-04	4.80E-05	7.70E-03	2.70E-04		
Fluoranthene	206440																					
Fluorene	86737																					
Fluorotrichloromethane (Trichlorofluoromethane)	75694									1.10E-06	1.10E-06											
Formaldehyde	50000																					
Furan (Epoxy-1,3-butadiene, 4-)	110009																		1.10E-07			
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394															4.10E-12	4.10E-12				5.63E-11	5.63E-11
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897																				2.31E-11	2.31E-11
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469															2.34E-12	2.34E-12				9.62E-12	9.62E-12
Hexachlorobenzene	118741																					
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683																					
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269															1.09E-12	1.09E-12				2.98E-11	2.98E-11
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449																				2.43E-11	2.43E-11
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219																				1.30E-11	1.30E-11
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345															9.26E-13	9.26E-13				3.62E-11	3.62E-11
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286																				1.89E-12	1.89E-12
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857																				3.13E-12	3.13E-12
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743																				2.43E-12	2.43E-12
Hexachloroethane	67721																			2.40E-06		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	8.40E-04	8.40E-04	8.40E-04	8.40E-04	8.40E-04	8.40E-04	1.20E-05	3.00E-08	3.00E-08	3.00E-08	3.00E-08	7.40E-03	9.60E-06	5.00E-08	7.40E-03	7.40E-03	7.40E-03		1.90E-04	7.40E-03	7.40E-03
Hexane, n-	110543	1.90E-05	1.50E-06		1.90E-05	1.50E-06		3.50E-06						9.30E-07	5.50E-07	1.90E-05	1.90E-05		7.70E-03	1.70E-06		
Hydrogen chloride	7647010									2.10E-01	2.10E-01	2.20E-01	3.80E-03					3.80E-03		1.70E-06	1.44E-04	1.44E-04
Hydrogen Cyanide	74908											6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04	6.86E-04		4.91E-04	4.91E-04
Indeno[1,2,3-cd]pyrene	193395																					
Iron	7439896																		9.48E-04		9.48E-04	9.48E-04
Isophorone	78591		5.20E-07			5.20E-07		2.80E-06						5.10E-06	1.00E-05				1.10E-04	4.10E-07		
Isoprene	9003310		6.70E-06			6.70E-06		5.10E-06					2.80E-06	1.70E-06	1.50E-06			2.80E-06	7.70E-03	1.20E-05		
Lead	7439921							1.30E-02											1.30E-02	1.30E-03		
Methylcholanthrene, 3-	56495																					
Methylcyclohexane	108872		5.20E-07			5.20E-07		2.80E-06						5.10E-06	1.00E-05	5.30E-06	5.30E-06		7.70E-03	4.10E-07		
Methylene chloride	75092									6.00E-07	6.00E-07		6.20E-03					6.20E-03		4.10E-04		
Methylethyl ketone	78933																		7.70E-03			
Methylnaphthalene, 2-	91576	5.00E-07		5.00E-07	5.00E-07		5.00E-07		5.00E-07	5.00E-07	5.00E-07	5.00E-07	1.70E-05					1.70E-05				
Methylphenol, 2-	95487																		1.10E-04			
Methylphenol, 3-	108394																		1.10E-04			
Methylphenol, 4-	106445																		1.10E-04			
Methyltertbutyl ether (MTBE)	1634044																		1.10E-07			
Molybdenum	7439987																					
Naphthalene	91203	5.00E-07		5.00E-07	5.00E-07		5.00E-07	5.40E-07	5.00E-07	5.00E-07	5.00E-07	5.00E-07	6.30E-05	1.80E-06		1.40E-06	1.40E-06	6.30E-05	6.30E-07			
Nickel and compounds	7440020																					
Nitric Oxide	10102439	2.40E-03	1.50E-02	5.20E-03	2.40E-03	1.50E-02	5.20E-03	2.40E-02	6.30E-03	2.10E-03	2.10E-03	4.00E-03	4.00E-03	1.80E-02	9.90E-03	1.20E-02	1.20E-02	4.00E-03	9.00E-04	1.30E-02	7.41E-03	7.41E-03
Nitroacenaphthene, 5-	602879																					
Nitroaniline, 2-	88744												6.30E-06					6.30E-06				
Nitrobenzene	98953																					
Nitrochrysene, 6-	7496028																					
Nitrogen Dioxide	10102440	5.20E-04	1.70E-03	2.10E-03	5.20E-04	1.70E-03	2.10E-03	2.80E-03	4.70E-04	1.00E-03	1.00E-03	2.40E-03	2.40E-03	2.50E-03	4.50E-05	1.70E-02	1.70E-02	2.40E-03	1.10E-03	2.80E-03	8.81E-03	8.81E-03
Nitroglycerin	55630	3.00E-08	5.00E-08	3.00E-08	3.00E-08	5.00E-08	3.00E-08	5.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08			5.00E-08	5.00E-08	3.00E-08		5.00E-08	3.00E-08	3.00E-08
Nitroguanidine	556887	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08	3.00E-08

Chemical	CAS #	Emission Factor by Family																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW+W)	(g/g EW+W)
Nitrophenol, 4-	100027																					
Nitropropane, 2-	79469												1.10E-05					1.10E-05				
Nitropyrene, 1-	5522430																					
Nitrosodiethylamine, N-	55185																					
Nitrosodimethylamine, N-	62759																					
Nitrosodi-n-butylamine, N-	924163																					
Nitrosodi-n-propylamine, N-	621647																					
Nitrosodiphenylamine, N-	86306																					
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956																					
Nitrosopiperidine, N-	100754																					
Nitrosopyrrolidine, N-	930552																					
Nitrotoluene, o-	88722																					
Nitrotoluene, p-	99990																					
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020															3.23E-12	3.23E-12				4.85E-11	4.85E-11
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879															6.64E-12	6.64E-12			1.80E-09	1.17E-11	1.17E-11
Pentachlorobenzene	608935																					
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416																				1.95E-11	1.95E-11
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314																				4.94E-11	4.94E-11
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764																				2.59E-12	2.59E-12
Pentachloronitrobenzene	82688																					
Pentachlorophenol	87865																					
Phenanthrene	85018																					
Phenol	108952																					
Propanol, 2-	67630																		7.70E-03			
Propylbenzene, n-	103651	2.60E-07	1.90E-06		2.60E-07	1.90E-06		4.60E-06						2.00E-06	2.30E-06				1.10E-04	2.40E-06		
Propylene (Propene)	115071	2.00E-06	6.00E-05		2.00E-06	6.00E-05		5.10E-05	1.10E-06	1.70E-06	1.70E-06		1.60E-05	7.20E-06	9.40E-06	7.30E-05	7.30E-05	1.60E-05	7.70E-03	5.60E-05		
Pyrene	129000																		7.70E-03			
Pyridine	110861																		1.10E-04			
Styrene	100425		9.40E-06			9.40E-06		3.60E-06					1.80E-06	1.50E-06		1.70E-03	1.70E-03	1.80E-06	1.10E-04	7.10E-06		
Sulfur Dioxide	7446095													2.60E-04					2.60E-04	1.00E-03	1.00E-03	1.00E-03
Tetrachlorobenzene, 1,2,4,5-	95943																					
Tetrachlorodibenzofuran, 2,3,7,8-	51207319																				1.34E-11	1.34E-11
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016																				9.40E-13	9.40E-13
Tetrachloroethane, 1,1,2,2-	79345																			2.40E-06		
Tetrachloroethylene (PCE)	127184																			2.40E-06		
Tetrachlorophenol, 2,3,4,6-	58902																			2.40E-06		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458															5.00E-08	5.00E-08					
Thallium and compounds	7446186																					
Toluene	108883	1.80E-06	1.70E-05		1.80E-06	1.70E-05		3.00E-05	3.40E-06					6.70E-06	3.30E-06	2.50E-04	2.50E-04		1.10E-04	3.00E-05	1.39E-05	1.39E-05
Toluidine, o- (Methylaniline, 2-)	95534	1.80E-06	1.70E-05		1.80E-06	1.70E-05		3.00E-05	3.40E-06													
Total HpCDD	35822469															5.34E-12	5.34E-12				1.86E-11	1.86E-11
Total HpCDF	67562394															6.13E-12	6.13E-12				1.32E-10	1.32E-10
Total HxCDD	19408743																				4.22E-11	4.22E-11
Total HxCDF	57117449															5.08E-12	5.08E-12				2.94E-10	2.94E-10
Total PeCDD	40321764																				5.37E-11	5.37E-11
Total PeCDF	57117314															2.98E-12	2.98E-12				4.63E-10	4.63E-10
Total TCDD	1746016																				5.52E-11	5.52E-11
Total TCDF	51207319															3.52E-12	3.52E-12				6.08E-10	6.08E-10
Trichlorobenzene, 1,2,4-	120821																					
Trichloroethane, 1,1,1- (Methyl chloroform)	71556												1.70E-05					1.70E-05			2.56E-05	2.56E-05
Trichloroethane, 1,1,2-	79005												1.70E-05					1.70E-05				
Trichloroethylene (TCE)	79016																					
Trichlorophenol, 2,4,5-	95954																					
Trichlorophenol,2,4,6-	88062																					
Trimethylbenzene, 1,2,4-	95636																		1.10E-04			
Trimethylbenzene, 1,3,5-	108678																		1.10E-04			
Trimethylpentane, 2,2,4-	540841		7.70E-07			7.70E-07		9.50E-06						2.90E-06	7.30E-07				7.70E-03	1.20E-06		
Trinitrobenzene, 1,3,5-	99354	3.00E-08			3.00E-08									5.90E-08		4.40E-08	4.40E-08		1.80E-08			
Trinitrotoluene, 2,4,6- (TNT)	118967	3.00E-08			3.00E-08									2.50E-07	5.00E-08							
Vanadium & Compounds	7440622																				8.07E-09	8.07E-09
Vinyl acetate	108054																		7.70E-03			
Vinyl Chloride	75014									1.50E-06	1.50E-06									2.30E-06		
Xylene, m-	108383																		1.10E-04			
Xylene, o-	95476																		1.10E-04			
Xylene, p-	106423																		1.10E-04			
Xylenes	1330207															8.37E-07	8.37E-07		1.10E-04		2.00E-05	2.00E-05
Zinc	7440666									2.75E-05	2.75E-05								5.04E-04	7.50E-05	5.04E-04	5.04E-04
Surrogates with EFs																						
Aminopyridine, 4-	504245																					
Bis(2-chloro-1-methylethyl)ether	108601																			3.10E-06		
Bis(chloromethyl)ether	542881																					
Chloronitrobenzene, o-	88733																					

OD Emission Factors

Chemical	CAS #	Emission Factor by Family																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW)	(g/g EW+W)	(g/g EW+W)
Chloropicrin (trichloronitromethane)	76062												1.10E-05					1.10E-05				
Diaminotoluene, 2,4-	95807																					
Diazomethane	334883																					
Dibutyl phthalate	84742		3.00E-04			3.00E-04																
Dimethylamine	124403	3.00E-08			3.00E-08			3.10E-07	3.00E-08				1.10E-05					1.10E-05	1.10E-05			
Dimethylcarbamoyl chloride	79447																			1.80E-05		
Dimethylhydrazine, 1,2-	540738																					
Dinitrobenzene, 1,2-	528290																					
Dinitrobenzene, 1,4-	100254																					
Dinitro-o-cresol, 4,6-	534521																					
Ethoxyethanol, 2-	110805																					
Ethyleneimine (Aziridine)	151564															9.06E-06	9.06E-06					
Glutaraldehyde	111308															1.34E-06	1.34E-06					
Malononitrile	109773																					
Manganese	7439965																		9.48E-04		9.48E-04	9.48E-04
Methacrylonitrile	126987															9.06E-06	9.06E-06					
Methanol	67561																					
Perchlorate	7601903									7.10E-07	7.10E-07									1.70E-06		
Phosgene	75445									7.10E-07	7.10E-07											
Phosphorus (white)	7723140																					
Selenium	7782492																					
Silica, Crystalline	1175																				9.48E-04	9.48E-04
Sulfuric acid	7664939													2.60E-04								
Urethane (Ethyl carbamate)	51796												5.40E-05					5.40E-05	5.40E-05			
Metals in Casings																						
Aluminum	7429905	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03	5.24E-03															
Antimony and Compounds	7440360	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05															
Barium	7440393	6.86E-07	6.86E-07	6.86E-07	6.86E-07	6.86E-07	6.86E-07															
Cadmium	7440439							5.38E-04	5.38E-04	5.38E-04	5.38E-04	5.38E-04		1.65E-05	1.65E-05	7.79E-05	1.65E-05	7.79E-05				
Chromium III	16065831							1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05		1.77E-07	1.77E-07	3.48E-06	1.77E-07	5.13E-06				
Chromium VI	18540299							3.01E-06	3.01E-06	3.01E-06	3.01E-06	3.01E-06		2.95E-08	2.95E-08	5.81E-07	2.95E-08	8.55E-07				
Copper	7440508	8.01E-02	8.01E-02	8.01E-02	8.01E-02	8.01E-02	8.01E-02															
Iron	7439896	2.32E-04	2.32E-04	2.32E-04	1.47E-04	1.47E-04	1.47E-04	2.63E-05	2.63E-05	2.63E-05	2.63E-05	2.63E-05		9.96E-05	9.96E-05	5.27E-05	9.96E-05	2.57E-04				
Lead	7439921	5.98E-05	5.98E-05	5.98E-05	5.98E-05	5.98E-05	5.98E-05															
Manganese	7439965	2.61E-04	2.61E-04	2.61E-04	1.48E-06	1.48E-06	1.48E-06	1.61E-07	1.61E-07	1.61E-07	1.61E-07	1.61E-07		9.05E-07	9.05E-07	4.40E-07	9.05E-07	2.14E-06				
Molybdenum	7439987							6.70E-08	6.70E-08	6.70E-08	6.70E-08	6.70E-08				1.65E-07		8.04E-07				
Nickel	7440020															1.10E-06		5.36E-06				
Strontium	7440246	3.28E-05	3.28E-05	3.28E-05				2.38E-05	2.38E-05	2.38E-05	2.38E-05	2.38E-05				3.57E-06		3.57E-06				
Zinc	7440666	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02	3.43E-02							7.56E-04	7.56E-04		7.56E-04					

NAWS China Lake OBOD HRA Update
OB Annual Emission Rates

Chemical	CAS #	OB Annual Emission Rates																	
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000
Acenaphthene	83329	1.83E-01		1.83E-01	1.83E-01		1.83E-01		1.83E-01	1.83E-01	1.83E-01	1.83E-01							
Acenaphthylene	208968	1.83E-01		1.83E-01	1.83E-01		1.83E-01		1.83E-01	1.83E-01	1.83E-01	1.83E-01							
Acetaldehyde	75070															4.89E-01	4.89E-01		
Acetone	67641												5.11E+00			1.35E+00	1.35E+00	5.11E+00	
Acetonitrile	75058																		
Acetophenone	98862																		
Acetylaminofluorene, 2-	53963																		
Acrolein	107028												7.67E-01			2.01E+00	2.01E+00	7.67E-01	
Acrylonitrile	107131															3.31E+00	3.31E+00		
Allyl chloride	107051																		
Aluminum	7429905									4.02E+03	4.02E+03		9.86E+03		6.21E+03		9.86E+03	9.86E+03	6.94E+04
Aminobiphenyl, 4-	92671																		
Ammonia	7664417	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02	2.51E+02
Aniline	62533																		
Anthracene	120127																		
Antimony and Compounds	7440360																		
Arsenic	7440382																		
Azobenzene	103333																		
Barium	7440393							2.01E+01											8.76E+01
Benzaldehyde	100527												2.19E+01					2.19E+01	4.02E+01
Benzene	71432	3.65E+00	2.45E+01		3.65E+00	2.45E+01		4.38E+01	1.17E+00	2.08E+01	2.08E+01		5.11E+00	3.54E+01	2.63E+00	2.96E+02	2.96E+02	5.11E+00	4.02E+01
Benzidine	92875	1.10E-02			1.10E-02			1.13E-01	1.10E-02										
Benzo(A)Anthracene	56553							5.11E-02	5.11E-02										
Benzo(A)pyrene	50328							2.96E-02											
Benzo(b)fluoranthene	205992																		
Benzo(k)fluoranthene	207089																		
Benzo[g,h,i]perylene	191242																		
Benzofuran, 2,3-	271896																		4.02E-02
Benzoic acid	65850																		4.02E+01
Benzyl alcohol	100516												3.39E+00					3.39E+00	4.02E+01
Benzyl chloride	100447																		
Beryllium	7440417																		
Biphenyl, 1,1-	92524																		4.02E+01
Bis(2-chloroethyl)ether	111444																		
Bis(2-chloroisopropyl)ether	39638329																		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		1.10E+02			1.10E+02													
Bromodichloromethane	75274									2.59E-01	2.59E-01		2.48E+00					2.48E+00	
Bromoform (tribromomethane)	75252									1.53E-01	1.53E-01		2.48E+00					2.48E+00	
Bromomethane	74839									2.59E-01	2.59E-01								
Butadiene-1,3	106990		2.45E+00			2.45E+00		1.86E+00					1.02E+00	6.21E-01	5.48E-01	7.67E+00	7.67E+00	1.02E+00	4.02E+01
Butanol, 1-	71363																		2.81E+03
Butyl benzyl phthalate	85687		1.10E+02			1.10E+02													
Butylacrylate	141322																		
Butylbenzene, n-	104518	9.49E-02	6.94E-01		9.49E-02	6.94E-01		1.68E+00						7.30E-01	8.40E-01				4.02E+01
Butylbenzene, T-	98066	9.49E-02	6.94E-01		9.49E-02	6.94E-01		1.68E+00						7.30E-01	8.40E-01				4.02E+01
Cadmium	7440439																		
Carbazole	86748	1.10E-02			1.10E-02			1.13E-01	1.10E-02										
Carbon Monoxide	630080	5.11E+03	5.11E+03	4.75E+01	5.11E+03	5.11E+03	4.75E+01	4.02E+04	9.86E+02	1.53E+03	1.53E+03	5.11E+01	2.59E+03	2.01E+04	1.90E+03	1.13E+04	1.13E+04	2.59E+03	1.93E+04
Carbon tetrachloride	56235									4.02E-01	4.02E-01								
Chlorine	7782505									1.68E+03	1.68E+03	3.36E+03	1.68E+03					1.68E+03	
Chloroacetophenone, 2-	532274																		
Chloroaniline, 4-	106478																		
Chlorobenzene	108907																		
Chloroethane (Ethyl chloride)	75003																		
Chloroform	67663									1.53E-01	1.53E-01		2.48E+00					2.48E+00	
Chloromethane (Methyl chloride)	74873									2.59E-01	2.59E-01								
Chloronaphthalene	91587																		
Chlorophenol, 2-	95578																		
Chlorotoluene, o-	95498																		
Chromium (hex.)	18540299																		
Chromium III	16065831																		
Chrysene	218019																		
Cobalt	7440484																		

NAWS China Lake OBOD HRA Update
OB Annual Emission Rates

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		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000
Copper	7440508									2.01E+01	2.01E+01		1.97E-01					1.97E-01	3.46E+02
Cumene (Isopropylbenzene)	98828		1.90E-01			1.90E-01									2.66E-01	1.10E-01	1.10E-01		4.02E+01
Cyclohexane	110827							2.52E-01						5.84E-01		2.74E+00	2.74E+00		4.02E+01
Dibenz[a,h]anthracene	53703							5.11E-02	5.11E-02										
Dibenzofuran	132649							4.38E-02						6.94E-02		7.30E-01	7.30E-01		4.02E-02
Dibromochloromethane	124481									1.53E-01	1.53E-01		2.26E+03					2.26E+03	
Dichlorobenzene, 1,2-	95501																		
Dichlorobenzene, 1,3-	541731																		
Dichlorobenzene, 1,4-	106467																		
Dichlorobenzidine, 3,3-	91941																		
Dichlorodifluoromethane	75718									4.02E-01	4.02E-01		2.26E+03					2.26E+03	
Dichloroethane, 1,1-	75343																		
Dichloroethane, 1,2-	107062																		
Dichloroethylene (cis), 1,2-	156592																		
Dichloroethylene (trans), 1,2-	156605																		
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354																		
Dichlorophenol, 2,4-	120832																		
Dichloropropane, 1,2-	78875																		
Dichloropropene, 1,3-	542756																		
Diethyl ether (Ethyl ether)	60297																		4.02E-02
Diethyl phthalate	84662		1.10E+02			1.10E+02										5.48E+02	5.48E+02		
Dimethyl Phthalate	131113																		
Dimethylbenz(a)anthracene, 7,12-	57976							5.11E-02	5.11E-02										
Dimethylbenzidine, 3,3'-	119937	1.10E-02			1.10E-02			1.13E-01	1.10E-02										4.02E+01
Dimethylphenol, 2,4-	105679																		4.02E+01
Dinitrobenzene, 1,3-	99650																		
Dinitrophenol, 2,4-	51285																		
Dinitropyrene, 1,6-	42397648																		
Dinitrotoluene, 2,4-	121142	1.10E-02			1.10E-02			5.84E-02						1.64E-01		7.67E-02	7.67E-02		2.15E-01
Dinitrotoluene, 2,6-	606202	1.10E-02			1.10E-02			5.11E-02						8.76E-03		1.50E-02	1.50E-02		2.92E-02
Di-n-octyl phthalate	117840		1.10E+02			1.10E+02													
Dioxane, 1,4-	123911																		4.02E-02
Diphenylamine	122394	1.10E-02			1.10E-02			1.13E-01	1.10E-02										
Ethylbenzene	100414	9.49E-02	6.94E-01		9.49E-02	6.94E-01		1.68E+00						7.30E-01	8.40E-01	1.39E+01	1.39E+01		4.02E+01
Ethylene	74851	2.85E+00	1.20E+02		2.85E+00	1.20E+02		1.06E+02	2.37E+00				1.75E+01	1.13E+01	1.17E+01	1.42E+02	1.42E+02	1.75E+01	2.81E+03
Fluoranthene	206440																		
Fluorene	86737																		
Fluorotrichloromethane (Trichlorofluoromethane)	75694									4.02E-01	4.02E-01								
Formaldehyde	50000																		
Furan (Epoxy-1,3-butadiene, 4-)	110009																		4.02E-02
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-																1.50E-06	1.50E-06		
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-																			
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-																8.54E-07	8.54E-07		
Hexachlorobenzene	118741																		
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683																		
Hexachlorodibenzofuran, 1,2,3,4,7,8-																3.98E-07	3.98E-07		
Hexachlorodibenzofuran, 1,2,3,6,7,8-																			
Hexachlorodibenzofuran, 1,2,3,7,8,9-																			
Hexachlorodibenzofuran, 2,3,4,6,7,8-																3.38E-07	3.38E-07		
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-																			
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-																			
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-																			
Hexachloroethane	67721																		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	3.07E+02	3.07E+02	3.07E+02	3.07E+02	3.07E+02	3.07E+02	4.38E+00	1.10E-02	1.10E-02	1.10E-02	1.10E-02	2.70E+03	3.50E+00	1.83E-02	2.70E+03	2.70E+03	2.70E+03	
Hexane, n-	110543	6.94E+00	5.48E-01		6.94E+00	5.48E-01		1.28E+00						3.39E-01	2.01E-01	6.94E+00	6.94E+00		2.81E+03
Hydrogen chloride	7647010									7.67E+04	7.67E+04	8.03E+04	1.39E+03					1.39E+03	
Hydrogen Cyanide	74908											2.50E+02	2.50E+02	2.50E+02	2.50E+02	2.50E+02	2.50E+02	2.50E+02	2.50E+02
Indeno[1,2,3-cd]pyrene	193395																		
Iron	7439896																		3.46E+02
Isophorone	78591		1.90E-01			1.90E-01		1.02E+00						1.86E+00	3.65E+00				4.02E+01
Isoprene	9003310		2.45E+00			2.45E+00		1.86E+00					1.02E+00	6.21E-01	5.48E-01			1.02E+00	2.81E+03
Lead	7439921							4.75E+03											4.75E+03
Methylcholanthrene, 3-	56495																		
Methylcyclohexane	108872		1.90E-01			1.90E-01		1.02E+00						1.86E+00	3.65E+00	1.93E+00	1.93E+00		2.81E+03

NAWS China Lake OBOD HRA Update
OB Annual Emission Rates

Chemical	CAS #	OB Annual Emission Rates																	
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000
Methylene chloride	75092									2.19E-01	2.19E-01		2.26E+03					2.26E+03	
Methylethyl ketone	78933																		2.81E+03
Methylnaphthalene, 2-	91576	1.83E-01		1.83E-01	1.83E-01		1.83E-01		1.83E-01	1.83E-01	1.83E-01	1.83E-01	6.21E+00					6.21E+00	
Methylphenol, 2-	95487																		4.02E+01
Methylphenol, 3-	108394																		4.02E+01
Methylphenol, 4-	106445																		4.02E+01
Methyltertbutyl ether (MTBE)	1634044																		4.02E-02
Molybdenum	7439987																		
Naphthalene	91203	1.83E-01		1.83E-01	1.83E-01		1.83E-01	1.97E-01	1.83E-01	1.83E-01	1.83E-01	1.83E-01	2.30E+01	6.57E-01		5.11E-01	5.11E-01	2.30E+01	2.30E-01
Nickel and compounds	7440020																		
Nitric Oxide	10102439	8.76E+02	5.48E+03	1.90E+03	8.76E+02	5.48E+03	1.90E+03	8.76E+03	2.30E+03	7.67E+02	7.67E+02	1.46E+03	1.46E+03	6.57E+03	3.61E+03	4.38E+03	4.38E+03	1.46E+03	3.29E+02
Nitroacenaphthene, 5-	602879																		
Nitroaniline, 2-	88744												2.30E+00					2.30E+00	
Nitrobenzene	98953																		
Nitrochrysene, 6-	7496028																		
Nitrogen Dioxide	10102440	1.90E+02	6.21E+02	7.67E+02	1.90E+02	6.21E+02	7.67E+02	1.02E+03	1.72E+02	3.65E+02	3.65E+02	8.76E+02	8.76E+02	9.13E+02	1.64E+01	6.21E+03	6.21E+03	8.76E+02	4.02E+02
Nitroglycerin	55630	1.10E-02	1.83E-02	1.10E-02	1.10E-02	1.83E-02	1.10E-02	1.83E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02			1.83E-02	1.83E-02	1.10E-02	
Nitroguanidine	556887	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02	1.10E-02
Nitrophenol, 4-	100027																		
Nitropropane, 2-	79469												4.02E+00					4.02E+00	
Nitropyrene, 1-	5522430																		
Nitrosodiethylamine, N-	55185																		
Nitrosodimethylamine, N-	62759																		
Nitrosodi-n-butylamine, N-	924163																		
Nitrosodi-n-propylamine, N-	621647																		
Nitrosodiphenylamine, N-	86306																		
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956																		
Nitrosopiperidine, N-	100754																		
Nitrosopyrrolidine, N-	930552																		
Nitrotoluene, o-	88722																		
Nitrotoluene, p-	99990																		
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-																1.18E-06	1.18E-06		
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-																2.42E-06	2.42E-06		
Pentachlorobenzene	608935																		
Pentachlorodibenzofuran, 1,2,3,7,8-																			
Pentachlorodibenzofuran, 2,3,4,7,8-																			
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-																			
Pentachloronitrobenzene	82688																		
Pentachlorophenol	87865																		
Phenanthrene	85018																		
Phenol	108952																		
Propanol, 2-	67630																		2.81E+03
Propylbenzene, n-	103651	9.49E-02	6.94E-01		9.49E-02	6.94E-01		1.68E+00						7.30E-01	8.40E-01				4.02E+01
Propylene (Propene)	115071	7.30E-01	2.19E+01		7.30E-01	2.19E+01		1.86E+01	4.02E-01	6.21E-01	6.21E-01		5.84E+00	2.63E+00	3.43E+00	2.66E+01	2.66E+01	5.84E+00	2.81E+03
Pyrene	129000																		2.81E+03
Pyridine	110861																		4.02E+01
Styrene	100425		3.43E+00			3.43E+00		1.31E+00					6.57E-01	5.48E-01		6.21E+02	6.21E+02	6.57E-01	4.02E+01
Sulfur Dioxide	7446095													9.49E+01					9.49E+01
Tetrachlorobenzene, 1,2,4,5-	95943																		
Tetrachlorodibenzofuran, 2,3,7,8-																			
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-																			
Tetrachloroethane, 1,1,2,2-	79345																		
Tetrachloroethylene (PCE)	127184																		
Tetrachlorophenol, 2,3,4,6-	58902																		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458															1.83E-02	1.83E-02		
Thallium and compounds	7446186																		
Toluene	108883	6.57E-01	6.21E+00		6.57E-01	6.21E+00		1.10E+01	1.24E+00					2.45E+00	1.20E+00	9.13E+01	9.13E+01		4.02E+01
Toluidine, o- (Methylaniline, 2-)	95534	6.57E-01	6.21E+00		6.57E-01	6.21E+00		1.10E+01	1.24E+00										
Total HpCDD	35822469															1.95E-06	1.95E-06		
Total HpCDF	67562394															2.24E-06	2.24E-06		
Total HxCDD	19408743																		
Total HxCDF	57117449															1.85E-06	1.85E-06		
Total PeCDD	40321764																		
Total PeCDF	57117314															1.09E-06	1.09E-06		

NAWS China Lake OBOD HRA Update
OB Annual Emission Rates

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		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000
Total TCDD	1746016																		
Total TCDF	51207319															1.28E-06	1.28E-06		
Trichlorobenzene, 1,2,4-	120821																		
Trichloroethane, 1,1,1- (Methyl chloroform)	71556												6.21E+00					6.21E+00	
Trichloroethane, 1,1,2-	79005												6.21E+00					6.21E+00	
Trichloroethylene (TCE)	79016																		
Trichlorophenol, 2,4,5-	95954																		
Trichlorophenol,2,4,6-	88062																		
Trimethylbenzene, 1,2,4-	95636																		4.02E+01
Trimethylbenzene, 1,3,5-	108678																		4.02E+01
Trimethylpentane, 2,2,4-	540841		2.81E-01			2.81E-01		3.47E+00						1.06E+00	2.66E-01				2.81E+03
Trinitrobenzene, 1,3,5-	99354	1.10E-02			1.10E-02									2.15E-02		1.61E-02	1.61E-02		6.57E-03
Trinitrotoluene, 2,4,6- (TNT)	118967	1.10E-02			1.10E-02									9.13E-02	1.83E-02				
Vanadium & Compounds	7440622																		
Vinyl acetate	108054																		2.81E+03
Vinyl Chloride	75014									5.48E-01	5.48E-01								
Xylene, m-	108383																		4.02E+01
Xylene, o-	95476																		4.02E+01
Xylene, p-	106423																		4.02E+01
Xylenes	1330207															3.06E-01	3.06E-01		4.02E+01
Zinc	7440666									1.00E+01	1.00E+01								1.84E+02
Surrogates with EFs																			
Aminopyridine, 4-	504245																		
Bis(2-chloro-1-methylethyl)ether	108601																		
Bis(chloromethyl)ether	542881																		
Chloronitrobenzene, o-	88733																		
Chloropicrin (trichloronitromethane)	76062												4.02E+00					4.02E+00	
Diaminotoluene, 2,4-	95807																		
Diazomethane	334883																		
Dibutyl phthalate	84742		1.10E+02			1.10E+02													
Dimethylamine	124403	1.10E-02			1.10E-02			1.13E-01	1.10E-02				4.02E+00					4.02E+00	4.02E+00
Dimethylcarbamoyl chloride	79447																		
Dimethylhydrazine, 1,2-	540738																		
Dinitrobenzene, 1,2-	528290																		
Dinitrobenzene, 1,4-	100254																		
Dinitro-o-cresol, 4,6-	534521																		
Ethoxyethanol, 2-	110805																		
Ethyleneimine (Aziridine)	151564															3.31E+00	3.31E+00		
Glutaraldehyde	111308															4.89E-01	4.89E-01		
Malononitrile	109773																		
Manganese	7439965																		3.46E+02
Methacrylonitrile	126987															3.31E+00	3.31E+00		
Methanol	67561																		
Perchlorate	7601903									2.59E-01	2.59E-01								
Phosgene	75445									2.59E-01	2.59E-01								
Phosphorus (white)	7723140																		
Selenium	7782492																		
Silica, Crystalline	1175																		
Sulfuric acid	7664939													9.49E+01					
Urethane (Ethyl carbamate)	51796												1.97E+01					1.97E+01	1.97E+01
Metals in Casings																			
Aluminum	7429905																		
Antimony and Compounds	7440360																		
Barium	7440393																		
Cadmium	7440439																		
Chromium III	16065831																		
Chromium VI	18540299																		
Copper	7440508																		
Iron	7439896																		
Lead	7439921																		
Manganese	7439965																		
Molybdenum	7439987																		

NAWS China Lake OBOD HRA Update
OB Annual Emission Rates

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		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000	365,000
Nickel	7440020																		
Strontium	7440246																		
Zinc	7440666																		

NAWS China Lake OBOD HRA Update
OB Hourly Emission Rates

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		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Acenaphthene	83329	5.00E-04		5.00E-04	5.00E-04		5.00E-04		5.00E-04	5.00E-04	5.00E-04	5.00E-04							
Acenaphthylene	208968	5.00E-04		5.00E-04	5.00E-04		5.00E-04		5.00E-04	5.00E-04	5.00E-04	5.00E-04							
Acetaldehyde	75070															1.34E-03	1.34E-03		
Acetone	67641												1.40E-02			3.71E-03	3.71E-03	1.40E-02	
Acetonitrile	75058																		
Acetophenone	98862																		
Acetylaminofluorene, 2-	53963																		
Acrolein	107028												2.10E-03			5.51E-03	5.51E-03	2.10E-03	
Acrylonitrile	107131															9.06E-03	9.06E-03		
Allyl chloride	107051																		
Aluminum	7429905									1.10E+01	1.10E+01		2.70E+01		1.70E+01		2.70E+01	2.70E+01	1.90E+02
Aminobiphenyl, 4-	92671																		
Ammonia	7664417	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01	6.87E-01
Aniline	62533																		
Anthracene	120127																		
Antimony and Compounds	7440360																		
Arsenic	7440382																		
Azobenzene	103333																		
Barium	7440393							5.50E-02											2.40E-01
Benzaldehyde	100527												6.00E-02					6.00E-02	1.10E-01
Benzene	71432	1.00E-02	6.70E-02		1.00E-02	6.70E-02		1.20E-01	3.20E-03	5.70E-02	5.70E-02		1.40E-02	9.70E-02	7.20E-03	8.10E-01	8.10E-01	1.40E-02	1.10E-01
Benzidine	92875	3.00E-05			3.00E-05			3.10E-04	3.00E-05										
Benzo(A)Anthracene	56553							1.40E-04	1.40E-04										
Benzo(A)pyrene	50328							8.10E-05											
Benzo(b)fluoranthene	205992																		
Benzo(k)fluoranthene	207089																		
Benzo[g,h,i]perylene	191242																		
Benzofuran, 2,3-	271896																		1.10E-04
Benzoic acid	65850																		1.10E-01
Benzyl alcohol	100516												9.30E-03					9.30E-03	1.10E-01
Benzyl chloride	100447																		
Beryllium	7440417																		
Biphenyl, 1,1-	92524																		1.10E-01
Bis(2-chloroethyl)ether	111444																		
Bis(2-chloroisopropyl)ether	39638329																		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		3.00E-01			3.00E-01													
Bromodichloromethane	75274									7.10E-04	7.10E-04		6.80E-03					6.80E-03	
Bromoform (tribromomethane)	75252									4.20E-04	4.20E-04		6.80E-03					6.80E-03	
Bromomethane	74839									7.10E-04	7.10E-04								
Butadiene-1,3	106990		6.70E-03			6.70E-03		5.10E-03					2.80E-03	1.70E-03	1.50E-03	2.10E-02	2.10E-02	2.80E-03	1.10E-01
Butanol, 1-	71363																		7.70E+00
Butyl benzyl phthalate	85687		3.00E-01			3.00E-01													
Butylacrylate	141322																		
Butylbenzene, n-	104518	2.60E-04	1.90E-03		2.60E-04	1.90E-03		4.60E-03						2.00E-03	2.30E-03				1.10E-01
Butylbenzene, T-	98066	2.60E-04	1.90E-03		2.60E-04	1.90E-03		4.60E-03						2.00E-03	2.30E-03				1.10E-01
Cadmium	7440439																		
Carbazole	86748	3.00E-05			3.00E-05			3.10E-04	3.00E-05										
Carbon Monoxide	630080	1.40E+01	1.40E+01	1.30E-01	1.40E+01	1.40E+01	1.30E-01	1.10E+02	2.70E+00	4.20E+00	4.20E+00	1.40E-01	7.10E+00	5.50E+01	5.20E+00	3.10E+01	3.10E+01	7.10E+00	5.30E+01
Carbon tetrachloride	56235									1.10E-03	1.10E-03								
Chlorine	7782505									4.60E+00	4.60E+00	9.20E+00	4.60E+00					4.60E+00	
Chloroacetophenone, 2-	532274																		
Chloroaniline, 4-	106478																		
Chlorobenzene	108907																		
Chloroethane (Ethyl chloride)	75003																		
Chloroform	67663									4.20E-04	4.20E-04		6.80E-03					6.80E-03	
Chloromethane (Methyl chloride)	74873									7.10E-04	7.10E-04								
Chloronaphthalene	91587																		
Chlorophenol, 2-	95578																		
Chlorotoluene, o-	95498																		
Chromium (hex.)	18540299																		
Chromium III	16065831																		
Chrysene	218019																		
Cobalt	7440484																		

NAWS China Lake OBOD HRA Update
OB Hourly Emission Rates

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		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Copper	7440508									5.50E-02	5.50E-02		5.40E-04					5.40E-04	9.48E-01
Cumene (Isopropylbenzene)	98828		5.20E-04			5.20E-04									7.30E-04	3.00E-04	3.00E-04		1.10E-01
Cyclohexane	110827							6.90E-04						1.60E-03		7.50E-03	7.50E-03		1.10E-01
Dibenz[a,h]anthracene	53703							1.40E-04	1.40E-04										
Dibenzofuran	132649							1.20E-04						1.90E-04		2.00E-03	2.00E-03		1.10E-04
Dibromochloromethane	124481									4.20E-04	4.20E-04		6.20E+00					6.20E+00	
Dichlorobenzene, 1,2-	95501																		
Dichlorobenzene, 1,3-	541731																		
Dichlorobenzene, 1,4-	106467																		
Dichlorobenzidine, 3,3-	91941																		
Dichlorodifluoromethane	75718									1.10E-03	1.10E-03		6.20E+00					6.20E+00	
Dichloroethane, 1,1-	75343																		
Dichloroethane, 1,2-	107062																		
Dichloroethylene (cis), 1,2-	156592																		
Dichloroethylene (trans), 1,2-	156605																		
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354																		
Dichlorophenol, 2,4-	120832																		
Dichloropropane, 1,2-	78875																		
Dichloropropene, 1,3-	542756																		
Diethyl ether (Ethyl ether)	60297																		1.10E-04
Diethyl phthalate	84662		3.00E-01			3.00E-01										1.50E+00	1.50E+00		
Dimethyl Phthalate	131113																		
Dimethylbenz(a)anthracene, 7,12-	57976							1.40E-04	1.40E-04										
Dimethylbenzidine, 3,3'-	119937	3.00E-05			3.00E-05			3.10E-04	3.00E-05										1.10E-01
Dimethylphenol, 2,4-	105679																		1.10E-01
Dinitrobenzene, 1,3-	99650																		
Dinitrophenol, 2,4-	51285																		
Dinitropyrene, 1,6-	42397648																		
Dinitrotoluene, 2,4-	121142	3.00E-05			3.00E-05			1.60E-04						4.50E-04		2.10E-04	2.10E-04		5.90E-04
Dinitrotoluene, 2,6-	606202	3.00E-05			3.00E-05			1.40E-04						2.40E-05		4.10E-05	4.10E-05		8.00E-05
Di-n-octyl phthalate	117840		3.00E-01			3.00E-01													
Dioxane, 1,4-	123911																		1.10E-04
Diphenylamine	122394	3.00E-05			3.00E-05			3.10E-04	3.00E-05										
Ethylbenzene	100414	2.60E-04	1.90E-03		2.60E-04	1.90E-03		4.60E-03						2.00E-03	2.30E-03	3.80E-02	3.80E-02		1.10E-01
Ethylene	74851	7.80E-03	3.30E-01		7.80E-03	3.30E-01		2.90E-01	6.50E-03				4.80E-02	3.10E-02	3.20E-02	3.90E-01	3.90E-01	4.80E-02	7.70E+00
Fluoranthene	206440																		
Fluorene	86737																		
Fluorotrichloromethane (Trichlorofluoromethane)	75694									1.10E-03	1.10E-03								
Formaldehyde	50000																		
Furan (Epoxy-1,3-butadiene, 4-)	110009																		1.10E-04
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-																4.10E-09	4.10E-09		
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-																			
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-																2.34E-09	2.34E-09		
Hexachlorobenzene	118741																		
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683																		
Hexachlorodibenzofuran, 1,2,3,4,7,8-																1.09E-09	1.09E-09		
Hexachlorodibenzofuran, 1,2,3,6,7,8-																			
Hexachlorodibenzofuran, 1,2,3,7,8,9-																			
Hexachlorodibenzofuran, 2,3,4,6,7,8-																9.26E-10	9.26E-10		
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-																			
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-																			
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-																			
Hexachloroethane	67721																		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	8.40E-01	8.40E-01	8.40E-01	8.40E-01	8.40E-01	8.40E-01	1.20E-02	3.00E-05	3.00E-05	3.00E-05	3.00E-05	7.40E+00	9.60E-03	5.00E-05	7.40E+00	7.40E+00	7.40E+00	
Hexane, n-	110543	1.90E-02	1.50E-03		1.90E-02	1.50E-03		3.50E-03						9.30E-04	5.50E-04	1.90E-02	1.90E-02		7.70E+00
Hydrogen chloride	7647010									2.10E+02	2.10E+02	2.20E+02	3.80E+00					3.80E+00	
Hydrogen Cyanide	74908											6.86E-01	6.86E-01	6.86E-01	6.86E-01	6.86E-01	6.86E-01	6.86E-01	6.86E-01
Indeno[1,2,3-cd]pyrene	193395																		
Iron	7439896																		9.48E-01
Isophorone	78591		5.20E-04			5.20E-04		2.80E-03						5.10E-03	1.00E-02				1.10E-01
Isoprene	9003310		6.70E-03			6.70E-03		5.10E-03					2.80E-03	1.70E-03	1.50E-03			2.80E-03	7.70E+00
Lead	7439921							1.30E+01											1.30E+01
Methylcholanthrene, 3-	56495																		
Methylcyclohexane	108872		5.20E-04			5.20E-04		2.80E-03						5.10E-03	1.00E-02	5.30E-03	5.30E-03		7.70E+00

NAWS China Lake OBOD HRA Update
OB Hourly Emission Rates

Chemical	CAS #	OB Hourly Emission Rates																	
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Methylene chloride	75092									6.00E-04	6.00E-04		6.20E+00					6.20E+00	
Methylethyl ketone	78933																		7.70E+00
Methylnaphthalene, 2-	91576	5.00E-04		5.00E-04	5.00E-04		5.00E-04		5.00E-04	5.00E-04	5.00E-04	5.00E-04	1.70E-02					1.70E-02	
Methylphenol, 2-	95487																		1.10E-01
Methylphenol, 3-	108394																		1.10E-01
Methylphenol, 4-	106445																		1.10E-01
Methyltertbutyl ether (MTBE)	1634044																		1.10E-04
Molybdenum	7439987																		
Naphthalene	91203	5.00E-04		5.00E-04	5.00E-04		5.00E-04	5.40E-04	5.00E-04	5.00E-04	5.00E-04	5.00E-04	6.30E-02	1.80E-03		1.40E-03	1.40E-03	6.30E-02	6.30E-04
Nickel and compounds	7440020																		
Nitric Oxide	10102439	2.40E+00	1.50E+01	5.20E+00	2.40E+00	1.50E+01	5.20E+00	2.40E+01	6.30E+00	2.10E+00	2.10E+00	4.00E+00	4.00E+00	1.80E+01	9.90E+00	1.20E+01	1.20E+01	4.00E+00	9.00E-01
Nitroacenaphthene, 5-	602879																		
Nitroaniline, 2-	88744												6.30E-03					6.30E-03	
Nitrobenzene	98953																		
Nitrochrysene, 6-	7496028																		
Nitrogen Dioxide	10102440	5.20E-01	1.70E+00	2.10E+00	5.20E-01	1.70E+00	2.10E+00	2.80E+00	4.70E-01	1.00E+00	1.00E+00	2.40E+00	2.40E+00	2.50E+00	4.50E-02	1.70E+01	1.70E+01	2.40E+00	1.10E+00
Nitroglycerin	55630	3.00E-05	5.00E-05	3.00E-05	3.00E-05	5.00E-05	3.00E-05	5.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05			5.00E-05	5.00E-05	3.00E-05	
Nitroguanidine	556887	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05	3.00E-05
Nitrophenol, 4-	100027																		
Nitropropane, 2-	79469												1.10E-02					1.10E-02	
Nitropyrene, 1-	5522430																		
Nitrosodiethylamine, N-	55185																		
Nitrosodimethylamine, N-	62759																		
Nitrosodi-n-butylamine, N-	924163																		
Nitrosodi-n-propylamine, N-	621647																		
Nitrosodiphenylamine, N-	86306																		
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956																		
Nitrosopiperidine, N-	100754																		
Nitrosopyrrolidine, N-	930552																		
Nitrotoluene, o-	88722																		
Nitrotoluene, p-	99990																		
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-																3.23E-09	3.23E-09		
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-																6.64E-09	6.64E-09		
Pentachlorobenzene	608935																		
Pentachlorodibenzofuran, 1,2,3,7,8-																			
Pentachlorodibenzofuran, 2,3,4,7,8-																			
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-																			
Pentachloronitrobenzene	82688																		
Pentachlorophenol	87865																		
Phenanthrene	85018																		
Phenol	108952																		
Propanol, 2-	67630																		7.70E+00
Propylbenzene, n-	103651	2.60E-04	1.90E-03		2.60E-04	1.90E-03		4.60E-03						2.00E-03	2.30E-03				1.10E-01
Propylene (Propene)	115071	2.00E-03	6.00E-02		2.00E-03	6.00E-02		5.10E-02	1.10E-03	1.70E-03	1.70E-03		1.60E-02	7.20E-03	9.40E-03	7.30E-02	7.30E-02	1.60E-02	7.70E+00
Pyrene	129000																		7.70E+00
Pyridine	110861																		1.10E-01
Styrene	100425		9.40E-03			9.40E-03		3.60E-03					1.80E-03	1.50E-03		1.70E+00	1.70E+00	1.80E-03	1.10E-01
Sulfur Dioxide	7446095													2.60E-01					2.60E-01
Tetrachlorobenzene, 1,2,4,5-	95943																		
Tetrachlorodibenzofuran, 2,3,7,8-																			
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-																			
Tetrachloroethane, 1,1,2,2-	79345																		
Tetrachloroethylene (PCE)	127184																		
Tetrachlorophenol, 2,3,4,6-	58902																		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458															5.00E-05	5.00E-05		
Thallium and compounds	7446186																		
Toluene	108883	1.80E-03	1.70E-02		1.80E-03	1.70E-02		3.00E-02	3.40E-03					6.70E-03	3.30E-03	2.50E-01	2.50E-01		1.10E-01
Toluidine, o- (Methylaniline, 2-)	95534	1.80E-03	1.70E-02		1.80E-03	1.70E-02		3.00E-02	3.40E-03										
Total HpCDD	35822469															5.34E-09	5.34E-09		
Total HpCDF	67562394															6.13E-09	6.13E-09		
Total HxCDD	19408743																		
Total HxCDF	57117449															5.08E-09	5.08E-09		
Total PeCDD	40321764																		
Total PeCDF	57117314															2.98E-09	2.98E-09		

NAWS China Lake OBOD HRA Update
OB Hourly Emission Rates

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		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total TCDD	1746016																		
Total TCDF	51207319															3.52E-09	3.52E-09		
Trichlorobenzene, 1,2,4-	120821																		
Trichloroethane, 1,1,1- (Methyl chloroform)	71556												1.70E-02					1.70E-02	
Trichloroethane, 1,1,2-	79005												1.70E-02					1.70E-02	
Trichloroethylene (TCE)	79016																		
Trichlorophenol, 2,4,5-	95954																		
Trichlorophenol,2,4,6-	88062																		
Trimethylbenzene, 1,2,4-	95636																		1.10E-01
Trimethylbenzene, 1,3,5-	108678																		1.10E-01
Trimethylpentane, 2,2,4-	540841		7.70E-04			7.70E-04		9.50E-03						2.90E-03	7.30E-04				7.70E+00
Trinitrobenzene, 1,3,5-	99354	3.00E-05			3.00E-05									5.90E-05		4.40E-05	4.40E-05		1.80E-05
Trinitrotoluene, 2,4,6- (TNT)	118967	3.00E-05			3.00E-05									2.50E-04	5.00E-05				
Vanadium & Compounds	7440622																		
Vinyl acetate	108054																		7.70E+00
Vinyl Chloride	75014									1.50E-03	1.50E-03								
Xylene, m-	108383																		1.10E-01
Xylene, o-	95476																		1.10E-01
Xylene, p-	106423																		1.10E-01
Xylenes	1330207															8.37E-04	8.37E-04		1.10E-01
Zinc	7440666									2.75E-02	2.75E-02								5.04E-01
Surrogates with EFs																			
Aminopyridine, 4-	504245																		
Bis(2-chloro-1-methylethyl)ether	108601																		
Bis(chloromethyl)ether	542881																		
Chloronitrobenzene, o-	88733																		
Chloropicrin (trichloronitromethane)	76062												1.10E-02					1.10E-02	
Diaminotoluene, 2,4-	95807																		
Diazomethane	334883																		
Dibutyl phthalate	84742		3.00E-01			3.00E-01													
Dimethylamine	124403	3.00E-05			3.00E-05			3.10E-04	3.00E-05				1.10E-02					1.10E-02	1.10E-02
Dimethylcarbamoyl chloride	79447																		
Dimethylhydrazine, 1,2-	540738																		
Dinitrobenzene, 1,2-	528290																		
Dinitrobenzene, 1,4-	100254																		
Dinitro-o-cresol, 4,6-	534521																		
Ethoxyethanol, 2-	110805																		
Ethyleneimine (Aziridine)	151564															9.06E-03	9.06E-03		
Glutaraldehyde	111308															1.34E-03	1.34E-03		
Malononitrile	109773																		
Manganese	7439965																		9.48E-01
Methacrylonitrile	126987															9.06E-03	9.06E-03		
Methanol	67561																		
Perchlorate	7601903									7.10E-04	7.10E-04								
Phosgene	75445									7.10E-04	7.10E-04								
Phosphorus (white)	7723140																		
Selenium	7782492																		
Silica, Crystalline	1175																		
Sulfuric acid	7664939													2.60E-01					
Urethane (Ethyl carbamate)	51796												5.40E-02					5.40E-02	5.40E-02
Metals in Casings																			
Aluminum	7429905																		
Antimony and Compounds	7440360																		
Barium	7440393																		
Cadmium	7440439																		
Chromium III	16065831																		
Chromium VI	18540299																		
Copper	7440508																		
Iron	7439896																		
Lead	7439921																		
Manganese	7439965																		
Molybdenum	7439987																		

NAWS China Lake OBOD HRA Update
OB Hourly Emission Rates

Chemical	CAS #	OB Hourly Emission Rates																	
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Nickel	7440020																		
Strontium	7440246																		
Zinc	7440666																		

Chemical	CAS #	OD Annual Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	1,495,000	1,500,000	1,500,000	1,500,000	1,500,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	580,000	5,475,000	5,475,000
Acenaphthene	83329	2.74E+00		2.74E+00	2.74E+00		2.74E+00		7.50E-01	7.50E-01	7.50E-01	7.50E-01										
Acenaphthylene	208968	2.74E+00		2.74E+00	2.74E+00		2.74E+00		7.50E-01	7.50E-01	7.50E-01	7.50E-01										
Acetaldehyde	75070															7.34E+00	7.34E+00					
Acetone	67641												7.67E+01			2.03E+01	2.03E+01	7.67E+01			4.75E+04	4.75E+04
Acetonitrile	75058																					
Acetophenone	98862																				9.86E+00	9.86E+00
Acetylaminofluorene, 2-	53963																					
Acrolein	107028												1.15E+01			3.02E+01	3.02E+01	1.15E+01			3.91E+01	3.91E+01
Acrylonitrile	107131															4.96E+01	4.96E+01					
Allyl chloride	107051																			1.04E+01		
Aluminum	7429905									1.65E+04	1.65E+04		1.48E+05		9.31E+04		1.48E+05	1.48E+05	1.04E+06	1.10E+04	1.04E+06	1.04E+06
Aminobiphenyl, 4-	92671																					
Ammonia	7664417	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.98E+02		
Aniline	62533																					
Anthracene	120127																					
Antimony and Compounds	7440360																					
Arsenic	7440382																					
Azobenzene	103333																					
Barium	7440393							8.22E+01											1.31E+03	1.39E+02		
Benzaldehyde	100527												3.29E+02					3.29E+02	6.02E+02			
Benzene	71432	5.48E+01	3.67E+02		5.48E+01	3.67E+02		1.79E+02	4.80E+00	8.55E+01	8.55E+01		7.67E+01	5.31E+02	3.94E+01	4.43E+03	4.43E+03	7.67E+01	6.02E+02	2.61E+01	6.41E+01	6.41E+01
Benzidine	92875	1.64E-01			1.64E-01			4.63E-01	4.50E-02													
Benzo(A)Anthracene	56553							2.09E-01	2.10E-01													
Benzo(A)pyrene	50328							1.21E-01														
Benzo(b)fluoranthene	205992																					
Benzo(k)fluoranthene	207089																					
Benzo[g,h,i]perylene	191242																					
Benzofuran, 2,3-	271896																		6.02E-01			
Benzoic acid	65850																		6.02E+02			
Benzyl alcohol	100516												5.09E+01					5.09E+01	6.02E+02			
Benzyl chloride	100447																					
Beryllium	7440417																					
Biphenyl, 1,1-	92524																		6.02E+02			
Bis(2-chloroethyl)ether	111444																			1.80E+00		
Bis(2-chloroisopropyl)ether	39638329																			1.80E+00		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		1.64E+03			1.64E+03														2.32E+02		
Bromodichloromethane	75274									1.07E+00	1.07E+00		3.72E+01					3.72E+01				
Bromoform (tribromomethane)	75252									6.30E-01	6.30E-01		3.72E+01					3.72E+01				
Bromomethane	74839									1.07E+00	1.07E+00									9.86E-01		
Butadiene-1,3	106990		3.67E+01			3.67E+01		7.62E+00					1.53E+01	9.31E+00	8.21E+00	1.15E+02	1.15E+02	1.53E+01	6.02E+02	6.96E+00		
Butanol, 1-	71363																		4.22E+04			
Butyl benzyl phthalate	85687		1.64E+03			1.64E+03														2.32E+02		
Butylacrylate	141322																					
Butylbenzene, n-	104518	1.42E+00	1.04E+01		1.42E+00	1.04E+01		6.88E+00						1.10E+01	1.26E+01				6.02E+02	1.39E+00		
Butylbenzene, T-	98066	1.42E+00	1.04E+01		1.42E+00	1.04E+01		6.88E+00						1.10E+01	1.26E+01				6.02E+02	1.39E+00		
Cadmium	7440439																			6.38E+02		
Carbazole	86748	1.64E-01			1.64E-01			4.63E-01	4.50E-02													
Carbon Monoxide	630080	7.67E+04	7.67E+04	7.12E+02	7.67E+04	7.67E+04	7.12E+02	1.64E+05	4.05E+03	6.30E+03	6.30E+03	2.10E+02	3.89E+04	3.01E+05	2.85E+04	1.70E+05	1.70E+05	3.89E+04	2.90E+05	1.28E+04		
Carbon tetrachloride	56235									1.65E+00	1.65E+00											
Chlorine	7782505									6.90E+03	6.90E+03	1.38E+04	2.52E+04					2.52E+04		9.22E+01	8.71E+02	8.71E+02
Chloroacetophenone, 2-	532274																					
Chloroaniline, 4-	106478																					
Chlorobenzene	108907																					
Chloroethane (Ethyl chloride)	75003																			1.80E+00		
Chloroform	67663									6.30E-01	6.30E-01		3.72E+01					3.72E+01				
Chloromethane (Methyl chloride)	74873									1.07E+00	1.07E+00									9.86E-01		
Chloronaphthalene	91587																					
Chlorophenol, 2-	95578																					
Chlorotoluene, o-	95498																					
Chromium (hex.)	18540299																			1.55E+01		
Chromium III	16065831																			7.73E+01		
Chrysene	218019																					
Cobalt	7440484																					
Copper	7440508									8.25E+01	8.25E+01		2.96E+00					2.96E+00	5.19E+03	6.96E+02	5.19E+03	5.19E+03
Cumene (Isopropylbenzene)	98828		2.85E+00			2.85E+00									4.00E+00	1.64E+00	1.64E+00		6.02E+02	5.34E-01		
Cyclohexane	110827							1.03E+00						8.76E+00		4.11E+01	4.11E+01		6.02E+02	3.25E-01		
Dibenz[a,h]anthracene	53703							2.09E-01	2.10E-01													
Dibenzofuran	132649							1.79E-01						1.04E+00		1.10E+01	1.10E+01		6.02E-01			
Dibromochloromethane	124481									6.30E-01	6.30E-01		3.39E+04					3.39E+04				
Dichlorobenzene, 1,2-	95501																					
Dichlorobenzene, 1,3-	541731																					
Dichlorobenzene, 1,4-	106467																					
Dichlorobenzidine, 3,3-	91941																					
Dichlorodifluoromethane	75718									1.65E+00	1.65E+00		3.39E+04					3.39E+04				
Dichloroethane, 1,1-	75343																					
Dichloroethane, 1,2-	107062																					
Dichloroethylene (cis), 1,2-	156592																					
Dichloroethylene (trans), 1,2-	156605																					
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354																					
Dichlorophenol, 2,4-	120832																					
Dichloropropane, 1,2-	78875																					
Dichloropropene, 1,3-	542756																					
Diethyl ether (Ethyl ether)	60297																		6.02E-01			
Diethyl phthalate	84662		1.64E+03			1.64E+03										8.21E+03	8.21E+03			2.32E+02		
Dimethyl Phthalate	131113																					
Dimethylbenz(a)anthracene, 7,12-	57976							2.09E-01	2.10E-01													
Dimethylbenzidine, 3,3'-	119937	1.64E-01			1.64E-01			4.63E-01	4.50E-02										6.02E+02			
Dimethylphenol, 2,4-	105679																		6.02E+02			
Dinitrobenzene, 1,3-	99650																					
Dinitrophenol, 2,4-	51285																					
Dinitropyrene, 1,6-	42397648																					
Dinitrotoluene, 2,4-	121142	1.64E-01			1.64E-01			2.39E-01						2.46E+00		1.15E+00	1.15E+00		3.23E+00			

Chemical	CAS #	OD Annual Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	1,495,000	1,500,000	1,500,000	1,500,000	1,500,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	580,000	5,475,000	5,475,000
Dinitrotoluene, 2,6-	606202	1.64E-01			1.64E-01			2.09E-01						1.31E-01		2.24E-01	2.24E-01		4.38E-01			
Di-n-octyl phthalate	117840		1.64E+03			1.64E+03														2.32E+02		
Dioxane, 1,4-	123911																		6.02E-01			
Diphenylamine	122394	1.64E-01			1.64E-01			4.63E-01	4.50E-02													
Ethylbenzene	100414	1.42E+00	1.04E+01		1.42E+00	1.04E+01		6.88E+00						1.10E+01	1.26E+01	2.08E+02	2.08E+02		6.02E+02	1.39E+00	1.12E+02	1.12E+02
Ethylene	74851	4.27E+01	1.81E+03		4.27E+01	1.81E+03		4.34E+02	9.75E+00				2.63E+02	1.70E+02	1.75E+02	2.14E+03	2.14E+03	2.63E+02	4.22E+04	1.57E+02		
Fluoranthene	206440																					
Fluorene	86737																					
Fluorotrichloromethane (Trichlorofluoromethane)	75694									1.65E+00	1.65E+00											
Formaldehyde	50000																					
Furan (Epoxy-1,3-butadiene, 4-)	110009																		6.02E-01			
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-																2.24E-05	2.24E-05				3.08E-04	3.08E-04
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-																					1.26E-04	1.26E-04
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-																1.28E-05	1.28E-05				5.27E-05	5.27E-05
Hexachlorobenzene	118741																					
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683																					
Hexachlorodibenzofuran, 1,2,3,4,7,8-																5.97E-06	5.97E-06				1.63E-04	1.63E-04
Hexachlorodibenzofuran, 1,2,3,6,7,8-																					1.33E-04	1.33E-04
Hexachlorodibenzofuran, 1,2,3,7,8,9-																					7.12E-05	7.12E-05
Hexachlorodibenzofuran, 2,3,4,6,7,8-																5.07E-06	5.07E-06				1.98E-04	1.98E-04
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-																					1.03E-05	1.03E-05
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-																					1.71E-05	1.71E-05
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-																					1.33E-05	1.33E-05
Hexachloroethane	67721																			1.39E+00		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	4.60E+03	4.60E+03	4.60E+03	4.60E+03	4.60E+03	4.60E+03	1.79E+01	4.50E-02	4.50E-02	4.50E-02	4.50E-02	4.05E+04	5.26E+01	2.74E-01	4.05E+04	4.05E+04	4.05E+04		1.10E+02	4.05E+04	4.05E+04
Hexane, n-	110543	1.04E+02	8.21E+00		1.04E+02	8.21E+00		5.23E+00						5.09E+00	3.01E+00	1.04E+02	1.04E+02		4.22E+04	9.86E-01		
Hydrogen chloride	7647010									3.15E+05	3.15E+05	3.30E+05	2.08E+04					2.08E+04		9.86E-01	7.88E+02	7.88E+02
Hydrogen Cyanide	74908											1.03E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03	3.76E+03		2.69E+03	2.69E+03
Indeno[1,2,3-cd]pyrene	193395																					
Iron	7439896																		5.19E+03		5.19E+03	5.19E+03
Isophorone	78591		2.85E+00			2.85E+00		4.19E+00						2.79E+01	5.48E+01				6.02E+02	2.38E-01		
Isoprene	9003310		3.67E+01			3.67E+01		7.62E+00					1.53E+01	9.31E+00	8.21E+00			1.53E+01	4.22E+04	6.96E+00		
Lead	7439921							1.94E+04											7.12E+04	7.54E+02		
Methylcholanthrene, 3-	56495																					
Methylcyclohexane	108872		2.85E+00			2.85E+00		4.19E+00						2.79E+01	5.48E+01	2.90E+01	2.90E+01		4.22E+04	2.38E-01		
Methylene chloride	75092									9.00E-01	9.00E-01		3.39E+04					3.39E+04		2.38E+02		
Methylethyl ketone	78933																		4.22E+04			
Methylnaphthalene, 2-	91576	2.74E+00		2.74E+00	2.74E+00		2.74E+00		7.50E-01	7.50E-01	7.50E-01	7.50E-01	9.31E+01					9.31E+01				
Methylphenol, 2-	95487																		6.02E+02			
Methylphenol, 3-	108394																		6.02E+02			
Methylphenol, 4-	106445																		6.02E+02			
Methyltertbutyl ether (MTBE)	1634044																		6.02E-01			
Molybdenum	7439987																					
Naphthalene	91203	2.74E+00		2.74E+00	2.74E+00		2.74E+00	8.07E-01	7.50E-01	7.50E-01	7.50E-01	7.50E-01	3.45E+02	9.86E+00		7.67E+00	7.67E+00	3.45E+02	3.45E+00			
Nickel and compounds	7440020																					
Nitric Oxide	10102439	1.31E+04	8.21E+04	2.85E+04	1.31E+04	8.21E+04	2.85E+04	3.59E+04	9.45E+03	3.15E+03	3.15E+03	6.00E+03	2.19E+04	9.86E+04	5.42E+04	6.57E+04	6.57E+04	2.19E+04	4.93E+03	7.54E+03	4.06E+04	4.06E+04
Nitroacenaphthene, 5-	602879																					
Nitroaniline, 2-	88744												3.45E+01					3.45E+01				
Nitrobenzene	98953																					
Nitrochrysene, 6-	7496028																					
Nitrogen Dioxide	10102440	2.85E+03	9.31E+03	1.15E+04	2.85E+03	9.31E+03	1.15E+04	4.19E+03	7.05E+02	1.50E+03	1.50E+03	3.60E+03	1.31E+04	1.37E+04	2.46E+02	9.31E+04	9.31E+04	1.31E+04	6.02E+03	1.62E+03	4.82E+04	4.82E+04
Nitroglycerin	55630	1.64E-01	2.74E-01	1.64E-01	1.64E-01	2.74E-01	1.64E-01	7.48E-02	4.50E-02	4.50E-02	4.50E-02	4.50E-02	1.64E-01			2.74E-01	2.74E-01	1.64E-01		2.90E-02	1.64E-01	1.64E-01
Nitroguanidine	556887	1.64E-01	1.64E-01	1.64E-01	1.64E-01	1.64E-01	1.64E-01	4.49E-02	4.50E-02	4.50E-02	4.50E-02	4.50E-02	1.64E-01	1.64E-01	1.64E-01	1.64E-01	1.64E-01	1.64E-01	1.64E-01	1.74E-02	1.64E-01	1.64E-01
Nitrophenol, 4-	100027																					
Nitropropane, 2-	79469												6.02E+01					6.02E+01				
Nitropyrene, 1-	5522430																					
Nitrosodiethylamine, N-	55185																					
Nitrosodimethylamine, N-	62759																					
Nitrosodi-n-butylamine, N-	924163																					
Nitrosodi-n-propylamine, N-	621647																					
Nitrosodiphenylamine, N-	86306																					
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956																					
Nitrosopiperidine, N-	100754																					
Nitrosopyrrolidine, N-	930552																					
Nitrotoluene, o-	88722																					
Nitrotoluene, p-	99990																					
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-																1.77E-05	1.77E-05				2.66E-04	2.66E-04
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-																3.64E-05	3.64E-05			1.04E-03	6.41E-05	6.41E-05
Pentachlorobenzene	608935																					
Pentachlorodibenzofuran, 1,2,3,7,8-																					1.07E-04	1.07E-04
Pentachlorodibenzofuran, 2,3,4,7,8-																					2.70E-04	2.70E-04
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-																					1.42E-05	1.42E-05
Pentachloronitrobenzene	82688																					
Pentachlorophenol	87865																					
Phenanthrene	85018																					
Phenol	108952																					
Propanol, 2-	67630																		4.22E+04			
Propylbenzene, n-	103651	1.42E+00	1.04E+01		1.42E+00	1.04E+01		6.88E+00						1.10E+01	1.26E+01				6.02E+02	1.39E+00		
Propylene (Propene)	115071	1.10E+01	3.29E+02		1.10E+01	3.29E+02		7.62E+01	1.65E+00	2.55E+00	2.55E+00		8.76E+01	3.94E+01	5.15E+01	4.00E+02	4.00E+02	8.76E+01	4.22E+04	3.25E+01		
Pyrene	129000																		4.22E+04			
Pyridine	110861																		6.02E+02			
Styrene	100425		5.15E+01			5.15E+01		5.38E+00					9.86E+00	8.21E+00		9.31E+03	9.31E+03	9.86E+00	6.02E+02	4.12E+00		
Sulfur Dioxide	7446095													1.42E+03					1.42E+03	5.80E+02	5.48E+03	5.48E+03
Tetrachlorobenzene, 1,2,4,5-	95943																					
Tetrachlorodibenzofuran, 2,3,7,8-																					7.34E-05	7.34E-05
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-																					5.15E-06	5.15E-06
Tetrachloroethane, 1,1,2,2-	79345																			1.39E+00		
Tetrachloroethylene (PCE)	127184																			1.39E+00		
Tetrachlorophenol, 2,3,4,6-	58902																			1.39E+00		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458															2.74E-01	2.74E-01					
Thallium and compounds	7446186																					
Toluene	108883	9.86E+00	9.31E+01		9.86E+00	9.31E+01		4.49E+01	5.10E+00					3.67E+01	1.81E+01	1.37E+03	1.37E+03		6.02E+02	1.74E+01	7.61E+01	7.61E+01
Toluidine, o- (Methylaniline, 2-)	95534	9.86E+00	9.31E+01		9.86E+00	9.31E+01		4.49E+01	5.10E+00													

OD Annual Emission Rates

Chemical	CAS #	OD Annual Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)	(lb/yr)
Annual Treatment Limit (lb EW/yr):		5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	1,495,000	1,500,000	1,500,000	1,500,000	1,500,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	5,475,000	580,000	5,475,000	5,475,000
Total HpCDD	35822469															2.92E-05	2.92E-05				1.02E-04	1.02E-04
Total HpCDF	67562394															3.36E-05	3.36E-05				7.23E-04	7.23E-04
Total HxCDD	19408743																				2.31E-04	2.31E-04
Total HxCDF	57117449															2.78E-05	2.78E-05				1.61E-03	1.61E-03
Total PeCDD	40321764																				2.94E-04	2.94E-04
Total PeCDF	57117314															1.63E-05	1.63E-05				2.53E-03	2.53E-03
Total TCDD	1746016																				3.02E-04	3.02E-04
Total TCDF	51207319															1.93E-05	1.93E-05				3.33E-03	3.33E-03
Trichlorobenzene, 1,2,4-	120821																					
Trichloroethane, 1,1,1- (Methyl chloroform)	71556												9.31E+01					9.31E+01			1.40E+02	1.40E+02
Trichloroethane, 1,1,2-	79005												9.31E+01					9.31E+01				
Trichloroethylene (TCE)	79016																					
Trichlorophenol, 2,4,5-	95954																					
Trichlorophenol,2,4,6-	88062																					
Trimethylbenzene, 1,2,4-	95636																		6.02E+02			
Trimethylbenzene, 1,3,5-	108678																		6.02E+02			
Trimethylpentane, 2,2,4-	540841		4.22E+00			4.22E+00		1.42E+01						1.59E+01	4.00E+00				4.22E+04	6.96E-01		
Trinitrobenzene, 1,3,5-	99354	1.64E-01			1.64E-01									3.23E-01		2.41E-01	2.41E-01		9.86E-02			
Trinitrotoluene, 2,4,6- (TNT)	118967	1.64E-01			1.64E-01									1.37E+00	2.74E-01							
Vanadium & Compounds	7440622																				4.42E-02	4.42E-02
Vinyl acetate	108054																		4.22E+04			
Vinyl Chloride	75014									2.25E+00	2.25E+00									1.33E+00		
Xylene, m-	108383																		6.02E+02			
Xylene, o-	95476																		6.02E+02			
Xylene, p-	106423																		6.02E+02			
Xylenes	1330207															4.58E+00	4.58E+00		6.02E+02		1.10E+02	1.10E+02
Zinc	7440666									4.13E+01	4.13E+01								2.76E+03	4.35E+01	2.76E+03	2.76E+03
Surrogates with EFs																						
Aminopyridine, 4-	504245																					
Bis(2-chloro-1-methylethyl)ether	108601																			1.80E+00		
Bis(chloromethyl)ether	542881																					
Chloronitrobenzene, o-	88733																					
Chloropicrin (trichloronitromethane)	76062												6.02E+01					6.02E+01				
Diaminotoluene, 2,4-	95807																					
Diazomethane	334883																					
Dibutyl phthalate	84742		1.64E+03			1.64E+03																
Dimethylamine	124403	1.64E-01			1.64E-01			4.63E-01	4.50E-02				6.02E+01					6.02E+01	6.02E+01			
Dimethylcarbamoyl chloride	79447																			1.04E+01		
Dimethylhydrazine, 1,2-	540738																					
Dinitrobenzene, 1,2-	528290																					
Dinitrobenzene, 1,4-	100254																					
Dinitro-o-cresol, 4,6-	534521																					
Ethoxyethanol, 2-	110805																					
Ethyleneimine (Aziridine)	151564															4.96E+01	4.96E+01					
Glutaraldehyde	111308															7.34E+00	7.34E+00					
Malononitrile	109773																					
Manganese	7439965																		5.19E+03		5.19E+03	5.19E+03
Methacrylonitrile	126987															4.96E+01	4.96E+01					
Methanol	67561																					
Perchlorate	7601903									1.07E+00	1.07E+00									9.86E-01		
Phosgene	75445									1.07E+00	1.07E+00											
Phosphorus (white)	7723140																					
Selenium	7782492																					
Silica, Crystalline	1175																				5.19E+03	5.19E+03
Sulfuric acid	7664939													1.42E+03								
Urethane (Ethyl carbamate)	51796												2.96E+02					2.96E+02	2.96E+02			
Metals in Casings																						
Aluminum	7429905	2.87E+04	2.87E+04	2.87E+04	2.87E+04	2.87E+04	2.87E+04															
Antimony and Compounds	7440360	2.01E+02	2.01E+02	2.01E+02	2.01E+02	2.01E+02	2.01E+02															
Barium	7440393	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00															
Cadmium	7440439							8.04E+02	8.07E+02	8.07E+02	8.07E+02	8.07E+02		9.03E+01	9.03E+01	4.27E+02	9.03E+01	4.27E+02				
Chromium III	16065831							2.71E+01	2.72E+01	2.72E+01	2.72E+01	2.72E+01		9.69E-01	9.69E-01	1.91E+01	9.69E-01	2.81E+01				
Chromium VI	18540299							4.50E+00	4.52E+00	4.52E+00	4.52E+00	4.52E+00		1.62E-01	1.62E-01	3.18E+00	1.62E-01	4.68E+00				
Copper	7440508	4.39E+05	4.39E+05	4.39E+05	4.39E+05	4.39E+05	4.39E+05															
Iron	7439896	1.27E+03	1.27E+03	1.27E+03	8.05E+02	8.05E+02	8.05E+02	3.93E+01	3.95E+01	3.95E+01	3.95E+01	3.95E+01		5.45E+02	5.45E+02	2.89E+02	5.45E+02	1.41E+03				
Lead	7439921	3.27E+02	3.27E+02	3.27E+02	3.27E+02	3.27E+02	3.27E+02															
Manganese	7439965	1.43E+03	1.43E+03	1.43E+03	8.10E+00	8.10E+00	8.10E+00	2.41E-01	2.42E-01	2.42E-01	2.42E-01	2.42E-01		4.95E+00	4.95E+00	2.41E+00	4.95E+00	1.17E+01				
Molybdenum	7439987							1.00E-01	1.01E-01	1.01E-01	1.01E-01	1.01E-01				9.03E-01		4.40E+00				
Nickel	7440020															6.02E+00		2.93E+01				
Strontium	7440246	1.80E+02	1.80E+02	1.80E+02				3.56E+01	3.57E+01	3.57E+01	3.57E+01	3.57E+01				1.95E+01		1.95E+01				
Zinc	7440666	1.88E+05	1.88E+05	1.88E+05	1.88E+05	1.88E+05	1.88E+05							4.14E+03	4.14E+03		4.14E+03					

OD Hourly Emission Rates

Chemical	CAS #	OD Hourly Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000
Acenaphthene	83329	1.50E-02		1.50E-02	1.50E-02		1.50E-02		1.50E-02	1.50E-02	1.50E-02	1.50E-02										
Acenaphthylene	208968	1.50E-02		1.50E-02	1.50E-02		1.50E-02		1.50E-02	1.50E-02	1.50E-02	1.50E-02										
Acetaldehyde	75070															4.02E-02	4.02E-02					
Acetone	67641												4.20E-01			1.11E-01	1.11E-01	4.20E-01			2.60E+02	2.60E+02
Acetonitrile	75058																					
Acetophenone	98862																				5.40E-02	5.40E-02
Acetylaminofluorene, 2-	53963																					
Acrolein	107028												6.30E-02			1.65E-01	1.65E-01	6.30E-02			2.15E-01	2.15E-01
Acrylonitrile	107131															2.72E-01	2.72E-01					
Allyl chloride	107051																			5.40E-01		
Aluminum	7429905									3.30E+02	3.30E+02		8.10E+02		5.10E+02		8.10E+02	8.10E+02	3.08E+03	5.70E+02	5.70E+03	5.70E+03
Aminobiphenyl, 4-	92671																					
Ammonia	7664417	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	1.11E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	1.11E+01	2.06E+01		
Aniline	62533																					
Anthracene	120127																					
Antimony and Compounds	7440360																					
Arsenic	7440382																					
Azobenzene	103333																					
Barium	7440393							8.91E-01											3.89E+00	7.20E+00		
Benzaldehyde	100527												1.80E+00					1.80E+00	1.78E+00			
Benzene	71432	3.00E-01	2.01E+00		3.00E-01	2.01E+00		1.94E+00	9.60E-02	1.71E+00	1.71E+00		4.20E-01	2.91E+00	2.16E-01	2.43E+01	2.43E+01	4.20E-01	1.78E+00	1.35E+00	3.51E-01	3.51E-01
Benzidine	92875	9.00E-04			9.00E-04			5.02E-03	9.00E-04													
Benzo(A)Anthracene	56553							2.27E-03	4.20E-03													
Benzo(A)pyrene	50328							1.31E-03														
Benzo(b)fluoranthene	205992																					
Benzo(k)fluoranthene	207089																					
Benzo[g,h,i]perylene	191242																					
Benzofuran, 2,3-	271896																		1.78E-03			
Benzoic acid	65850																		1.78E+00			
Benzyl alcohol	100516												2.79E-01					2.79E-01	1.78E+00			
Benzyl chloride	100447																					
Beryllium	7440417																					
Biphenyl, 1,1-	92524																		1.78E+00			
Bis(2-chloroethyl)ether	111444																			9.30E-02		
Bis(2-chloroisopropyl)ether	39638329																			9.30E-02		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		9.00E+00			9.00E+00														1.20E+01		
Bromodichloromethane	75274									2.13E-02	2.13E-02		2.04E-01					2.04E-01				
Bromoform (tribromomethane)	75252									1.26E-02	1.26E-02		2.04E-01					2.04E-01				
Bromomethane	74839									2.13E-02	2.13E-02									5.10E-02		
Butadiene-1,3	106990		2.01E-01			2.01E-01		8.26E-02					8.40E-02	5.10E-02	4.50E-02	6.30E-01	6.30E-01	8.40E-02	1.78E+00	3.60E-01		
Butanol, 1-	71363																		1.25E+02			
Butyl benzyl phthalate	85687		9.00E+00			9.00E+00														1.20E+01		
Butylacrylate	141322																					
Butylbenzene, n-	104518	7.80E-03	5.70E-02		7.80E-03	5.70E-02		7.45E-02						6.00E-02	6.90E-02				1.78E+00	7.20E-02		
Butylbenzene, T-	98066	7.80E-03	5.70E-02		7.80E-03	5.70E-02		7.45E-02						6.00E-02	6.90E-02				1.78E+00	7.20E-02		
Cadmium	7440439																			3.30E+01		
Carbazole	86748	9.00E-04			9.00E-04			5.02E-03	9.00E-04													
Carbon Monoxide	630080	4.20E+02	4.20E+02	3.90E+00	4.20E+02	4.20E+02	3.90E+00	1.78E+03	8.10E+01	1.26E+02	1.26E+02	4.20E+00	2.13E+02	1.65E+03	1.56E+02	9.30E+02	9.30E+02	2.13E+02	8.59E+02	6.60E+02		
Carbon tetrachloride	56235									3.30E-02	3.30E-02											
Chlorine	7782505									1.38E+02	1.38E+02	2.76E+02	1.38E+02					1.38E+02		4.77E+00	4.77E+00	4.77E+00
Chloroacetophenone, 2-	532274																					
Chloroaniline, 4-	106478																					
Chlorobenzene	108907																					
Chloroethane (Ethyl chloride)	75003																			9.30E-02		
Chloroform	67663									1.26E-02	1.26E-02		2.04E-01					2.04E-01				
Chloromethane (Methyl chloride)	74873									2.13E-02	2.13E-02									5.10E-02		
Chloronaphthalene	91587																					
Chlorophenol, 2-	95578																					
Chlorotoluene, o-	95498																					
Chromium (hex.)	18540299																			8.00E-01		
Chromium III	16065831																			4.00E+00		
Chrysene	218019																					
Cobalt	7440484																					
Copper	7440508									1.65E+00	1.65E+00		1.62E-02					1.62E-02	1.54E+01	3.60E+01	2.84E+01	2.84E+01
Cumene (Isopropylbenzene)	98828		1.56E-02			1.56E-02									2.19E-02	9.00E-03	9.00E-03		1.78E+00	2.76E-02		
Cyclohexane	110827							1.12E-02						4.80E-02		2.25E-01	2.25E-01		1.78E+00	1.68E-02		
Dibenz[a,h]anthracene	53703							2.27E-03	4.20E-03													
Dibenzofuran	132649							1.94E-03						5.70E-03		6.00E-02	6.00E-02		1.78E-03			
Dibromochloromethane	124481									1.26E-02	1.26E-02		1.86E+02					1.86E+02				
Dichlorobenzene, 1,2-	95501																					
Dichlorobenzene, 1,3-	541731																					
Dichlorobenzene, 1,4-	106467																					
Dichlorobenzidine, 3,3-	91941																					
Dichlorodifluoromethane	75718									3.30E-02	3.30E-02		1.86E+02					1.86E+02				
Dichloroethane, 1,1-	75343																					

OD Hourly Emission Rates

Chemical	CAS #	OD Hourly Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000
Dichloroethane, 1,2-	107062																					
Dichloroethylene (cis), 1,2-	156592																					
Dichloroethylene (trans), 1,2-	156605																					
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354																					
Dichlorophenol, 2,4-	120832																					
Dichloropropane, 1,2-	78875																					
Dichloropropene, 1,3-	542756																					
Diethyl ether (Ethyl ether)	60297																		1.78E-03			
Diethyl phthalate	84662		9.00E+00			9.00E+00										4.50E+01	4.50E+01			1.20E+01		
Dimethyl Phthalate	131113																					
Dimethylbenz(a)anthracene, 7,12-	57976							2.27E-03	4.20E-03													
Dimethylbenzidine, 3,3'-	119937	9.00E-04			9.00E-04			5.02E-03	9.00E-04										1.78E+00			
Dimethylphenol, 2,4-	105679																		1.78E+00			
Dinitrobenzene, 1,3-	99650																					
Dinitrophenol, 2,4-	51285																					
Dinitropyrene, 1,6-	42397648																					
Dinitrotoluene, 2,4-	121142	9.00E-04			9.00E-04			2.59E-03						1.35E-02		6.30E-03	6.30E-03		9.56E-03			
Dinitrotoluene, 2,6-	606202	9.00E-04			9.00E-04			2.27E-03						7.20E-04		1.23E-03	1.23E-03		1.30E-03			
Di-n-octyl phthalate	117840		9.00E+00			9.00E+00														1.20E+01		
Dioxane, 1,4-	123911																		1.78E-03			
Diphenylamine	122394	9.00E-04			9.00E-04			5.02E-03	9.00E-04													
Ethylbenzene	100414	7.80E-03	5.70E-02		7.80E-03	5.70E-02		7.45E-02						6.00E-02	6.90E-02	1.14E+00	1.14E+00		1.78E+00	7.20E-02	6.15E-01	6.15E-01
Ethylene	74851	2.34E-01	9.90E+00		2.34E-01	9.90E+00		4.70E+00	1.95E-01				1.44E+00	9.30E-01	9.60E-01	1.17E+01	1.17E+01	1.44E+00	1.25E+02	8.10E+00		
Fluoranthene	206440																					
Fluorene	86737																					
Fluorotrichloromethane (Trichlorofluoromethane)	75694									3.30E-02	3.30E-02											
Formaldehyde	50000																					
Furan (Epoxy-1,3-butadiene, 4-)	110009																		1.78E-03			
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-																1.23E-07	1.23E-07				1.69E-06	1.69E-06
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-																					6.93E-07	6.93E-07
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-																7.02E-08	7.02E-08				2.89E-07	2.89E-07
Hexachlorobenzene	118741																					
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683																					
Hexachlorodibenzofuran, 1,2,3,4,7,8-																3.27E-08	3.27E-08				8.94E-07	8.94E-07
Hexachlorodibenzofuran, 1,2,3,6,7,8-																					7.29E-07	7.29E-07
Hexachlorodibenzofuran, 1,2,3,7,8,9-																					3.90E-07	3.90E-07
Hexachlorodibenzofuran, 2,3,4,6,7,8-																2.78E-08	2.78E-08				1.09E-06	1.09E-06
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-																					5.67E-08	5.67E-08
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-																					9.39E-08	9.39E-08
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-																					7.29E-08	7.29E-08
Hexachloroethane	67721																			7.20E-02		
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	2.52E+01	2.52E+01	2.52E+01	2.52E+01	2.52E+01	2.52E+01	1.94E-01	9.00E-04	9.00E-04	9.00E-04	9.00E-04	2.22E+02	2.88E-01	1.50E-03	2.22E+02	2.22E+02	2.22E+02		5.70E+00	2.22E+02	2.22E+02
Hexane, n-	110543	5.70E-01	4.50E-02		5.70E-01	4.50E-02		5.67E-02						2.79E-02	1.65E-02	5.70E-01	5.70E-01		1.25E+02	5.10E-02		
Hydrogen chloride	7647010									6.30E+03	6.30E+03	6.60E+03	1.14E+02					1.14E+02		5.10E-02	4.32E+00	4.32E+00
Hydrogen Cyanide	74908											2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	2.06E+01	1.11E+01		1.47E+01	1.47E+01
Indeno[1,2,3-cd]pyrene	193395																					
Iron	7439896																		1.54E+01		2.84E+01	2.84E+01
Isophorone	78591		1.56E-02			1.56E-02		4.54E-02						1.53E-01	3.00E-01				1.78E+00	1.23E-02		
Isoprene	9003310		2.01E-01			2.01E-01		8.26E-02					8.40E-02	5.10E-02	4.50E-02			8.40E-02	1.25E+02	3.60E-01		
Lead	7439921							2.11E+02											2.11E+02	3.90E+01		
Methylcholanthrene, 3-	56495																					
Methylcyclohexane	108872		1.56E-02			1.56E-02		4.54E-02						1.53E-01	3.00E-01	1.59E-01	1.59E-01		1.25E+02	1.23E-02		
Methylene chloride	75092									1.80E-02	1.80E-02		1.86E+02					1.86E+02		1.23E+01		
Methylethyl ketone	78933																		1.25E+02			
Methylnaphthalene, 2-	91576	1.50E-02		1.50E-02	1.50E-02		1.50E-02		1.50E-02	1.50E-02	1.50E-02	1.50E-02	5.10E-01					5.10E-01				
Methylphenol, 2-	95487																		1.78E+00			
Methylphenol, 3-	108394																		1.78E+00			
Methylphenol, 4-	106445																		1.78E+00			
Methyltertbutyl ether (MTBE)	1634044																		1.78E-03			
Molybdenum	7439987																					
Naphthalene	91203	1.50E-02		1.50E-02	1.50E-02		1.50E-02	8.75E-03	1.50E-02	1.50E-02	1.50E-02	1.50E-02	1.89E+00	5.40E-02		4.20E-02	4.20E-02	1.89E+00	1.02E-02			
Nickel and compounds	7440020																					
Nitric Oxide	10102439	7.20E+01	4.50E+02	1.56E+02	7.20E+01	4.50E+02	1.56E+02	3.89E+02	1.89E+02	6.30E+01	6.30E+01	1.20E+02	1.20E+02	5.40E+02	2.97E+02	3.60E+02	3.60E+02	1.20E+02	1.46E+01	3.90E+02	2.22E+02	2.22E+02
Nitroacenaphthene, 5-	602879																					
Nitroaniline, 2-	88744												1.89E-01					1.89E-01				
Nitrobenzene	98953																					
Nitrochrysene, 6-	7496028																					
Nitrogen Dioxide	10102440	1.56E+01	5.10E+01	6.30E+01	1.56E+01	5.10E+01	6.30E+01	4.54E+01	1.41E+01	3.00E+01	3.00E+01	7.20E+01	7.20E+01	7.50E+01	1.35E+00	5.10E+02	5.10E+02	7.20E+01	1.78E+01	8.40E+01	2.64E+02	2.64E+02
Nitroglycerin	55630	9.00E-04	1.50E-03	9.00E-04	9.00E-04	1.50E-03	9.00E-04	8.10E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04			1.50E-03	1.50E-03	9.00E-04		1.50E-03	9.00E-04	9.00E-04
Nitroguanidine	556887	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	4.86E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	9.00E-04	4.86E-04	9.00E-04	9.00E-04	9.00E-04
Nitrophenol, 4-	100027																					
Nitropropane, 2-	79469												3.30E-01					3.30E-01				
Nitropyrene, 1-	5522430																					
Nitrosodiethylamine, N-	55185																					
Nitrosodimethylamine, N-	62759																					
Nitrosodi-n-butylamine, N-	924163																					

OD Hourly Emission Rates

Chemical	CAS #	OD Hourly Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000
Nitrosodi-n-propylamine, N-	621647																					
Nitrosodiphenylamine, N-	86306																					
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956																					
Nitrosopiperidine, N-	100754																					
Nitrosopyrrolidine, N-	930552																					
Nitrotoluene, o-	88722																					
Nitrotoluene, p-	99990																					
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-																9.69E-08	9.69E-08				1.46E-06	1.46E-06
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-																1.99E-07	1.99E-07			5.40E-05	3.51E-07	3.51E-07
Pentachlorobenzene	608935																					
Pentachlorodibenzofuran, 1,2,3,7,8-																					5.85E-07	5.85E-07
Pentachlorodibenzofuran, 2,3,4,7,8-																					1.48E-06	1.48E-06
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-																					7.77E-08	7.77E-08
Pentachloronitrobenzene	82688																					
Pentachlorophenol	87865																					
Phenanthrene	85018																					
Phenol	108952																					
Propanol, 2-	67630																		1.25E+02			
Propylbenzene, n-	103651	7.80E-03	5.70E-02		7.80E-03	5.70E-02		7.45E-02						6.00E-02	6.90E-02				1.78E+00	7.20E-02		
Propylene (Propene)	115071	6.00E-02	1.80E+00		6.00E-02	1.80E+00		8.26E-01	3.30E-02	5.10E-02	5.10E-02		4.80E-01	2.16E-01	2.82E-01	2.19E+00	2.19E+00	4.80E-01	1.25E+02	1.68E+00		
Pyrene	129000																		1.25E+02			
Pyridine	110861																		1.78E+00			
Styrene	100425		2.82E-01			2.82E-01		5.83E-02					5.40E-02	4.50E-02		5.10E+01	5.10E+01	5.40E-02	1.78E+00	2.13E-01		
Sulfur Dioxide	7446095													7.80E+00					4.21E+00	3.00E+01	3.00E+01	3.00E+01
Tetrachlorobenzene, 1,2,4,5-	95943																					
Tetrachlorodibenzofuran, 2,3,7,8-																					4.02E-07	4.02E-07
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-																					2.82E-08	2.82E-08
Tetrachloroethane, 1,1,2,2-	79345																			7.20E-02		
Tetrachloroethylene (PCE)	127184																			7.20E-02		
Tetrachlorophenol, 2,3,4,6-	58902																			7.20E-02		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458															1.50E-03	1.50E-03					
Thallium and compounds	7446186																					
Toluene	108883	5.40E-02	5.10E-01		5.40E-02	5.10E-01		4.86E-01	1.02E-01					2.01E-01	9.90E-02	7.50E+00	7.50E+00		1.78E+00	9.00E-01	4.17E-01	4.17E-01
Toluidine, o- (Methylaniline, 2-)	95534	5.40E-02	5.10E-01		5.40E-02	5.10E-01		4.86E-01	1.02E-01													
Total HpCDD	35822469															1.60E-07	1.60E-07				5.58E-07	5.58E-07
Total HpCDF	67562394															1.84E-07	1.84E-07				3.96E-06	3.96E-06
Total HxCDD	19408743																				1.27E-06	1.27E-06
Total HxCDF	57117449															1.52E-07	1.52E-07				8.82E-06	8.82E-06
Total PeCDD	40321764																				1.61E-06	1.61E-06
Total PeCDF	57117314															8.94E-08	8.94E-08				1.39E-05	1.39E-05
Total TCDD	1746016																				1.66E-06	1.66E-06
Total TCDF	51207319															1.06E-07	1.06E-07				1.82E-05	1.82E-05
Trichlorobenzene, 1,2,4-	120821																					
Trichloroethane, 1,1,1- (Methyl chloroform)	71556												5.10E-01					5.10E-01			7.68E-01	7.68E-01
Trichloroethane, 1,1,2-	79005												5.10E-01					5.10E-01				
Trichloroethylene (TCE)	79016																					
Trichlorophenol, 2,4,5-	95954																					
Trichlorophenol,2,4,6-	88062																					
Trimethylbenzene, 1,2,4-	95636																		1.78E+00			
Trimethylbenzene, 1,3,5-	108678																		1.78E+00			
Trimethylpentane, 2,2,4-	540841		2.31E-02			2.31E-02		1.54E-01						8.70E-02	2.19E-02				1.25E+02	3.60E-02		
Trinitrobenzene, 1,3,5-	99354	9.00E-04			9.00E-04									1.77E-03		1.32E-03	1.32E-03		2.92E-04			
Trinitrotoluene, 2,4,6- (TNT)	118967	9.00E-04			9.00E-04									7.50E-03	1.50E-03							
Vanadium & Compounds	7440622																				2.42E-04	2.42E-04
Vinyl acetate	108054																		1.25E+02			
Vinyl Chloride	75014									4.50E-02	4.50E-02									6.90E-02		
Xylene, m-	108383																		1.78E+00			
Xylene, o-	95476																		1.78E+00			
Xylene, p-	106423																		1.78E+00			
Xylenes	1330207															2.51E-02	2.51E-02		1.78E+00		6.00E-01	6.00E-01
Zinc	7440666									8.25E-01	8.25E-01								8.16E+00	2.25E+00	1.51E+01	1.51E+01
Surrogates with EFs																						
Aminopyridine, 4-	504245																					
Bis(2-chloro-1-methylethyl)ether	108601																			9.30E-02		
Bis(chloromethyl)ether	542881																					
Chloronitrobenzene, o-	88733																					
Chloropicrin (trichloronitromethane)	76062												3.30E-01					3.30E-01				
Diaminotoluene, 2,4-	95807																					
Diazomethane	334883																					
Dibutyl phthalate	84742		9.00E+00			9.00E+00																
Dimethylamine	124403	9.00E-04			9.00E-04			5.02E-03	9.00E-04				3.30E-01					3.30E-01	1.78E-01			
Dimethylcarbamoyl chloride	79447																			5.40E-01		
Dimethylhydrazine, 1,2-	540738																					
Dinitrobenzene, 1,2-	528290																					
Dinitrobenzene, 1,4-	100254																					

OD Hourly Emission Rates

Chemical	CAS #	OD Hourly Emission Rates																				
		IAw	IBw	ICw	IAwo	IBwo	ICwo	IIA	IIB	IIC	IID	IIE	IIF	A1	A2	B1	B2	B3	C1	P	W	M
		(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)	(lb/hr)
Event Treatment Limit (lb EW/hr):		30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	16,200	30,000	30,000	30,000
Dinitro-o-cresol, 4,6-	534521																					
Ethoxyethanol, 2-	110805																					
Ethyleneimine (Aziridine)	151564															2.72E-01	2.72E-01					
Glutaraldehyde	111308															4.02E-02	4.02E-02					
Malononitrile	109773																					
Manganese	7439965																		1.54E+01		2.84E+01	2.84E+01
Methacrylonitrile	126987															2.72E-01	2.72E-01					
Methanol	67561																					
Perchlorate	7601903									2.13E-02	2.13E-02									5.10E-02		
Phosgene	75445									2.13E-02	2.13E-02											
Phosphorus (white)	7723140																					
Selenium	7782492																					
Silica, Crystalline	1175																				2.84E+01	2.84E+01
Sulfuric acid	7664939													7.80E+00								
Urethane (Ethyl carbamate)	51796												1.62E+00					1.62E+00	8.75E-01			
Metals in Casings																						
Aluminum	7429905	1.57E+02	1.57E+02	1.57E+02	1.57E+02	1.57E+02	1.57E+02															
Antimony and Compounds	7440360	1.10E+00	1.10E+00	1.10E+00	1.10E+00	1.10E+00	1.10E+00															
Barium	7440393	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02	2.06E-02															
Cadmium	7440439							8.72E+00	1.61E+01	1.61E+01	1.61E+01	1.61E+01		4.95E-01	4.95E-01	2.34E+00	4.95E-01	2.34E+00				
Chromium III	16065831							2.93E-01	5.43E-01	5.43E-01	5.43E-01	5.43E-01		5.31E-03	5.31E-03	1.04E-01	5.31E-03	1.54E-01				
Chromium VI	18540299							4.88E-02	9.03E-02	9.03E-02	9.03E-02	9.03E-02		8.85E-04	8.85E-04	1.74E-02	8.85E-04	2.57E-02				
Copper	7440508	2.40E+03	2.40E+03	2.40E+03	2.40E+03	2.40E+03	2.40E+03															
Iron	7439896	6.95E+00	6.95E+00	6.95E+00	4.41E+00	4.41E+00	4.41E+00	4.26E-01	7.89E-01	7.89E-01	7.89E-01	7.89E-01		2.99E+00	2.99E+00	1.58E+00	2.99E+00	7.71E+00				
Lead	7439921	1.79E+00	1.79E+00	1.79E+00	1.79E+00	1.79E+00	1.79E+00															
Manganese	7439965	7.84E+00	7.84E+00	7.84E+00	4.44E-02	4.44E-02	4.44E-02	2.61E-03	4.83E-03	4.83E-03	4.83E-03	4.83E-03		2.72E-02	2.72E-02	1.32E-02	2.72E-02	6.42E-02				
Molybdenum	7439987							1.09E-03	2.01E-03	2.01E-03	2.01E-03	2.01E-03				4.95E-03		2.41E-02				
Nickel	7440020															3.30E-02		1.61E-01				
Strontium	7440246	9.84E-01	9.84E-01	9.84E-01				3.86E-01	7.14E-01	7.14E-01	7.14E-01	7.14E-01				1.07E-01		1.07E-01				
Zinc	7440666	1.03E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03	1.03E+03							2.27E+01	2.27E+01		2.27E+01					

NAWS China Lake OBOD HRA Update
Formulae Used - Indirect Emission Rates

Quantity	Formula
Crater PM_{10} Emission Rate (lbs/yr)	(Value reported in GBUAPCD Annual Emissions Reports, 381 lbs PM_{10}/event) x (365 events/yr)
Crater PM_{10} Emission Rate (lbs/hr)	(Value reported in GBUAPCD Annual Emissions Reports, 381 lbs PM_{10}/event) x (2 events/hr)
Crater COC Annual Emissions (g/s)	(Average Concentration in the Soil, mg/kg) x ($1x10^{-6}$ kg/mg) x (PM_{10} Emission Rate, lbs/yr) x [(453.6 g/lb) / ($3.1536x10^{7}$ s/yr)]
Crater COC Hourly Emission Rate (g/s)	(Average Concentration in the Soil, mg/kg) x ($1x10^{-6}$ kg/mg) x (PM_{10} Emission Rate, lbs/hr) x [(453.6 g/lb) / (3,600 s/hr)]
Ash PM_{10} Emission Rate (lbs/yr)	(PM_{10} Emission Factor, $2.88x10^{-5}$ kg/Mg ash) x (Amount of Ash Loaded, 36,500 lbs/yr)
Ash PM_{10} Emission Rate (lbs/hr)	Not calculated directly. The ash COC hourly emission rate was derived by including this calculation directly.
Ash COC Annual Emission Rate (g/s)	(Average Concentration in the Ash, mg/kg) x ($1x10^{-6}$ kg/mg) x (PM_{10} Emission Rate, lbs/yr) x [(453.6 g/lb) / ($3.1536x10^{7}$ s/yr)]
Ash COC Hourly Emission Rate (g/s)	(Average Concentration in the Ash, mg/kg) x ($1x10^{-6}$ kg/mg) x (100 lbs/event) x (PM_{10} Emission Factor, kg/Mg ash) x ($1x10^{-3}$ Mg/kg) x [(453.6 g/lb) / (3,600 s/hr)]
Grading PM_{10} Emission Rate (lbs/yr)	(PM_{10} Emission Factor, lb/acre) x (Erodible Area, 5.5 acres) * (Tilling Frequency, 365 tillings/yr)
Grading PM_{10} Emission Rate (lbs/hr)	(PM_{10} Emission Factor, lb/acre) x (Erodible Area, 5.5 acres); Assumed to occur over a maximum of one hour
Grading COC Annual Emission Rate (g/s)	(Average Concentration in the Soil, mg/kg) x ($1x10^{-6}$ kg/mg) x (PM_{10} Emission Rate, lbs/yr) x [(453.6 g/lb) / ($3.1536x10^{7}$ s/yr)]
Grading COC Hourly Emission Rate (g/s)	(Average Concentration in the Soil, mg/kg) x ($1x10^{-6}$ kg/mg) x (PM_{10} Emission Rate, lbs/hr) x [(453.6 g/lb) / (3,600 s/hr)]
Wind Erosion PM_{10} Emission Rate (lbs/yr)	{Total Suspended Particulate (TSP) Emission Rate, [County Emission Factor (1,778 lb/acre/yr) x Erodible Area (39 acres)]} x (0.5 lbs PM_{10}/lb TSP)
Wind Erosion PM_{10} Emission Rate (lbs/hr)	Not calculated directly. The wind erosion COC hourly emission rate was derived by including this calculation directly.
Wind Erosion COC Annual Emission Rate (g/s)	(Average Concentration in the Soil, mg/kg) x ($1x10^{-6}$ kg/mg) x (PM_{10} Emission Rate, lbs/yr) x [(453.6 g/lb) / ($3.1536x10^{7}$ s/yr)]
Wind Erosion COC Hourly Emission Rate (g/s)	(Wind Erosion COC Annual Emission Rate, lb/yr) / (8760 hrs/yr) x [(453.6 g/lb) / (3,600 s/hr)]
Diesel COC Annual Emission Rate (g/s)	(Emission Factor, lb/1000 gal) x (Diesel Usage, 51,830 gal/yr) / (1000) x [(453.6 g/lb) / ($3.1536x10^{7}$ s/yr)]
Diesel COC Hourly Emission Rate (g/s)	(Emission Factor, lb/1000 gal) x (Diesel Usage, 142 gal/event) / (1000) x [(453.6 g/lb) / (3,600 s/hr)]
Wood COC Annual Emission Rate (g/s)	(Emission Factor, lb/ton) x (Wood Usage, 365,000 lb/yr) / (2000 lbs/ton) x [(453.6 g/lb) / ($3.1536x10^{7}$ s/yr)]
Wood COC Hourly Emission Rate (g/s)	(Emission Factor, lb/ton) x (Wood Usage, 1000 lb/event) / (2000 lbs/ton) x [(453.6 g/lb) / (3,600 s/hr)]

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Constituent Concentration in Soils

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)
Metals			
Aluminum	7429905	5416	5.42E-03
Antimony	7440360	1.4	1.40E-06
Arsenic	7440382	2.3	2.26E-06
Barium	7440393	87.8	8.78E-05
Beryllium	7440417	0.20	2.03E-07
Cadmium	7440439	1.15	1.15E-06
Chromium III	16065831	11.9	1.19E-05
Chromium (hex.)	18540299	0.08	8.00E-08
Cobalt	7440484	4.47	4.47E-06
Copper	7440508	72.1	7.21E-05
Lead	7439921	31.0	3.10E-05
Mercury	7439976	0.02	2.00E-08
Molybdenum	7439987	1.15	1.15E-06
Nickel and compounds	7440020	8.72	8.72E-06
Selenium	7782492	1.65	1.65E-06
Thallium and compounds	7446186	11.0	1.10E-05
Vanadium & Compounds	7440622	29.7	2.97E-05
Zinc	7440666	40.0	4.00E-05
Inorganics			
Perchlorate	7601903	45.5	4.55E-05
Dioxins/Furans			
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	0.00E+00	0.00E+00
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0.00E+00	0.00E+00
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	3.93E-06	3.93E-12
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	3.44E-05	3.44E-11
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1.01E-06	1.01E-12
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0.00E+00	0.00E+00
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	3.06E-06	3.06E-12
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0.00E+00	0.00E+00
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.62E-06	4.62E-12
Total TCDD	1746016	0.00E+00	0.00E+00
Total PeCDD	40321764	0.00E+00	0.00E+00
Total HxCDD	19408743	0.00E+00	0.00E+00
Total HpCDD	35822469	5.43E-06	5.43E-12
Total TCDF	51207319	1.66E-06	1.66E-12
Total PeCDF	57117314	0.00E+00	0.00E+00
Total HxCDF	57117449	1.14E-06	1.14E-12
Total HpCDF	67562394	3.04E-06	3.04E-12
Explosives			
Cyclotetramethylene Tetranitramine (HMX)	2691410	0.79	7.90E-07
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	2.15	2.15E-06
Trinitrobenzene, 1,3,5-	99354	0.25	2.50E-07
Dinitrobenzene, 1,3-	99650	0.03	3.00E-08
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458	0.12	1.20E-07
Nitrobenzene	98953	0.04	4.00E-08
4-Amino-2,6-dinitrotoluene	19406510	0.07	7.00E-08
2-Amino-4,6-dinitrotoluene	35572782	0.13	1.30E-07
Trinitrotoluene, 2,4,6- (TNT)	118967	0.67	6.70E-07
Dinitrotoluene, 2,6-	606202	0.06	6.00E-08
Dinitrotoluene, 2,4-	121142	0.04	4.00E-08
Nitrotoluene, o-	88722	0.06	6.00E-08

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Constituent Concentration in Soils

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)
Nitrotoluene, p-	99990	0.08	8.00E-08
Nitrotoluene, m-	99081	0.08	8.00E-08

Source: China Lake, "Soil Investigation Report for the Sixth Site Investigation (Soil Only) at the Burro Canyon OB/OD Facility," October 2003.

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Constituent Concentration in Ash

Constituent Name	CAS Number	Average Concentration in the Ash (mg/kg)	Average Concentration in the Ash (lb/lb)
Antimony	7440360	19.4	1.94E-05
Barium	7440393	59.4	5.94E-05
Chromium III	16065831	21.7	2.17E-05
Cobalt	7440484	3.0	3.00E-06
Copper	7440508	27.1	2.71E-05
Lead	7439921	180.4	1.80E-04
Nickel	7440020	3.1	3.10E-06
Vanadium	7440622	20.0	2.00E-05
Zinc	7440666	102.3	1.02E-04
Chloromethane	74873	0.01	1.00E-08
Chloroethane	75003	0.025	2.50E-08
Trichlorofluoromethane	75694	0.07	7.00E-08
Acetone	67641	0.503	5.03E-07
Carbon Disulfide	75150	0.006	6.00E-09
Methylene Chloride	75092	0.057	5.70E-08
2-Butanone (MEK)	78933	0.664	6.64E-07
Chloroform	67663	0.02	2.00E-08
1,1,1-Trichloroethane	71556	0.075	7.50E-08
Benzene	71432	0.018	1.80E-08
2-Hexanone	591786	0.024	2.40E-08
Toluene	108883	0.079	7.90E-08
Ethybenzene	100414	0.005	5.00E-09
Meta+Para-Xylene	1330207	0.019	1.90E-08
Ortho-Xylene	1330207	0.005	5.00E-09
HMX	2691410	2.87	2.87E-06
RDX	121824	6.15	6.15E-06
1,3-DNB	99650	2.17	2.17E-06
2,4,6-TNT	118967	5.08	5.08E-06
4-Am-2,6-DNT	19406510	0.77	7.70E-07
2,6/2,4-DNT	121142	23.4	2.34E-05

Sources:
China Lake, Laboratory Report, Diversified Analytical Services, November 1992.
China Lake, Laboratory Metals Analysis, EPA Method 3055, November 1995.

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

OD Crater Emissions

Number of Events per Year:	365
Events per hour:	2
Event Energetic Weight (lb):	15000
Hourly Treatment Limit (lb):	30000
PM_{10} Emission Rate (lb/hr):	762

Annual Treatment Limit (lb)	Hourly Treatment Limit (lb)	PM_{10} Emission Rate	
		(lb/yr)	(lb/hr)
5475000	30000	139065	762

Description:

The parameters were set as follows: The number of events per year is set by the RCRA permit application. China Lake expects to potentially be able to handle 2 events per hour, maximum. The maximum amount per event would be 15,000 pounds; therefore the hourly treatment limit at 2 events per hour is 30,000 pounds. The annual treatment limit is based on 365 events per year. The crater volume is calculated as per Source 2 below.

Source:

1. Event treatment limit from China Lake.
2. PM_{10} Emission Rate reported to GBUAPCD as 381 lbs/event. Therefore, two events in one hour yields 762 lbs of PM_{10}/hr.

Notes:

1. Total PM_{10} Emission Rate in lb/yr = lb/event * Annual Treatment Limit / Event Treatment Limit
2. Two events are assumed to occur over one hour.

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Annual Emission Rates from OD Craters

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)
Aluminum	7429905	5416	5.42E-03	7.53E+02	1.08E-02
Antimony	7440360	1.4	1.40E-06	1.95E-01	2.80E-06
Arsenic	7440382	2.3	2.26E-06	3.14E-01	4.52E-06
Barium	7440393	87.8	8.78E-05	1.22E+01	1.76E-04
Beryllium	7440417	0.2	2.03E-07	2.83E-02	4.07E-07
Cadmium	7440439	1.2	1.15E-06	1.60E-01	2.30E-06
Chromium III	16065831	11.9	1.19E-05	1.66E+00	2.39E-05
Chromium (hex.)	18540299	0.1	8.00E-08	1.11E-02	1.60E-07
Cobalt	7440484	4.5	4.47E-06	6.21E-01	8.93E-06
Copper	7440508	72.1	7.21E-05	1.00E+01	1.44E-04
Lead	7439921	31.0	3.10E-05	4.31E+00	6.19E-05
Mercury	7439976	0.02	2.00E-08	2.78E-03	4.00E-08
Molybdenum	7439987	1.2	1.15E-06	1.60E-01	2.30E-06
Nickel and compounds	7440020	8.7	8.72E-06	1.21E+00	1.74E-05
Selenium	7782492	1.7	1.65E-06	2.29E-01	3.30E-06
Thallium and compounds	7446186	11.0	1.10E-05	1.53E+00	2.20E-05
Vanadium & Compounds	7440622	29.7	2.97E-05	4.13E+00	5.95E-05
Zinc	7440666	40.0	4.00E-05	5.57E+00	8.01E-05
Inorganics					
Perchlorate	7601903	45.5	4.55E-05	6.32E+00	9.09E-05
Dioxins/Furans					
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	3.93E-06	3.93E-12	5.47E-07	7.86E-12
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	3.44E-05	3.44E-11	4.78E-06	6.88E-11
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1.01E-06	1.01E-12	1.40E-07	2.02E-12
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	3.06E-06	3.06E-12	4.26E-07	6.12E-12
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.62E-06	4.62E-12	6.42E-07	9.24E-12
Total TCDD	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total PeCDD	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDD	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HpCDD	35822469	5.43E-06	5.43E-12	7.55E-07	1.09E-11
Total TCDF	51207319	1.66E-06	1.66E-12	2.31E-07	3.32E-12
Total PeCDF	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDF	57117449	1.14E-06	1.14E-12	1.59E-07	2.28E-12
Total HpCDF	67562394	3.04E-06	3.04E-12	4.23E-07	6.08E-12
Explosives					
Cyclotetramethylene Tetranitramine (HMX)	2691410	0.79	7.90E-07	1.10E-01	1.58E-06
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	2.15	2.15E-06	2.99E-01	4.30E-06
Trinitrobenzene, 1,3,5-	99354	0.25	2.50E-07	3.48E-02	5.00E-07
Dinitrobenzene, 1,3-	99650	0.03	3.00E-08	4.17E-03	6.00E-08
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitra	479458	0.12	1.20E-07	1.67E-02	2.40E-07
Nitrobenzene	98953	0.04	4.00E-08	5.56E-03	8.00E-08
4-Amino-2,6-dinitrotoluene	19406510	0.07	7.00E-08	9.73E-03	1.40E-07
2-Amino-4,6-dinitrotoluene	35572782	0.13	1.30E-07	1.81E-02	2.60E-07
Trinitrotoluene, 2,4,6- (TNT)	118967	0.67	6.70E-07	9.32E-02	1.34E-06
Dinitrotoluene, 2,6-	606202	0.06	6.00E-08	8.34E-03	1.20E-07
Dinitrotoluene, 2,4-	121142	0.04	4.00E-08	5.56E-03	8.00E-08

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Annual Emission Rates from OD Craters

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)
Nitrotoluene, o-	88722	0.06	6.00E-08	8.34E-03	1.20E-07
Nitrotoluene, p-	99990	0.08	8.00E-08	1.11E-02	1.60E-07
Nitrotoluene, m-	99081	0.08	8.00E-08	1.11E-02	1.60E-07

Note:

1. Annual emission rate of each constituent (lb/yr) = Annual PM10 emission rate due to OD event (lb/yr) * Average concentration of constituent in the soil (lb/lb)

Source:

1. China Lake, "Soil Investigation Report for the Sixth Site Investigation (Soil Only) at the Burro Canyon OB/OD Facility", October 2003
2. PM10 emission rates from China Lake crater data

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Hourly Emission Rates from OD Craters

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Aluminum	7429905	5416	5.42E-03	4.13E+00	5.20E-01
Antimony	7440360	1.4	1.40E-06	1.07E-03	1.34E-04
Arsenic	7440382	2.26	2.26E-06	1.72E-03	2.17E-04
Barium	7440393	87.8	8.78E-05	6.69E-02	8.43E-03
Beryllium	7440417	0.2	2.03E-07	1.55E-04	1.95E-05
Cadmium	7440439	1.15	1.15E-06	8.76E-04	1.10E-04
Chromium III	16065831	11.9	1.19E-05	9.09E-03	1.15E-03
Chromium (hex.)	18540299	0.08	8.00E-08	6.10E-05	7.68E-06
Cobalt	7440484	4.47	4.47E-06	3.40E-03	4.29E-04
Copper	7440508	72.1	7.21E-05	5.50E-02	6.92E-03
Lead	7439921	31.0	3.10E-05	2.36E-02	2.97E-03
Mercury	7439976	0.02	2.00E-08	1.52E-05	1.92E-06
Molybdenum	7439987	1.15	1.15E-06	8.78E-04	1.11E-04
Nickel and compounds	7440020	8.72	8.72E-06	6.65E-03	8.37E-04
Selenium	7782492	1.65	1.65E-06	1.26E-03	1.58E-04
Thallium and compounds	7446186	11.0	1.10E-05	8.40E-03	1.06E-03
Vanadium & Compounds	7440622	29.7	2.97E-05	2.27E-02	2.85E-03
Zinc	7440666	40.0	4.00E-05	3.05E-02	3.84E-03
Inorganics					
Perchlorate	7601903	45.5	4.55E-05	3.46E-02	4.36E-03
Dioxins/Furans					
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	3.93E-06	3.93E-12	2.99E-09	3.77E-10
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	3.44E-05	3.44E-11	2.62E-08	3.30E-09
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1.01E-06	1.01E-12	7.70E-10	9.70E-11
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	3.06E-06	3.06E-12	2.33E-09	2.94E-10
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.62E-06	4.62E-12	3.52E-09	4.44E-10
Total TCDD	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total PeCDD	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDD	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HpCDD	35822469	5.43E-06	5.43E-12	4.14E-09	5.21E-10
Total TCDF	51207319	1.66E-06	1.66E-12	1.26E-09	1.59E-10
Total PeCDF	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDF	57117449	1.14E-06	1.14E-12	8.69E-10	1.09E-10
Total HpCDF	67562394	3.04E-06	3.04E-12	2.32E-09	2.92E-10
Explosives					
Cyclotetramethylene Tetranitramine (HMX)	2691410	0.79	7.90E-07	6.02E-04	7.58E-05
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	2.15	2.15E-06	1.64E-03	2.06E-04
Trinitrobenzene, 1,3,5-	99354	0.25	2.50E-07	1.91E-04	2.40E-05
Dinitrobenzene, 1,3-	99650	0.03	3.00E-08	2.29E-05	2.88E-06
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine	479458	0.12	1.20E-07	9.14E-05	1.15E-05
Nitrobenzene	98953	0.04	4.00E-08	3.05E-05	3.84E-06
4-Amino-2,6-dinitrotoluene	19406510	0.07	7.00E-08	5.33E-05	6.72E-06
2-Amino-4,6-dinitrotoluene	35572782	0.13	1.30E-07	9.91E-05	1.25E-05
Trinitrotoluene, 2,4,6- (TNT)	118967	0.67	6.70E-07	5.11E-04	6.43E-05
Dinitrotoluene, 2,6-	606202	0.06	6.00E-08	4.57E-05	5.76E-06
Dinitrotoluene, 2,4-	121142	0.04	4.00E-08	3.05E-05	3.84E-06
Nitrotoluene, o-	88722	0.06	6.00E-08	4.57E-05	5.76E-06
Nitrotoluene, p-	99990	0.08	8.00E-08	6.10E-05	7.68E-06

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Hourly Emission Rates from OD Craters

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Nitrotoluene, m-	99081	0.08	8.00E-08	6.10E-05	7.68E-06

Note:

1. Hourly emission rate of each constituent (lb/yr) = Hourly PM10 emission rate due to OD event (lb/yr) * Average concentration of constituent in the soil (lb/lb)

Source:

1. NAWS China Lake, October 2003
2. PM10 emission rates from China Lake crater data

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Emission of Ash Constituents from Loading of Ash Residue

Constituent Name	CAS Number	Average Concentration in the Ash (mg/kg)	Average Concentration in the Ash (lb/lb)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Antimony	7440360	19.4	1.94E-05	2.03E-08	2.93E-13	5.59E-11	7.04E-12
Barium	7440393	59.4	5.94E-05	6.23E-08	8.96E-13	1.71E-10	2.15E-11
Chromium III	16065831	21.7	2.17E-05	2.28E-08	3.27E-13	6.25E-11	7.87E-12
Cobalt	7440484	3	3.00E-06	3.15E-09	4.52E-14	8.64E-12	1.09E-12
Copper	7440508	27.1	2.71E-05	2.84E-08	4.09E-13	7.80E-11	9.83E-12
Lead	7439921	180.4	1.80E-04	1.89E-07	2.72E-12	5.19E-10	6.54E-11
Nickel	7440020	3.1	3.10E-06	3.25E-09	4.68E-14	8.92E-12	1.12E-12
Vanadium	7440622	20	2.00E-05	2.10E-08	3.02E-13	5.76E-11	7.25E-12
Zinc	7440666	102.3	1.02E-04	1.07E-07	1.54E-12	2.95E-10	3.71E-11
Chloromethane	74873	0.01	1.00E-08	1.05E-11	1.51E-16	2.88E-14	3.63E-15
Chloroethane	75003	0.025	2.50E-08	2.62E-11	3.77E-16	7.20E-14	9.07E-15
Trichlorofluoromethane	75694	0.07	7.00E-08	7.34E-11	1.06E-15	2.02E-13	2.54E-14
Acetone	67641	0.503	5.03E-07	5.27E-10	7.59E-15	1.45E-12	1.82E-13
Carbon Disulfide	75150	0.006	6.00E-09	6.29E-12	9.05E-17	1.73E-14	2.18E-15
Methylene Chloride	75092	0.057	5.70E-08	5.98E-11	8.60E-16	1.64E-13	2.07E-14
2-Butanone (MEK)	78933	0.664	6.64E-07	6.96E-10	1.00E-14	1.91E-12	2.41E-13
Chloroform	67663	0.02	2.00E-08	2.10E-11	3.02E-16	5.76E-14	7.25E-15
1,1,1-Trichloroethane	71556	0.075	7.50E-08	7.86E-11	1.13E-15	2.16E-13	2.72E-14
Benzene	71432	0.018	1.80E-08	1.89E-11	2.71E-16	5.18E-14	6.53E-15
2-Hexanone	591786	0.024	2.40E-08	2.52E-11	3.62E-16	6.91E-14	8.71E-15
Toluene	108883	0.079	7.90E-08	8.28E-11	1.19E-15	2.27E-13	2.87E-14
Ethybenzene	100414	0.005	5.00E-09	5.24E-12	7.54E-17	1.44E-14	1.81E-15
Meta+Para-Xylene	1330207	0.019	1.90E-08	1.99E-11	2.87E-16	5.47E-14	6.89E-15
Ortho-Xylene	1330207	0.005	5.00E-09	5.24E-12	7.54E-17	1.44E-14	1.81E-15
HMX	2691410	2.87	2.87E-06	3.01E-09	4.33E-14	8.26E-12	1.04E-12
RDX	121824	6.15	6.15E-06	6.45E-09	9.28E-14	1.77E-11	2.23E-12
1,3-DNB	99650	2.17	2.17E-06	2.28E-09	3.27E-14	6.25E-12	7.87E-13
2,4,6-TNT	118967	5.08	5.08E-06	5.33E-09	7.66E-14	1.46E-11	1.84E-12
4-Am-2,6-DNT	19406510	0.77	7.70E-07	8.07E-10	1.16E-14	2.22E-12	2.79E-13
2,6/2,4-DNT	121142	23.4	2.34E-05	2.45E-08	3.53E-13	6.74E-11	8.49E-12

Note: Loading emissions are assumed to occur throughout the year.

PM10 Emission Calculations

PM_{10} Emission Rate = PM_{10} Emission Factor * Amount of Ash Loaded

PM_{10} Emission Factor (kg/Mg) = k * 0.0016 * [(U/2.2)^1.3 / (M/2)^1.4]

Particle Size Multiplier, k =	0.35	
Mean Wind Speed, U (m/s) =	3.7	
Moisture Content, M (%) =	27	
PM_{10} Emission Factor (kg/Mg ash) =	2.88E-05	
Amount of Ash Loaded (lb/yr) =	36500	100 lb/event (or lb/hr)
Amount of Ash Loaded (Mg/yr) =	16.56	365 events/yr
PM_{10} Emission Rate (kg/yr) =	4.77E-04	
PM_{10} Emission Rate (lb/yr) =	1.05E-03	

Source:

1. Section 13.2.4 of EPA's Compilation of Air Pollutant Emission Factors (AP-42), last updated in January 1995. 2006 reference printed.
2. Mean wind speed from 1999-2002 Greenpoint metdata
3. Moisture content for fly ash, AP-42 Section 13.2.4

DIVERSIFIED ANALYTICAL SERVICES, INC.
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L A B O R A T O R Y R E P O R T

Reference: Naval Air Weapons Station, China Lake - Ash Samples for Delivery Order #0006 Collected 10/19/92

Test Methods: EPA Method 8240 for Volatile Compounds
EPA Method 8270 for Semivolatile Compounds
EPA Method 8330 for Explosives Residues
EPA Method 6010 for Heavy Metals

Date Received: October 23, 1992
Date Analyzed: October 26 - November 6, 1992
Date Reported: November 16, 1992

Note: See attached documents for further information.

A N A L Y T I C A L R E S U L T S

All Results in ppb (ug/kg) Unless Otherwise Specified

Constituent	BC-ASH
Chloromethane	10
Vinyl Chloride	<10
Bromomethane	<10
Chloroethane	25
Trichlorofluoromethane	70
1,1-Dichloroethene	< 5
Acetone	503
Carbon Disulfide	6
Methylene Chloride	57
trans-1,2-Dichloroethene	< 5
1,1-Dichloroethane	< 5
cis-1,2-Dichloroethene	< 5
2-Butanone (MEK)	664
Chloroform	20
1,1,1-Trichloroethane	75
Carbon Tetrachloride	< 5
Benzene	18
1,2-Dichloroethane	< 5
Trichloroethene	< 5
1,2-Dichloropropane	< 5
Bromodichloromethane	< 5
2-Chloroethyl Vinyl Ether	< 5
cis-1,3-Dichloropropene	< 5
2-Hexanone	24
Toluene	79
trans-1,3-Dichloropropene	< 5
1,1,2-Trichloroethane	< 5
Tetrachloroethene	< 5
4-Methyl-2-Pentanone (MIBK)	<25
Dibromochloromethane	< 5
Chlorobenzene	< 5
Ethylbenzene	5
Meta+Para-Xylene	19
Ortho-Xylene	5

Results continued on next page.

NAWS, China Lake D.O. #0006 Ash Report

Constituent	BC-ASH
Styrene	< 5
Bromoform	<10
1,1,2,2-Tetrachloroethane	< 5
1,3-Dichlorobenzene	< 5
1,4-Dichlorobenzene	< 5
1,2-Dichlorobenzene	< 5

Constituent	BC-ASH
N-Nitrosodimethylamine	<333
Phenol	<333
Bis(2-Chloroethyl)Ether	<333
2-Chlorophenol	<333
1,3-Dichlorobenzene	<400
1,4-Dichlorobenzene	<400
Benzyl Alcohol	<666
1,2-Dichlorobenzene	<400
2-Methylphenol	<333
Bis(2-Chloroisopropyl)Ether	<333
N-Nitrosodi-N-Propylamine	<333
4-Methylphenol	<333
Hexachloroethane	<333
Nitrobenzene	<333
Isophorone	<333
2-Nitrophenol	<333
2,4-Dimethylphenol	<333
Bis(2-Chloroethoxy)Methane	<333
2,4-Dichlorophenol	<333
Benzoic Acid	<1665
1,2,4-Trichlorobenzene	<333
Naphthalene	<333
4-Chloroanaline	<666
Hexachlorobutadiene	<333
4-Chloro-3-Methylphenol	<666
2-Methylnaphthalene	<333
Hexachlorocyclopentadiene	<666
2,4,6-Trichlorophenol	<333
2,4,5-Trichlorophenol	<333
2-Chloronaphthalene	<333
2-Nitroanaline	<1665
Dimethyl Phthalate	<333
Acenaphthylene	<333
2,6-Dinitrotoluene	<333
3-Nitroanaline	<1665
Acenaphthene	<333
2,4-Dinitrophenol	<1665
Dibenzofuran	<333
4-Nitrophenol	<1665
2,4-Dinitrotoluene	<333
Fluorene	<333

Results continued on next page.

NAWS, China Lake D.O. #0006 Ash Report

Constituent	BC-ASH
Diethyl Phthalate	<333
4-Chlorophenyl-Phenyl Ether	<333
4-Nitroanaline	<1665
4,6-Dinitro-2-Methylphenol	<1665
N-Nitrosodiphenylamine	<333
4-Bromophenyl Phenyl Ether	<333
Hexachlorobenzene	<333
Pentachlorophenol	<1665
Phenanthrene	<333
Anthracene	<333
Di-N-Butyl Phthalate	<333
Fluoranthene	<333
Benzidene	<1665
Pyrene	<333
Butyl Benzyl Phthalate	<333
Benzo(A)Anthracene	<333
3,3'-Dichlorobenzidine	<666
Chrysene	<333
Bis(2-Ethylhexyl)Phthalate	<333
Di-N-Octyl Phthalate	<333
Benzo(B)Fluoranthene	<333
Benzo(K)Fluoranthene	<333
Benzo(A)Pyrene	<333
Indeno(1,2,3-CD)Pyrene	<333
Dibenzo(A,H)Anthracene	<333
Benzo(G,H,I)Perylene	<333

Note: All subsequent results are in ppm (mg/kg)

Constituent	BC-ASH
HMX	2.87
RDX	6.15
1,3,5-TNB	<0.5
1,3-DNB	2.17
NB	<0.25
Tetryl	<0.25
2,4,6-TNT	5.08
2-Am-4,6-DNT	<0.5
4-Am-2,6-DNT	0.77
2,6/2,4-DNT	23.4
2-NT	<0.25
4-NT	<0.25

Results continued on next page.

NAWS, China Lake D.O. #0006 Ash Report

Constituent	BC-ASH	Total Metals (ppm)
Antimony	36.2	- 500
Arsenic	<1.0	- 10,000
Barium	48.2	
Beryllium	<0.5	
Cadmium	<0.5	
Chromium (total)	14.2	2,500
Cobalt	<0.5	
Copper	1.1	2,500
Lead	51.8	1,000
Mercury	<1.0	
Molybdenum	<2.0	
Nickel	<0.5	2,000
Selenium	<1.0	
Silver	<0.5	
Thallium	<2.0	
Vanadium	<0.5	
Zinc	48.5	5,000

< = less than the number following this sign is the detection lim for that specific constituent.

Diversified Analytical Services currently maintains Certificate Number 1201 under the California State Department of Health Services Environmental Laboratory Accreditation Program.

Respectfully Submitted,

Shawn A. Coleman,
Laboratory Director/
Analytical Chemist

5216
474230D/417
22 Nov 95

MEMORANDUM

From: Loretta Lusk, Materials Characterization Section, Code 474230D
To: Lt Knight, Code 828E00D

Subj: METALS ANALYSIS OF SAMPLES

Encl: (1) Metals analysis results

1. An ash sample was received on 8 November 1995. It was requested that we analyze the sample for CCR metals.

2. The sample was digested using EPA method 3055. The metal analysis was then conducted using EPA method 6010, inductively coupled plasma spectrometry. Results from the analysis have been tabulated on the enclosed report form.

3. If I can be of any further assistance do not hesitate to contact me. I can be reached at 939-1755.

Loretta A. Lusk
LORETTA A. LUSK

Copy to:
Code 474230D (Nissan, Lusk)

ENCL (2)

NAWC Metals Analysis

Digestion Method: EPA method 3055
Analysis Method: Inductively Coupled Plasma Spectrometry, EPA methos 6010
Analyst: Lori Lusk

Sample: ash

Lab. ID. No. 105-96

Element:	mg/kg
Ag	<1.0
As	<5.0
Ba	70.6
Be	<0.01
Cd	<1.0
Co	5.65
Cr	29.1
Cu	53.1
Mo	<5.0
Ni	5.95
Pb	309
Sb	<5.0
Se	<5.0
Tl	<5.0
U	39.8
Zn	156

13.2.4 Aggregate Handling And Storage Piles

13.2.4.1 General

Inherent in operations that use minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the need for frequent material transfer into or out of storage.

Dust emissions occur at several points in the storage cycle, such as material loading onto the pile, disturbances by strong wind currents, and loadout from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust.

13.2.4.2 Emissions And Correction Parameters

The quantity of dust emissions from aggregate storage operations varies with the volume of aggregate passing through the storage cycle. Emissions also depend on 3 parameters of the condition of a particular storage pile: age of the pile, moisture content, and proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, the potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents, either from aggregate transfer itself or from high winds. As the aggregate pile weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and then the drying process is very slow.

Silt (particles equal to or less than 75 micrometers [μm] in diameter) content is determined by measuring the portion of dry aggregate material that passes through a 200-mesh screen, using ASTM-C-136 method.[1] Table 13.2.4-1 summarizes measured silt and moisture values for industrial aggregate materials.

Table 13.2.4-1. TYPICAL SILT AND MOISTURE CONTENTS OF MATERIALS AT VARIOUS INDUSTRIES[a]

Industry	No. Of Facilities	Material	Silt Content (%)			Moisture Content (%)		
			No. Of Samples	Range	Mean	No. Of Samples	Range	Mean
Iron and steel production	9	Pellet ore	13	1.3 - 13	4.3	11	0.64 - 4.0	2.2
		Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.0	5.4
		Coal	12	2.0 - 7.7	4.6	11	2.8 - 11	4.8
		Slag	3	3.0 - 7.3	5.3	3	0.25 - 2.0	0.92
		Flue dust	3	2.7 - 23	13	1	—	7
		Coke breeze	2	4.4 - 5.4	4.9	2	6.4 - 9.2	7.8
		Blended ore	1	—	15	1	—	6.6
		Sinter	1	—	0.7	0	—	—
		Limestone	3	0.4 - 2.3	1.0	2	ND	0.2
Stone quarrying and processing	2	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
		Various limestone products	8	0.8 - 14	3.9	8	0.46 - 5.0	2.1
Taconite mining and processing	1	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.0	0.9
		Tailings	2	ND	11	1	—	0.4
Western surface coal mining	4	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
		Overburden	15	3.8 - 15	7.5	0	—	—
		Exposed ground	3	5.1 - 21	15	3	0.8 - 6.4	3.4
Coal-fired power plant	1	Coal (as received)	60	0.6 - 4.8	2.2	59	2.7 - 7.4	4.5
Municipal solid waste landfills	4	Sand	1	—	2.6	1	—	7.4
		Slag	2	3.0 - 4.7	3.8	2	2.3 - 4.9	3.6
		Cover	5	5.0 - 16	9.0	5	8.9 - 16	12
		Clay/dirt mix	1	—	9.2	1	—	14
		Clay	2	4.5 - 7.4	6.0	2	8.9 - 11	10
		Fly ash	4	78 - 81	80	4	26 - 29	27
		Misc. fill materials	1	—	12	1	—	11

[a] References 1-10. ND = no data.

13.2.4.3 Predictive Emission Factor Equations

Total dust emissions from aggregate storage piles result from several distinct source activities within the storage cycle:

1. Loading of aggregate onto storage piles (batch or continuous drop operations).
2. Equipment traffic in storage area.
3. Wind erosion of pile surfaces and ground areas around piles.
4. Loadout of aggregate for shipment or for return to the process stream (batch or continuous drop operations).

Either adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out from the pile to a truck with a front-end loader are examples of batch drop operations. Adding material to the pile by a conveyor stacker is an example of a continuous drop operation.

The quantity of particulate emissions generated by either type of drop operation, per kilogram (kg) (ton) of material transferred, may be estimated, with a rating of A, using the following empirical expression:[11]

$$E = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (kg/megagram [Mg])}$$

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (pound [lb]/ton)} \quad (1)$$

where:

E = emission factor
k = particle size multiplier (dimensionless)
U = mean wind speed, meters per second (m/s) (miles per hour [mph])
M = material moisture content (%)

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 µm taken from Reference 14.

The equation retains the assigned quality rating if applied within the ranges of source conditions that were tested in developing the equation, as follows. Note that silt content is included, even though silt content does not appear as a correction parameter in the equation. While it is reasonable to expect that silt content and emission factors are interrelated, no significant correlation between the 2 was found during the derivation of the equation, probably because most tests with high silt contents were conducted under lower winds, and vice versa. It is recommended that estimates from the equation be reduced 1 quality rating level if the silt content used in a particular application falls outside the range given:

Ranges Of Source Conditions For Equation 1			
Silt Content (%)	Moisture Content (%)	Wind Speed	
		m/s	mph
0.44 - 19	0.25 - 4.8	0.6 - 6.7	1.3 - 15

To retain the quality rating of the equation when it is applied to a specific facility, reliable correction parameters must be determined for specific sources of interest. The field and laboratory procedures for aggregate sampling are given in Reference 3. In the event that site-specific values for

correction parameters cannot be obtained, the appropriate mean from Table 13.2.4-1 may be used, but the quality rating of the equation is reduced by 1 letter.

For emissions from equipment traffic (trucks, front-end loaders, dozers, etc.) traveling between or on piles, it is recommended that the equations for vehicle traffic on unpaved surfaces be used (see Section 13.2.2). For vehicle travel between storage piles, the silt value(s) for the areas among the piles (which may differ from the silt values for the stored materials) should be used.

Worst-case emissions from storage pile areas occur under dry, windy conditions. Worst-case emissions from materials-handling operations may be calculated by substituting into the equation appropriate values for aggregate material moisture content and for anticipated wind speeds during the worst case averaging period, usually 24 hours. The treatment of dry conditions for Section 13.2.2, vehicle traffic, "Unpaved Roads", follows the methodology described in that section centering on parameter p. A separate set of nonclimatic correction parameters and source extent values corresponding to higher than normal storage pile activity also may be justified for the worst-case averaging period.

13.2.4.4 Controls[12-13]

Watering and the use of chemical wetting agents are the principal means for control of aggregate storage pile emissions. Enclosure or covering of inactive piles to reduce wind erosion can also reduce emissions. Watering is useful mainly to reduce emissions from vehicle traffic in the storage pile area. Watering of the storage piles themselves typically has only a very temporary slight effect on total emissions. A much more effective technique is to apply chemical agents (such as surfactants) that permit more extensive wetting. Continuous chemical treating of material loaded onto piles, coupled with watering or treatment of roadways, can reduce total particulate emissions from aggregate storage operations by up to 90 percent.[12]

References For Section 13.2.4

1. C. Cowherd, Jr., *et al., Development Of Emission Factors For Fugitive Dust Sources*, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

2. R. Bohn, *et al., Fugitive Emissions From Integrated Iron And Steel Plants*, EPA-600/2-78-050, U. S. Environmental Protection Agency, Cincinnati, OH, March 1978.

3. C. Cowherd, Jr., *et al., Iron And Steel Plant Open Dust Source Fugitive Emission Evaluation*, EPA-600/2-79-103, U. S. Environmental Protection Agency, Cincinnati, OH, May 1979.

4. *Evaluation Of Open Dust Sources In The Vicinity Of Buffalo, New York*, EPA Contract No. 68-02-2545, Midwest Research Institute, Kansas City, MO, March 1979.

5. C. Cowherd, Jr., and T. Cuscino, Jr., *Fugitive Emissions Evaluation*, MRI-4343-L, Midwest Research Institute, Kansas City, MO, February 1977.

6. T. Cuscino, Jr., *et al., Taconite Mining Fugitive Emissions Study*, Minnesota Pollution Control Agency, Roseville, MN, June 1979.

7. *Improved Emission Factors For Fugitive Dust From Western Surface Coal Mining Sources,* 2 Volumes, EPA Contract No. 68-03-2924, PEDCo Environmental, Kansas City, MO, and Midwest Research Institute, Kansas City, MO, July 1981.

8. *Determination Of Fugitive Coal Dust Emissions From Rotary Railcar Dumping,* TRC, Hartford, CT, May 1984.

9. *PM-10 Emission Inventory Of Landfills In the Lake Calumet Area*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, September 1987.

10. *Chicago Area Particulate Matter Emission Inventory — Sampling And Analysis*, EPA Contract No. 68-02-4395, Midwest Research Institute, Kansas City, MO, May 1988.

11. *Update Of Fugitive Dust Emission Factors In AP-42 Section 11.2*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, July 1987.

12. G. A. Jutze, *et al., Investigation Of Fugitive Dust Sources Emissions And Control*, EPA-450/3-74-036a, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

13. C. Cowherd, Jr., *et al., Control Of Open Fugitive Dust Sources*, EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

14. C. Cowherd, *Background Document for Revisions to Fine Fraction Ratios &sed for AP-42 Fugitive Dust Emission Factors*. Prepared by Midwest Research Institute for Western Governors Association, Western Regional Air Partnership, Denver, CO, February 1, 2006.

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Emission of Soil Constituents from Grading

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Aluminum	7429905	5416	5.42E-03	1.31E+01	1.88E-04	3.58E-02	4.51E-03
Antimony	7440360	1.4	1.40E-06	3.38E-03	4.86E-08	9.26E-06	1.17E-06
Arsenic	7440382	2.3	2.26E-06	5.46E-03	7.85E-08	1.50E-05	1.88E-06
Barium	7440393	87.8	8.78E-05	2.12E-01	3.05E-06	5.80E-04	7.31E-05
Beryllium	7440417	0.2	2.03E-07	4.91E-04	7.06E-09	1.34E-06	1.69E-07
Cadmium	7440439	1.2	1.15E-06	2.78E-03	3.99E-08	7.60E-06	9.58E-07
Chromium III	16065831	11.9	1.19E-05	2.88E-02	4.14E-07	7.89E-05	9.94E-06
Chromium (hex.)	18540299	0.1	8.00E-08	1.93E-04	2.78E-09	5.29E-07	6.67E-08
Cobalt	7440484	4.5	4.47E-06	1.08E-02	1.55E-07	2.95E-05	3.72E-06
Copper	7440508	72.1	7.21E-05	1.74E-01	2.50E-06	4.77E-04	6.01E-05
Lead	7439921	31.0	3.10E-05	7.47E-02	1.08E-06	2.05E-04	2.58E-05
Mercury	7439976	0.02	2.00E-08	4.83E-05	6.94E-10	1.32E-07	1.67E-08
Molybdenum	7439987	1.2	1.15E-06	2.78E-03	4.00E-08	7.62E-06	9.60E-07
Nickel and compounds	7440020	8.7	8.72E-06	2.11E-02	3.03E-07	5.77E-05	7.27E-06
Selenium	7782492	1.7	1.65E-06	3.98E-03	5.73E-08	1.09E-05	1.37E-06
Thallium and compounds	7446186	11.0	1.10E-05	2.66E-02	3.83E-07	7.29E-05	9.18E-06
Vanadium & Compounds	7440622	29.7	2.97E-05	7.18E-02	1.03E-06	1.97E-04	2.48E-05
Zinc	7440666	40.0	4.00E-05	9.66E-02	1.39E-06	2.65E-04	3.34E-05
Inorganics							
Perchlorate	7601903	45.5	4.55E-05	1.10E-01	1.58E-06	3.01E-04	3.79E-05
Dioxins/Furans							
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	3.93E-06	3.93E-12	9.49E-09	1.36E-13	2.60E-11	3.27E-12
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	3.44E-05	3.44E-11	8.30E-08	1.19E-12	2.27E-10	2.87E-11
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1.01E-06	1.01E-12	2.44E-09	3.51E-14	6.68E-12	8.41E-13
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	3.06E-06	3.06E-12	7.39E-09	1.06E-13	2.02E-11	2.55E-12
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.62E-06	4.62E-12	1.12E-08	1.60E-13	3.05E-11	3.85E-12
Total TCDD	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total PeCDD	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDD	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HpCDD	35822469	5.43E-06	5.43E-12	1.31E-08	1.89E-13	3.59E-11	4.52E-12
Total TCDF	51207319	1.66E-06	1.66E-12	4.01E-09	5.76E-14	1.10E-11	1.38E-12
Total PeCDF	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDF	57117449	1.14E-06	1.14E-12	2.75E-09	3.96E-14	7.54E-12	9.50E-13
Total HpCDF	67562394	3.04E-06	3.04E-12	7.34E-09	1.06E-13	2.01E-11	2.53E-12
Explosives							
Cyclotetramethylene Tetranitramine (HMX)	2691410	0.79	7.90E-07	1.91E-03	2.74E-08	5.22E-06	6.58E-07
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	2.15	2.15E-06	5.19E-03	7.46E-08	1.42E-05	1.79E-06
Trinitrobenzene, 1,3,5-	99354	0.25	2.50E-07	6.03E-04	8.68E-09	1.65E-06	2.08E-07
Dinitrobenzene, 1,3-	99650	0.03	3.00E-08	7.24E-05	1.04E-09	1.98E-07	2.50E-08
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458	0.12	1.20E-07	2.90E-04	4.17E-09	7.93E-07	1.00E-07
Nitrobenzene	98953	0.04	4.00E-08	9.65E-05	1.39E-09	2.64E-07	3.33E-08
4-Amino-2,6-dinitrotoluene	19406510	0.07	7.00E-08	1.69E-04	2.43E-09	4.63E-07	5.83E-08
2-Amino-4,6-dinitrotoluene	35572782	0.13	1.30E-07	3.14E-04	4.51E-09	8.60E-07	1.08E-07
Trinitrotoluene, 2,4,6- (TNT)	118967	0.67	6.70E-07	1.62E-03	2.33E-08	4.43E-06	5.58E-07
Dinitrotoluene, 2,6-	606202	0.06	6.00E-08	1.45E-04	2.08E-09	3.97E-07	5.00E-08
Dinitrotoluene, 2,4-	121142	0.04	4.00E-08	9.65E-05	1.39E-09	2.64E-07	3.33E-08
Nitrotoluene, o-	88722	0.06	6.00E-08	1.45E-04	2.08E-09	3.97E-07	5.00E-08
Nitrotoluene, p-	99990	0.08	8.00E-08	1.93E-04	2.78E-09	5.29E-07	6.67E-08
Nitrotoluene, m-	99081	0.08	8.00E-08	1.93E-04	2.78E-09	5.29E-07	6.67E-08

Note: Tilling emissions are assumed to occur throughout the year.

PM10 Emission Calculations

PM_{10} Emission Rate (lb/yr) = PM_{10} Emission Factor (lb/acre/pas) * Erodible Area (acre) * Tilling Frequency (passes/yr)

PM_{10} Emission Factor (lb/acre/pass) =		1.2	(From Table A in reference source 1)
Erodible Area (m^2) =	22,300		
Erodible Area (acre) =		5.5	
Tillings per year, N =		365	1 event/day
PM_{10} Emission Rate (lb/yr) =		2413.5	6.61 lb/hr

Source:

1. Agricultural Land Preparation (Revised January 2003), ARB Miscellaneous Process Methodologies, CARB 2004
http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-4.pdf
2. Erodible Area from China Lake

SECTION 7.4

AGRICULTURAL LAND PREPARATION

(Revised January 2003)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Farming Operations

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
620-614-5400-0000 (47332) Agricultural Land Preparation

METHODS AND SOURCES

The land preparation source category includes estimates of the airborne soil particulate emissions produced during the preparation of agricultural lands for planting and after-harvest activities. Operations included in this methodology are discing, shaping, chiseling, leveling, and other mechanical operations used to prepare the soil. Dust emissions are produced by the mechanical disturbance of the soil by the implement used and the tractor pulling it. Soil preparation activities tend to be performed in the early spring and fall months. Table 1 shows the estimated soil preparation particulate emissions for each California county.

Particulate emissions from land preparation are computed by multiplying a crop specific emission factor by an activity factor. The crop specific emission factors are calculated using operation specific (i.e., discing or chiseling) emission factors developed by UC Davis researchers[1], which are combined with the number of operations provided in the crop calendars. The activity factor is based on the harvested acreage of each crop for each county in the state. In addition, acre-passes are computed, which are the number of passes per acre that are typically needed to prepare a field for planting a particular crop. By combining the crop acreage and the operation specific emission factor, we estimate the particulate matter produced by agricultural land preparation operations.

The particulate dust emissions from agricultural land preparation are estimated for each crop in each county in California using the following equation.

$$\text{Emissions}_{\text{crop}} = \text{Emission Factor}_{\text{crop}} \times \text{Acres}_{\text{crop}}$$

The crop emissions for each county are summed to produce the county and statewide particulate matter (PM) and PM_{10} emission estimates. The remainder of this section discusses each component of and related to the above equation.

Acres. The acreage data used for estimating land preparation emissions are from the California Department of Food and Agriculture's (CDFA) summary of crop acreage harvested in 2000. The acreage data are subdivided by county and crop type for the entire state, and are compiled from individual county agricultural commissioner reports. Acres for more than 200 crop commodities were reported by CDFA. Complete listings of individual county crop acreage are provided in the land preparation background document.

Crop Calendars & Acre-Passes. Acre-passes are the total number of passes typically performed to prepare land for planting during a year. Acre-passes are used in computing crop specific emission factors for land preparation. These land preparation operations may occur following harvest or closer to planting, and can include discing, tilling, land leveling, and other operations. Each crop is different in the type of soil operations performed and when they occur. To get the best estimates available, staff of the ARB met with producers of the various commodities to gather the most realistic and current information available on agricultural practices. Focusing on the largest acreage crops, we were able to gather updated information for about 90 percent of California's crop acreage. For the crops that were not explicitly updated, we either applied an updated crop profile from a similar crop, or used one of the existing ARB profiles. Table 2.a provides a listing of the land preparation operations of all crop profiles and their emission factors used in California.

For updating acre-pass data, we also collected specific information on when agricultural operations occur. Using these data, it was possible to create detailed temporal profiles that help to indicate when PM emissions from land preparations may be highest. The more detailed background document includes detailed crop calendars for each crop with updated information. For all the acre-pass and crop calendar information, the farmers and other agricultural experts of the San Joaquin Valley were instrumental in helping us to update our crop information.

The crop calendar consists of twenty representative crop profiles. To make better emission estimates for the over 200 crop commodities reported by CDFA, we assigned each crop to the profile with the highest similarity. The complete listings of individual crop commodities and the assigned profiles are provided in Table 3.

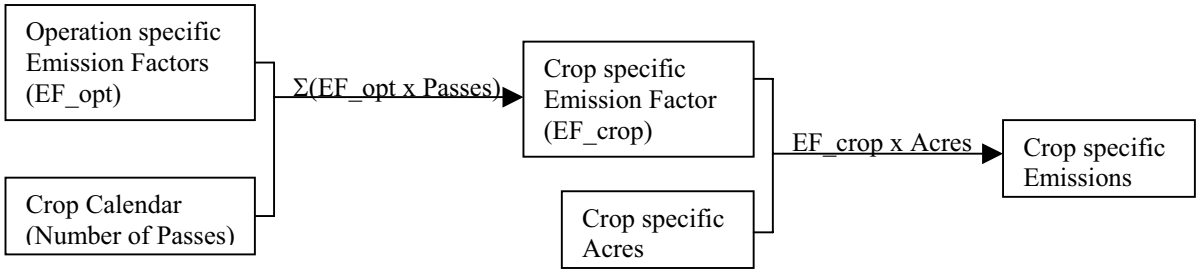
Emission factor. The operation specific emission factors used to estimate the crop specific emission factor for agricultural land preparations were initially from a report of University of California at Davis and their subsequent supplementary data analysis [4]. After discussions with regulators, researchers, and industry representatives, the emission factors were adjusted based on a combination of scientific applicability, general experience and observations. The initial emission factors were developed based on 1995-1998 test data measured in cotton and wheat fields in California. The operations tested include root cutting, discing, ripping and subsoiling, land planing and floating, and weeding, which are summarized in Table A below.

Table A. Land Preparation Operation Emission Factor

Land Preparation Operations	**Emission Factor** (lbs PM_{10}/acre-pass)
Root cutting	0.3
Discing, Tilling, Chiseling	1.2
Ripping, Subsoiling	4.6
Land Planing & Floating	12.5
Weeding	0.8

There are more than thirty different land preparation operations commonly used in California. With five emission factors available, the other operations were assigned "best-fit" factors based on similar potential emission levels. The assignment of emission factors for operations was based on the expertise and experience of regulators, researchers, and industry representatives. The complete list of land preparation operations and the assigned operation categories are provided in Table 2.b.

For each crop, the emission factor is the sum of acre-pass weighted emission factor for each land preparation operation. Table 2.a provides the emission factors for each representative crops in the crop calendar. The figure below illustrates the entire emissions estimation process.



ASSUMPTIONS

1. The land preparation emission factors for discing, tilling, etc., are assumed to produce the same level of emissions, regardless of the crop type.

2. The land preparation emission factors do not change geographically for counties.

3. A limited number of emission factors are assigned to all land preparation activities.

4. Crop calendar data collected for San Joaquin crops and practices were extrapolated to the same crops in the remainder of the State. Existing crop profiles were used for the small percentage of crops in which update information was not collected.

5. In addition to the activities provided in the crop calendars, it is also assumed that field and row crop acreage receive a land planing pass once every five years.

6. UC Davis directly measured PM_{10} emissions. To compute TSP emissions, multiply the PM_{10} by 2.22, which is the ARB's soil size speciation value for agricultural tilling dust.

TEMPORAL ACTIVITY

Temporal activity for harvesting is derived by summing, for each county, the monthly emissions from all crops. For each crop, the monthly emissions were calculated based on its monthly crop calendar profile, which reflects the percentage of harvesting activities that occurs in that month. Below is an example of the monthly profile for almonds, cotton, and wheat. Because the crop composite differs by county, the monthly profiles for counties are different. An example of some composite county monthly profiles is shown below in Tables B-1 through B-3. Table 3 lists the composite temporal data for every county. The background document provides details on how the monthly temporal profiles were developed.

Table B-1. Temporal Profiles

CES	Hours	Days	Weeks
47332	24	7	52

Table B-2. Monthly Activity Profile of Selected Crops

Crops	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Almonds	0	0	0	0	0	0	0	0	0	0	50	50
Cotton	0	9	9	0	0	0	0	0	0	0	41	41
Grapes-wine	0	0	0	4	16	16	12	12	12	28	0	0

Table B.3 County Land Preparation Profile Composite

County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Fresno	3	6	6	2	2	1	3	4	2	12	30	29

COMMENTS AND RECOMMENDATIONS

Studies are ongoing by the University of California, Davis, to analyze field test data from 70 to 90 additional land preparation tests. As the UCD results become available, they will be incorporated to the emission estimation methodology. If possible, future updates could include county specific crop calendars and crop-pass information instead of being based on San Joaquin Valley practices.

CHANGES IN METHOD AND EMISSION ESTIMATES

There were significant improvements to the land preparation emissions estimates for this update. These include:

- Incorporation of new operation specific land preparation emission factors;
- Development of new crop specific emission factors;

- Use of updated 2000 crop acreage data from the California Department of Food and Agriculture.

These changes produced an emissions reduction of about 50% from the previous 1997 published emission inventory estimates for agricultural land preparation.

GROWTH PARAMETERS

Growth in this category is based on the crop acreage projection estimated by the Department of Water Resources. The growth varies by regions.

SAMPLE CALCULATIONS

The instructions and table below summarizes the data computations necessary to estimate the PM10 emissions from agricultural land preparations in Fresno County. The following steps are performed:

Step 1: Crop Acreage. The acres harvested for a few of the crops in Fresno County are shown in the 'Acres' column of the table. These data are available from the county agricultural commissioner annual reports or the CDFA. The 2000 acreage data are summarized in the agricultural tilling background document.

Step 2: Insert emission Factor for Crop. Using the crop profile in Table 2.a to get the appropriate crop emission factor.

Step 3: Compute Crop Emissions. Multiply the annual harvested acreage for each crop by the emission factor and divide by 2000 lbs/ton to get the annual PM_{10} emissions.
Emissions = (Acres x Emission Factor) / 2000

Step 4: Compute County Total Emissions. Sum the crop PM_{10} emissions for each county to compute the total county agricultural soil preparation particulate matter emissions.

Step 5: Compute TSP. Divide the PM_{10} emissions by a factor of 0.4543.

Table C. Estimating Agricultural Land Preparation PM_{10} Emissions in Fresno County

Crop	Crop Profile	Acres	Emission Factor (lbs PM_{10}/acre)	PM_{10} Emissions (tons/yr)	TSP Emissions (tons/yr)
Wheat all	Wheat	69500	3.7	128.6	283.1
Rice Milling	Rice	6160	20	61.6	135.6
Cotton lint pima	Cotton	33400	8.9	148.6	327.1
Apples All	Citrus	3205	0.07	0.1	0.2
Etc…	…	…	…	…	
Total	…	…	…	…	

REFERENCES

1. Flocchini, R.G., James, T.A., et al. Sources and Sinks of PM10 in the San Joaquin Valley (Interim Report), a study for United States Department of Agriculture Special Research Grants Program. Contract Nos. 94-33825-0383 and 98-38825-6063. August 10, 2001.

2. California Agricultural Statistics Service. 2000 acreage extracted from agricultural commissioner's reports. Sacramento, CA.

3. Gaffney, P.H., Yu, H. Agricultural Harvest: Geologic Particulate Matter Emission Estimates, Background Document. California Air Resources Board. December 2002.

4. Terry Cassel, Informal write-up for SJV Ag Tech Committee, Evaluation of ARB application of UCD emission factors, July 12, 2002.

UPDATED BY

Hong Yu, Patrick Gaffney
January 2003

TABLE 1
2000 Agricultural Land Preparation PM10 and TSP Emissions
EIC: 620-614-5400-0000; CES: 47332; Activity: Acre-Passes

Air Basin	ID#	County	Acreage	AcrePass	PM_{10} Emissions (tons/year)	TSP Emissions (tons/year)
GBV	2	ALPINE	0	0	0	0
	14	INYO	4,660	7,230	10.1	22.3
	26	MONO	10,935	20,972	33.2	73.1
LC	17	LAKE	18,457	13,503	21.8	48.0
LT	9	EL DORADO	396	221	0.2	0.5
	31	PLACER	2,233	9,702	16.9	37.2
MC	3	AMADOR	6,196	8,514	8.7	19.1
	5	CALAVERAS	1,880	1,485	2.3	5.2
	9	EL DORADO	2,908	1,620	1.7	3.8
	22	MARIPOSA	1,239	3,785	3.1	6.8
	29	NEVADA	303	308	0.2	0.5
	31	PLACER	13,624	59,183	103.0	226.8
	32	PLUMAS	12,950	18,778	25.9	57.0
	46	SIERRA	4,500	6,525	9.0	19.8
	55	TUOLUMNE	770	1,117	1.5	3.4
MD	15	KERN	280,668	775,461	771.9	1,699.1
	19	LOS ANGELES	13,790	44,740	41.1	90.5
	33	RIVERSIDE	68,678	173,202	184.3	405.7
	36	SAN BERNARDINO	11,171	21,093	22.7	49.9
NC	8	DEL NORTE	2,440	3,538	4.9	10.7
	12	HUMBOLDT	1,600	2,170	3.1	6.8
	23	MENDOCINO	16,301	15,063	11.2	24.7
	49	SONOMA	36,726	39,854	37.1	81.7
	53	TRINITY	175	254	0.4	0.8
NCC	27	MONTEREY	319,356	1,361,021	1,517.3	3,339.8
	35	SAN BENITO	56,726	164,716	193.8	426.7
	44	SANTA CRUZ	19,652	59,829	63.1	138.8
NEP	18	LASSEN	76,895	121,815	171.2	376.8
	25	MODOC	363,716	545,563	773.0	1,701.5
	47	SISKIYOU	103,879	169,712	259.9	572.0
SC	19	LOS ANGELES	9,194	29,827	27.4	60.3
	30	ORANGE	11,328	43,467	36.2	79.7
	33	RIVERSIDE	84,186	212,313	226.0	497.4
	36	SAN BERNARDINO	27,349	51,641	55.6	122.3
SCC	40	SAN LUIS OBISPO	109,106	271,633	288.7	635.5
	42	SANTA BARBARA	115,638	428,580	406.2	894.1
	56	VENTURA	99,157	224,330	241.6	531.9
SD	37	SAN DIEGO	58,006	65,430	61.8	135.9
SF	1	ALAMEDA	8,789	17,848	17.5	38.5
	7	CONTRA COSTA	31,480	97,355	85.3	187.7
	21	MARIN	6,336	9,167	12.6	27.7
	28	NAPA	33,436	34,263	26.4	58.1
	38	SAN FRANCISCO				0.0
	41	SAN MATEO	3,897	13,085	11.6	25.5
	43	SANTA CLARA	21,268	73,223	69.4	152.7
	48	SOLANO	32,379	82,817	82.8	182.2
	49	SONOMA	23,481	25,481	23.7	52.2
SJV	10	FRESNO	1,189,319	4,315,089	3,624.9	7,979.0
	15	KERN	596,420	1,647,854	1,640.2	3,610.5
	16	KINGS	573,639	2,312,623	1,933.0	4,254.9
	20	MADERA	302,610	514,663	530.4	1,167.4
	24	MERCED	503,793	1,385,331	1,463.4	3,221.2
	39	SAN JOAQUIN	548,940	1,368,065	1,469.9	3,235.5
	50	STANISLAUS	386,435	845,789	933.5	2,054.8
	54	TULARE	761,224	1,505,110	1,450.5	3,192.8
SS	13	IMPERIAL	589,996	1,412,555	1,917.8	4,221.4
	33	RIVERSIDE	68,678	173,202	184.3	405.7
SV	4	BUTTE	198,477	672,571	1,174.5	2,585.4
	6	COLUSA	292,410	1,320,937	1,950.7	4,293.9
	11	GLENN	224,816	777,154	1,220.0	2,685.5
	31	PLACER	6,477	28,136	49.0	107.8
	34	SACRAMENTO	132,613	377,036	409.2	900.8
	45	SHASTA	26,401	52,022	78.3	172.4
	48	SOLANO	129,514	331,268	331.1	728.7
	51	SUTTER	262,736	974,087	1,487.0	3,273.1
	52	TEHAMA	52,769	52,858	82.5	181.5
	57	YOLO	325,147	1,137,427	1,202.5	2,646.9
	58	YUBA	74,329	231,120	401.9	884.6
		STATE TOTAL	**9,374,598**	**26,766,332**	**29,499.9**	**64,934.9**

Fraction of PM10 = 0.45 (PM_{10} Emissions = TSP x 0.4543)

TABLE 2.a
Summary of Crop Profile, Acre-Pass, and Emission Factor

Crop profile	Land Preparation Operations	Category	Acre-Pass	Emission Factor	
				Operation (lbs/Acre-pass)	Crop (lbs/Acre/year)
Alfalfa	Unspecified	Discing	1.25	1.2	
	Land Maintenance	Land Planing	0.2	12.5	4
Almonds	Float	Land Planing	0.25	12.5	3.13
Citrus	Unspecified	Discing	0.06	1.2	0.07
Corn	List & Fertilize	Weeding	1	0.8	
	Mulch Beds	Discing	1	1.2	
	Finish Disc	Discing	1	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
	Stubble Disc	Discing	1	1.2	6.9
Cotton	Land Preparation	Discing	4	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
	Seed Bed Preparation	Weeding	2	0.8	8.9
DryBeans	Land Maintenance	Land Planing	0.2	12.5	
	Chisel	Discing	1	1.2	
	Shaping	Weeding	1	0.8	
	Disc	Discing	2	1.2	
	Listing	Weeding	1	0.8	7.7
Garbanzo	Chisel	Discing	1	1.2	
	Listing	Weeding	1	0.8	
	Shaping	Weeding	1	0.8	
	Disc	Discing	2	1.2	
	Land Maintenance	Land Planing	0.2	12.5	7.7
Garlic	Land Maintenance	Land Planing	0.2	12.5	
	Disc & Roll	Discing	1	1.2	
	Chisel	Discing	1	1.2	
	List	Weeding	1	0.8	
	Shape Beds	Weeding	1	0.8	6.5
Grapes-Raisin	Terrace	Weeding	1	0.8	
	Spring Tooth	Weeding	0.2	0.8	
	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	1	1.2	
	Level (new vineyard)	Land Planing	0.02	12.5	2.6
Grapes-Table	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	0.5	1.2	0.83
Grapes-Wine	Level (new vineyard)	Land Planing	0.02	12.5	
	Spring Tooth	Weeding	0.2	0.8	
	Subsoil	Ripping	0.05	4.6	
	Disc & Furrow-out	Discing	0.75	1.2	1.5
Lettuce*	Land Maintenance	Land Planing	0.2	12.5	
	Disc & Roll	Discing	2/2	1.2	
	Chisel	Discing	2/2	1.2	
	List	Weeding	2/2	0.8	
	Plane	Land Planing	½	12.5	
	Shape Beds & Roll	Weeding	2/2	0.8	12.75
Melon	Plow	Discing	1	1.2	
	Shape Beds	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Disc	Discing	1	1.2	5.7
No Land Prep.	Unspecified	Discing	0	1.2	0
Onions	List	Weeding	1	0.8	
	Shape Beds	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Chisel	Discing	1	1.2	
	Disc & Roll	Discing	1	1.2	6.5
Rice	Chisel	Discing	1	1.2	
	Land Maintenance	Land Planing	0.2	12.5	
	Post Burn/Harvest Disc	Discing	0.5	1.2	
	Roll	Weeding	1	0.8	
	3 Wheel Plane	Land Planing	1	12.5	
	Harrow Disc	Discing	1	1.2	
	Stubble Disc	Discing	1	1.2	20
Safflower	List	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	
	Stubble Disc	Discing	1	1.2	4.5

Crop profile	Land Preparation Operations	Category	Acre-Pass	Emission Factor	
				Operation (lbs/Acre-pass)	Crop (lbs/Acre/year)
Sugar Beets	Disc	Discing	1	1.2	
	Land Plane	Land Planing	1	12.5	
	Subsoil-deep chisel	Ripping	1	4.6	
	Stubble Disc	Discing	1	1.2	
	List	Weeding	1	0.8	
	Land Maintenance	Land Planing	0.2	12.5	22.8
Tomatoes	Bed Preparation	Weeding	2	0.8	
	Land Preparation	Discing	5	1.2	
	Land Maintenance	Land Planing	0.2	12.5	10.1
Vegetables	Land Maintenance	Land Planing	0.2	12.5	
	Unspecified	Discing	5	1.2	8.5
Wheat	Stubble Disc	Discing	1	1.2	
	Land Maintenance	Land Planing	0.2	12.5	3.7

* Lettuce profile acre-passes are divided by 2 except for land maintenance operation to remove double cropping count because double cropping is accounted for in the 'Harvested Acres' in the emission calculations. (e.g., if the same land is harvested twice in the same year, the same acreage is counted twice in the county Ag. commissioner crop reports)

TABLE 2.b
Summary of Land Preparation Operations and Assigned Operation Categories

Operation	Category	Emission Factor (lbs/Acre-pass)
Chisel	Discing	1.2
Disc	Discing	1.2
Disc & Furrow-out	Discing	1.2
Disc & Roll	Discing	1.2
Finish Disc	Discing	1.2
Harrow Disc	Discing	1.2
Land Preparation	Discing	1.2
Mulch Beds	Discing	1.2
Plow	Discing	1.2
Post Burn/Harvest Disc	Discing	1.2
Stubble Disc	Discing	1.2
Unspecified	Discing	1.2
3 Wheel Plane	Land Planing	12.5
Float	Land Planing	12.5
Land Plane	Land Planing	12.5
Laser Level	Land Planing	12.5
Level	Land Planing	12.5
Level (new vineyard)	Land Planing	12.5
Plane	Land Planing	12.5
Land Maintenance	Land Planing	12.5
Subsoil	Ripping	4.6
Subsoil-deep chisel	Ripping	4.6
Bed Preparation	Weeding	0.8
List	Weeding	0.8
List & Fertilize	Weeding	0.8
Listing	Weeding	0.8
Roll	Weeding	0.8
Seed Bed Preparation	Weeding	0.8
Shape Beds	Weeding	0.8
Shape Beds & Roll	Weeding	0.8
Shaping	Weeding	0.8
Spring Tooth	Weeding	0.8
Terrace	Weeding	0.8
Sulfur Dusting	None	0

TABLE 3
Summary of CDFA Commodity and Assigned Crop Profile

CDFA Commodity Code	CDFA Crop Name	Crop Profile Used	Emission Factor (lbs/Acre/year)
101999	WHEAT ALL	Wheat	3.70
104999	RYE GRAIN	Wheat	3.70
106199	RICE MILLING	Rice	20.00
106269	FIELD CROP BY-PRODUCTS	Cotton	8.90
108999	FOOD GRAINS MISC.	Corn	6.90
111559	CORN WHITE	Corn	6.90
111991	CORN GRAIN	Corn	6.90
111992	CORN SILAGE	Corn	6.90
112999	OATS GRAIN	Wheat	3.70
113994	BARLEY MALTING	Wheat	3.70
113995	BARLEY FEED	Wheat	3.70
113999	BARLEY UNSPECIFIED	Wheat	3.70
114991	SORGHUM GRAIN	Wheat	3.70
121219	COTTON LINT UPLAND	Cotton	8.90
121229	COTTON LINT PIMA	Cotton	8.90
121299	COTTON LINT UNSPECIFIED	Cotton	8.90
132999	SUGAR BEETS	Sugar Beets	22.80
151999	COTTONSEED	Cotton	8.90
153999	PEANUTS ALL	Safflower	4.50
158269	SAFFLOWER	Safflower	4.50
158316	SUNFLOWER SEED PLANTING	Corn	6.90
158319	SUNFLOWER SEED	Corn	6.90
158499	JOJOBA	Melon	5.70
161131	BEANS LIMA LG. DRY	DryBeans	7.70
161132	BEANS LIMA BABY DRY	DryBeans	7.70
161199	BEANS LIMA UNSPECIFIED	DryBeans	7.70
161717	BEANS KIDNEY RED	DryBeans	7.70
161721	BEANS PINK	DryBeans	7.70
161741	BEANS BLACKEYE (PEAS)	DryBeans	7.70
161742	BEANS GARBANZO	Garbanzo	7.70
162399	BEANS FAVA	DryBeans	7.70
163999	PEAS DRY EDIBLE	DryBeans	7.70
169999	BEANS DRY EDIBLE UNSPEC.	DryBeans	7.70
171019	WHEAT SEED	Wheat	3.70
171049	RYE SEED	Wheat	3.70
171069	RICE SEED	Rice	20.00
171129	OATS SEED	Wheat	3.70
171139	BARLEY SEED	Wheat	3.70
171519	COTTON SEED PLANTING	Cotton	8.90
171582	SAFFLOWER SEED PLANTING	Safflower	4.50
171619	BEANS SEED	DryBeans	7.70
171639	PEAS SEED	DryBeans	7.70
171949	FIELD CROPS SEED MISC.	Corn	6.90
171959	SEED VEG & VINECROP	Vegetables	8.50
172119	SEED ALFALFA	Alfalfa	4.00
172289	SEED CLOVER UNSPECIFIED	Alfalfa	4.00
173079	SEED BERMUDA GRASS	Alfalfa	4.00
173669	SEED SUDAN GRASS	Alfalfa	4.00
173999	SEED GRASS UNSPECIFIED	Alfalfa	4.00
178999	SEED OTHER (NO FLOWERS)	Alfalfa	4.00
181999	HAY ALFALFA	Alfalfa	4.00
188499	HAY GRAIN	Alfalfa	4.00
188799	HAY WILD	Alfalfa	4.00
188899	HAY SUDAN	Alfalfa	4.00
188999	HAY OTHER UNSPECIFIED	Alfalfa	4.00
194599	PASTURE IRRIGATED	No Land Prep.	0.00
194699	PASTURE RANGE	No Land Prep.	0.00
194799	PASTURE FORAGE MISC.	No Land Prep.	0.00
195199	SILAGE	Wheat	3.70
195299	HAY GREEN CHOP	Alfalfa	4.00
195399	STRAW	Alfalfa	4.00
198199	RICE WILD	Rice	20.00
198999	FIELD CROPS UNSPECIFIED	Corn	6.90
201119	ORANGES NAVEL	Citrus	0.07
201519	ORANGES VALENCIA	Citrus	0.07
201999	ORANGES UNSPECIFIED	Citrus	0.07
202999	GRAPEFRUIT ALL	Citrus	0.07

TABLE 3 (continued)
Summary of CDFA Commodity Code and Assigned Crop Profile

CDFA Commodity Code	CDFA Crop Name	Crop Profile Used	Emission Factor (lbs/Acre/year)
203999	TANGERINES & MANDARINS	Citrus	0.07
204999	LEMONS ALL	Citrus	0.07
205999	LIMES ALL	Citrus	0.07
206999	TANGELOS	Citrus	0.07
207999	KUMQUATS	Citrus	0.07
208059	CITRUS BY-PRODUCTS MISC.	Citrus	0.07
209999	CITRUS UNSPECIFIED	Citrus	0.07
211999	APPLES ALL	Citrus	0.07
212199	PEACHES FREESTONE	Citrus	0.07
212399	PEACHES CLINGSTONE	Citrus	0.07
212999	PEACHES UNSPECIFIED	Citrus	0.07
213199	CHERRIES SWEET	Citrus	0.07
214199	PEARS BARTLETT	Citrus	0.07
214899	PEARS ASIAN	Citrus	0.07
214999	PEARS UNSPECIFIED	Citrus	0.07
215199	PLUMS	Citrus	0.07
215399	PLUMCOTS	Citrus	0.07
215999	PLUMS DRIED	Citrus	0.07
216199	GRAPES TABLE	Grapes-Table	0.83
216299	GRAPES WINE	Grapes-Wine	1.50
216399	GRAPES RAISIN	Grapes-Raisin	2.60
216999	GRAPES UNSPECIFIED	Grapes-Wine	1.50
217999	APRICOTS ALL	Citrus	0.07
218199	NECTARINES	Citrus	0.07
218299	PERSIMMONS	Citrus	0.07
218399	POMEGRANATES	Citrus	0.07
218499	QUINCE	Citrus	0.07
218839	CHERIMOYAS	Citrus	0.07
218889	BIOMASS ORCHARD	Almonds	3.13
218899	FRUITS & NUTS UNSPECIFIED	Citrus	0.07
221999	AVOCADOS ALL	Citrus	0.07
224999	DATES	Citrus	0.07
225999	FIGS DRIED	Citrus	0.07
226999	OLIVES	Citrus	0.07
228019	GUAVAS	Citrus	0.07
229999	KIWIFRUIT	Citrus	0.07
230639	BERRIES BLACKBERRIES	Grapes-Table	0.83
230869	BERRIES BOYSENBERRIES	Grapes-Table	0.83
234799	BERRIES LOGANBERRIES	Grapes-Table	0.83
236199	BERRIES RASPBERRIES	Grapes-Table	0.83
237199	BERRIES STRAWBERRIES F MKT	Melon	5.70
237299	BERRIES STRAWBERRIES PROC.	Melon	5.70
237999	BERRIES STRAWBERRIES UNSPEC	Melon	5.70
239999	BERRIES BUSHBERRIES UNSPEC.	Grapes-Table	0.83
261999	ALMONDS ALL	Almonds	3.13
263999	WALNUTS ENGLISH	Almonds	3.13
264999	PECANS	Almonds	3.13
265999	WALNUTS BLACK	Almonds	3.13
266999	CHESTNUTS	Almonds	3.13
267999	MACADAMIA NUTS	Almonds	3.13
268079	PISTACHIOS	Almonds	3.13
268099	ALMOND HULLS	Almonds	3.13
301999	ARTICHOKES	Melon	5.70
302199	ASPARAGUS FRESH MARKET	Melon	5.70
302299	ASPARAGUS PROCESSING	Melon	5.70
302999	ASPARAGUS UNSPECIFIED	Melon	5.70
303999	BEANS LIMA GREEN	DryBeans	7.70
304199	BEANS SNAP FRESH MARKET	DryBeans	7.70
304299	BEANS SNAP PROCESSING	DryBeans	7.70
304399	BEANS FRESH UNSPECIFIED	DryBeans	7.70
304999	BEANS SNAP UNSPECIFIED	DryBeans	7.70
305999	BEETS GARDEN	Sugar Beets	22.80
306999	RAPPINI	Sugar Beets	22.80
307189	BROCCOLI FOOD SERVICE	Vegetables	8.50
307199	BROCCOLI FRESH MARKET	Vegetables	8.50
307299	BROCCOLI PROCESSING	Vegetables	8.50
307919	BROCCOLI UNSPECIFIED	Vegetables	8.50
308999	BRUSSELS SPROUTS	Melon	5.70

TABLE 3 (continued)
Summary of CDFA Commodity Code and Assigned Crop Profile

CDFA Commodity Code	CDFA Crop Name	Crop Profile Used	Emission Factor (lbs/Acre/year)
309999	CABBAGE CH. & SPECIALTY	Lettuce	11.50
310999	CABBAGE HEAD	Lettuce	11.50
313189	CARROTS FOOD SERVICE	Sugar Beets	22.80
313199	CARROTS FRESH MARKET	Sugar Beets	22.80
313299	CARROTS PROCESSING	Sugar Beets	22.80
313999	CARROTS UNSPECIFIED	Sugar Beets	22.80
314189	CAULIFLOWER FOOD SERVICE	Vegetables	8.50
314199	CAULIFLOWER FRESH MARKET	Vegetables	8.50
314299	CAULIFLOWER PROCESSING	Vegetables	8.50
314999	CAULIFLOWER UNSPECIFIED	Vegetables	8.50
316189	CELERY FOOD SERVICE	Lettuce	11.50
316199	CELERY FRESH MARKET	Lettuce	11.50
316299	CELERY PROCESSING	Lettuce	11.50
316999	CELERY UNSPECIFIED	Lettuce	11.50
318999	RADICCHIO	Lettuce	11.50
320999	CHIVES	Lettuce	11.50
322999	COLLARD GREENS	Lettuce	11.50
323999	CORN SWEET ALL	Corn	6.90
325999	CUCUMBERS	Vegetables	8.50
330999	EGGPLANT ALL	Vegetables	8.50
331999	ENDIVE ALL	Lettuce	11.50
332999	ESCAROLE ALL	Lettuce	11.50
333999	ANISE (FENNEL)	Lettuce	11.50
335999	GARLIC ALL	Garlic	6.50
337999	KALE	Lettuce	11.50
338999	KOHLRABI	Lettuce	11.50
339196	LETTUCE BULK SALAD PRODS.	Lettuce	11.50
339999	LETTUCE UNSPECIFIED	Lettuce	11.50
340999	LETTUCE HEAD	Lettuce	11.50
341999	LETTUCE ROMAINE	Lettuce	11.50
342999	LETTUCE LEAF	Lettuce	11.50
343999	MELONS CANTALOUPE	Melon	5.70
348999	MELONS HONEYDEW	Melon	5.70
354299	MELONS UNSPECIFIED	Melon	5.70
354999	MELONS WATERMELON	Melon	5.70
355999	MUSHROOMS	No Land Prep.	0.00
356999	MUSTARD	Lettuce	11.50
357999	OKRA	Lettuce	11.50
358999	ONIONS	Onions	6.50
359999	PARSLEY	Lettuce	11.50
361299	PEAS GREEN PROCESSING	DryBeans	7.70
361999	PEAS GREEN UNSPECIFIED	DryBeans	7.70
363999	PEPPERS BELL	Tomatoes	10.10
364999	PEPPERS CHILI HOT	Tomatoes	10.10
366999	PUMPKINS	Melon	5.70
367999	RADISHES	Sugar Beets	22.80
368999	RHUBARB	Lettuce	11.50
370999	RUTABAGAS	Sugar Beets	22.80
372999	ONIONS GREEN & SHALLOT	Onions	6.50
374189	SPINACH FOOD SERVICE	Lettuce	11.50
374199	SPINACH FRESH MARKET	Lettuce	11.50
374299	SPINACH PROCESSING	Lettuce	11.50
374999	SPINACH UNSPECIFIED	Lettuce	11.50
375999	SQUASH	Melon	5.70
376999	SWISS CHARD	Lettuce	11.50
378199	TOMATOES FRESH MARKET	Tomatoes	10.10
378299	TOMATOES PROCESSING	Tomatoes	10.10
378999	TOMATOES UNSPECIFIED	Tomatoes	10.10
380999	TURNIPS ALL	Sugar Beets	22.80
381999	GREENS TURNIP & MUSTARD	Lettuce	11.50
387999	LEEKS	Onions	6.50
391999	POTATOES IRISH ALL	Sugar Beets	22.80
392999	POTATOES SWEET	Sugar Beets	22.80
393999	HORSERADISH	Onions	6.50
394199	SALAD GREENS NEC.	Lettuce	11.50
394999	PEAS EDIBLE POD (SNOW)	DryBeans	7.70
395999	VEGETABLES ORIENTAL ALL	Vegetables	8.50
396999	SPROUTS ALFALFA & BEAN	Lettuce	11.50

TABLE 3 (continued)
Summary of CDFA Commodity Code and Assigned Crop Profile

CDFA Commodity Code	CDFA Crop Name	Crop Profile Used	Emission Factor (lbs/Acre/year)
398199	CUCUMBERS GREENHOUSE	No Land Prep.	0.00
398299	TOMATOES GREENHOUSE	No Land Prep.	0.00
398399	TOMATOES CHERRY	Tomatoes	10.10
398499	TOMATILLO	Tomatoes	10.10
398559	CILANTRO	Lettuce	11.50
398599	SPICES AND HERBS	Lettuce	11.50
398899	VEGETABLES BABY	Vegetables	8.50
398999	VEGETABLES UNSPECIFIED	Vegetables	8.50
832919	POTATOES SEED	Sugar Beets	22.80
824999	NURSERY FRT/VINE/NUT N-BEAR	None	
825379	NURSERY PLANTS STRAWBERRY	None	
834999	NURSERY PLANTS VEG. BEDDING	None	
851999	CHRISTMAS TREES & CUT GREENS	None	
861999	NURSERY FLOWER SEEDS	None	
862480	NURSERY BULBS LILY	None	
862999	NURSERY FL BLBS./CRMS./RHZ.	None	
863999	NURSERY FL. PROPG. MTRLS	None	
864663	NURSERY PLANTS ROSE	None	
864999	NURSERY PLANTS BEDDING	None	
866209	FLOWERS MUMS POTTED	None	
866559	NURSERY PLANTS ORCHID	None	
866605	FLOWERS POINSETTIA POTTED	None	
866999	NURSERY PLANTS POT'D UNSP	None	
867055	FLOWERS ASTERS CUT	None	
867170	FLOWERS CARNATION CUT STD.	None	
867171	FLOWERS CARNATION CUT MIN.	None	
867179	FLOWERS CARNATION UNSPEC.	None	
867205	FLOWERS CHRYSNTH. CUT STD.	None	
867206	FLOWERS CHRYSNTH. CUT POM.	None	
867209	FLOWERS CHRYSNTH. UNSPEC.	None	
867360	FLOWERS GARDENIAS CUT	None	
867435	FLOWERS IRISES CUT	None	
867559	FLOWERS ORCHIDS CUT ALL	None	
867663	FLOWERS ROSES CUT STANDARD	None	
867664	FLOWERS ROSES CUT MIN.	None	
867669	FLOWERS ROSES UNSPECIFIED	None	
867899	FLOWERS DECORATIVE DRIED	None	
867999	FLOWERS CUT UNSPECIFIED	None	
868999	FLOWERS FOLIAGE CUT ALL	None	
876130	FLOWERS CACTI SUCCULENTS	None	
879999	FLOWERS FOLIAGE PLANTS	None	
892999	NURSERY TURF	No Land Prep.	0.00
894999	NURSERY HERBAC. PRRNLS	None	
895999	NURSERY WOODY ORNAMNTALS	None	
898999	NURSERY HORT. SPECMN. MISC.	None	
899999	NURSERY PRODUCTS MISC.	None	
933179	FOREST PRODUCTS FIREWOOD	None	

TABLE 4
2000 Agricultural Land Preparation PM_{10} emissions and Seasonal Profile

AB	CO	County	JANT	FEBT	MART	APRT	MAYT	JUNT	JULT	AUGT	SEPT	OCTT	NOVT	DECT
GBV	2	ALPINE												
	14	INYO	0.090	0.007	0.007	0.007	0.007	0.007	0.009	0.013	0.013	0.281	0.281	0.277
	26	MONO	0.083	0.030	0.030	0.030	0.030	0.030	0.037	0.044	0.044	0.217	0.217	0.210
LC	17	LAKE	0.048	0.000	0.000	0.005	0.021	0.021	0.016	0.016	0.016	0.194	0.331	0.331
LT	9	EL DORADO	0.033	0.000	0.000	0.016	0.071	0.071	0.055	0.055	0.055	0.240	0.203	0.203
	31	PLACER	0.005	0.000	0.076	0.415	0.415	0.000	0.000	0.000	0.000	0.026	0.031	0.031
MC	3	AMADOR	0.077	0.000	0.069	0.011	0.048	0.048	0.037	0.037	0.037	0.198	0.220	0.220
	5	CALAVERAS	0.047	0.000	0.043	0.005	0.024	0.024	0.019	0.019	0.019	0.113	0.344	0.344
	9	EL DORADO	0.033	0.000	0.000	0.016	0.071	0.071	0.055	0.055	0.055	0.240	0.203	0.203
	22	MARIPOSA	0.170	0.000	0.284	0.001	0.003	0.003	0.002	0.002	0.002	0.006	0.264	0.264
	29	NEVADA	0.000	0.000	0.000	0.035	0.159	0.159	0.123	0.123	0.123	0.276	0.000	0.000
	31	PLACER	0.005	0.000	0.076	0.415	0.415	0.000	0.000	0.000	0.000	0.026	0.031	0.031
	32	PLUMAS	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.302	0.302	0.302
	46	SIERRA	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.302	0.302	0.302
	55	TUOLUMNE	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.302	0.302	0.302
MD	15	KERN	0.031	0.054	0.057	0.016	0.016	0.016	0.020	0.021	0.021	0.081	0.337	0.332
	19	LOS ANGELES	0.063	0.033	0.047	0.032	0.032	0.032	0.056	0.054	0.054	0.204	0.198	0.194
	33	RIVERSIDE	0.055	0.047	0.069	0.020	0.017	0.017	0.073	0.021	0.021	0.162	0.254	0.242
	36	SAN BERNARDINO	0.094	0.015	0.060	0.014	0.015	0.015	0.023	0.015	0.015	0.221	0.257	0.256
NC	8	DEL NORTE	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.302	0.302	0.302
	12	HUMBOLDT	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.194	0.373	0.373
	23	MENDOCINO	0.008	0.008	0.008	0.038	0.144	0.144	0.114	0.114	0.114	0.261	0.024	0.024
	49	SONOMA	0.030	0.003	0.009	0.021	0.086	0.086	0.067	0.067	0.067	0.226	0.169	0.169
	53	TRINITY	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.302	0.302	0.302
NCC	27	MONTEREY	0.022	0.029	0.030	0.020	0.023	0.023	0.293	0.025	0.025	0.330	0.110	0.070
	35	SAN BENITO	0.036	0.011	0.015	0.004	0.005	0.005	0.248	0.009	0.009	0.345	0.173	0.139
	44	SANTA CRUZ	0.013	0.048	0.048	0.017	0.013	0.013	0.250	0.013	0.013	0.278	0.166	0.128
NEP	18	LASSEN	0.078	0.000	0.008	0.042	0.042	0.000	0.017	0.000	0.000	0.270	0.271	0.269
	25	MODOC	0.088	0.006	0.006	0.006	0.006	0.006	0.008	0.009	0.009	0.273	0.291	0.291
	47	SISKIYOU	0.066	0.018	0.018	0.018	0.018	0.018	0.030	0.026	0.026	0.187	0.288	0.287
SC	19	LOS ANGELES	0.063	0.033	0.047	0.032	0.032	0.032	0.056	0.054	0.054	0.204	0.198	0.194
	30	ORANGE	0.035	0.139	0.147	0.007	0.007	0.007	0.080	0.007	0.007	0.188	0.214	0.160
	33	RIVERSIDE	0.055	0.047	0.069	0.020	0.017	0.017	0.073	0.021	0.021	0.162	0.254	0.242
	36	SAN BERNARDINO	0.094	0.015	0.060	0.014	0.015	0.015	0.023	0.015	0.015	0.221	0.257	0.256
SCC	40	SAN LUIS OBISPO	0.033	0.036	0.041	0.018	0.024	0.024	0.155	0.022	0.024	0.244	0.205	0.176
	42	SANTA BARBARA	0.036	0.058	0.065	0.033	0.028	0.028	0.183	0.028	0.028	0.255	0.147	0.109
	56	VENTURA	0.022	0.048	0.052	0.012	0.012	0.012	0.273	0.015	0.015	0.317	0.134	0.089
SD	37	SAN DIEGO	0.063	0.064	0.043	0.024	0.025	0.025	0.054	0.028	0.028	0.209	0.222	0.215
SF	1	ALAMEDA	0.120	0.000	0.132	0.004	0.018	0.018	0.014	0.014	0.014	0.162	0.253	0.253
	7	CONTRA COSTA	0.118	0.021	0.160	0.005	0.006	0.006	0.006	0.006	0.006	0.096	0.286	0.284
	21	MARIN	0.056	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.179	0.367	0.367
	28	NAPA	0.006	0.000	0.000	0.033	0.146	0.146	0.114	0.114	0.114	0.275	0.026	0.026
	38	SAN FRANCISCO												
	41	SAN MATEO	0.027	0.133	0.133	0.014	0.014	0.014	0.014	0.023	0.023	0.126	0.257	0.219
	43	SANTA CLARA	0.058	0.036	0.043	0.008	0.010	0.010	0.140	0.017	0.017	0.283	0.202	0.177
	48	SOLANO	0.075	0.039	0.089	0.003	0.004	0.004	0.004	0.004	0.004	0.128	0.328	0.318
	49	SONOMA	0.030	0.003	0.009	0.021	0.086	0.086	0.067	0.067	0.067	0.226	0.169	0.169
SJV	10	FRESNO	0.033	0.062	0.062	0.016	0.021	0.014	0.034	0.035	0.020	0.119	0.297	0.287
	15	KERN	0.031	0.054	0.057	0.016	0.016	0.016	0.020	0.021	0.021	0.081	0.337	0.332
	16	KINGS	0.047	0.059	0.117	0.003	0.003	0.003	0.003	0.004	0.003	0.036	0.363	0.359
	20	MADERA	0.038	0.024	0.059	0.009	0.025	0.025	0.020	0.047	0.020	0.091	0.322	0.321
	24	MERCED	0.060	0.044	0.089	0.022	0.023	0.010	0.012	0.012	0.012	0.087	0.316	0.313
	39	SAN JOAQUIN	0.073	0.051	0.109	0.032	0.037	0.019	0.020	0.022	0.022	0.116	0.255	0.244
	50	STANISLAUS	0.064	0.056	0.113	0.015	0.016	0.005	0.014	0.005	0.005	0.113	0.307	0.286
	54	TULARE	0.065	0.034	0.115	0.008	0.008	0.008	0.007	0.012	0.007	0.062	0.341	0.334
SS	13	IMPERIAL	0.068	0.035	0.045	0.026	0.026	0.026	0.069	0.035	0.035	0.191	0.225	0.219
	33	RIVERSIDE	0.055	0.047	0.069	0.020	0.017	0.017	0.073	0.021	0.021	0.162	0.254	0.242
SV	4	BUTTE	0.005	0.004	0.081	0.387	0.387	0.001	0.001	0.001	0.001	0.015	0.060	0.058
	6	COLUSA	0.009	0.016	0.079	0.355	0.355	0.002	0.002	0.002	0.002	0.035	0.074	0.070
	11	GLENN	0.018	0.013	0.094	0.331	0.331	0.003	0.004	0.004	0.004	0.028	0.087	0.082
	31	PLACER	0.005	0.000	0.076	0.415	0.415	0.000	0.000	0.000	0.000	0.026	0.031	0.031
	34	SACRAMENTO	0.078	0.014	0.123	0.117	0.123	0.016	0.016	0.016	0.016	0.071	0.205	0.205
	45	SHASTA	0.051	0.000	0.028	0.152	0.152	0.000	0.039	0.000	0.000	0.208	0.188	0.182
	48	SOLANO	0.075	0.039	0.089	0.003	0.004	0.004	0.004	0.004	0.004	0.128	0.328	0.318
	51	SUTTER	0.011	0.012	0.086	0.362	0.362	0.001	0.001	0.001	0.001	0.028	0.071	0.067
	52	TEHAMA	0.051	0.024	0.083	0.054	0.054	0.000	0.000	0.000	0.000	0.083	0.331	0.320
	57	YOLO	0.062	0.021	0.088	0.136	0.137	0.003	0.003	0.003	0.003	0.095	0.223	0.223
	58	YUBA	0.006	0.000	0.082	0.405	0.405	0.000	0.000	0.000	0.000	0.015	0.043	0.043

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Emission of Soil Constituents from Wind Erosion of Graded Area

Constituent Name	CAS Number	Average Concentration in the Soil (mg/kg)	Average Concentration in the Soil (lb/lb)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Aluminum	7429905	5416	5.42E-03	1.88E+02	2.70E-03	2.14E-02	2.70E-03
Antimony	7440360	1.40E+00	1.40E-06	4.85E-02	6.98E-07	5.54E-06	6.98E-07
Arsenic	7440382	2.26E+00	2.26E-06	7.84E-02	1.13E-06	8.95E-06	1.13E-06
Barium	7440393	8.78E+01	8.78E-05	3.04E+00	4.38E-05	3.47E-04	4.38E-05
Beryllium	7440417	2.03E-01	2.03E-07	7.05E-03	1.01E-07	8.05E-07	1.01E-07
Cadmium	7440439	1.15E+00	1.15E-06	3.99E-02	5.73E-07	4.55E-06	5.73E-07
Chromium III	16065831	1.19E+01	1.19E-05	4.14E-01	5.95E-06	4.72E-05	5.95E-06
Chromium (hex.)	18540299	8.00E-02	8.00E-08	2.77E-03	3.99E-08	3.17E-07	3.99E-08
Cobalt	7440484	4.47E+00	4.47E-06	1.55E-01	2.23E-06	1.77E-05	2.23E-06
Copper	7440508	7.21E+01	7.21E-05	2.50E+00	3.60E-05	2.85E-04	3.60E-05
Lead	7439921	3.10E+01	3.10E-05	1.07E+00	1.54E-05	1.23E-04	1.54E-05
Mercury	7439976	2.00E-02	2.00E-08	6.93E-04	9.97E-09	7.92E-08	9.97E-09
Molybdenum	7439987	1.15E+00	1.15E-06	3.99E-02	5.75E-07	4.56E-06	5.75E-07
Nickel and compounds	7440020	8.72E+00	8.72E-06	3.02E-01	4.35E-06	3.45E-05	4.35E-06
Selenium	7782492	1.65E+00	1.65E-06	5.72E-02	8.23E-07	6.53E-06	8.23E-07
Thallium and compounds	7446186	1.10E+01	1.10E-05	3.82E-01	5.50E-06	4.36E-05	5.50E-06
Vanadium & Compounds	7440622	2.97E+01	2.97E-05	1.03E+00	1.48E-05	1.18E-04	1.48E-05
Zinc	7440666	4.00E+01	4.00E-05	1.39E+00	2.00E-05	1.58E-04	2.00E-05
Inorganics							
Perchlorate	7601903	4.55E+01	4.55E-05	1.58E+00	2.27E-05	1.80E-04	2.27E-05
Dioxins/Furans							
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	3.93E-06	3.93E-12	1.36E-07	1.96E-12	1.56E-11	1.96E-12
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	3.44E-05	3.44E-11	1.19E-06	1.72E-11	1.36E-10	1.72E-11
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1.01E-06	1.01E-12	3.50E-08	5.04E-13	4.00E-12	5.04E-13
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	3.06E-06	3.06E-12	1.06E-07	1.53E-12	1.21E-11	1.53E-12
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.62E-06	4.62E-12	1.60E-07	2.30E-12	1.83E-11	2.30E-12
Total TCDD	1746016	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total PeCDD	40321764	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDD	19408743	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HpCDD	35822469	5.43E-06	5.43E-12	1.88E-07	2.71E-12	2.15E-11	2.71E-12
Total TCDF	51207319	1.66E-06	1.66E-12	5.76E-08	8.28E-13	6.57E-12	8.28E-13
Total PeCDF	57117314	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total HxCDF	57117449	1.14E-06	1.14E-12	3.95E-08	5.69E-13	4.51E-12	5.69E-13
Total HpCDF	67562394	3.04E-06	3.04E-12	1.05E-07	1.52E-12	1.20E-11	1.52E-12
Explosives							
Cyclotetramethylene Tetranitramine (HMX)	2691410	7.90E-01	7.90E-07	2.74E-02	3.94E-07	3.13E-06	3.94E-07
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	2.15E+00	2.15E-06	7.45E-02	1.07E-06	8.51E-06	1.07E-06
Trinitrobenzene, 1,3,5-	99354	2.50E-01	2.50E-07	8.67E-03	1.25E-07	9.89E-07	1.25E-07
Dinitrobenzene, 1,3-	99650	3.00E-02	3.00E-08	1.04E-03	1.50E-08	1.19E-07	1.50E-08
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458	1.20E-01	1.20E-07	4.16E-03	5.98E-08	4.75E-07	5.98E-08
Nitrobenzene	98953	4.00E-02	4.00E-08	1.39E-03	1.99E-08	1.58E-07	1.99E-08
4-Amino-2,6-dinitrotoluene	19406510	7.00E-02	7.00E-08	2.43E-03	3.49E-08	2.77E-07	3.49E-08
2-Amino-4,6-dinitrotoluene	35572782	1.30E-01	1.30E-07	4.51E-03	6.48E-08	5.15E-07	6.48E-08
Trinitrotoluene, 2,4,6- (TNT)	118967	6.70E-01	6.70E-07	2.32E-02	3.34E-07	2.65E-06	3.34E-07
Dinitrotoluene, 2,6-	606202	6.00E-02	6.00E-08	2.08E-03	2.99E-08	2.37E-07	2.99E-08
Dinitrotoluene, 2,4-	121142	4.00E-02	4.00E-08	1.39E-03	1.99E-08	1.58E-07	1.99E-08
Nitrotoluene, o-	88722	6.00E-02	6.00E-08	2.08E-03	2.99E-08	2.37E-07	2.99E-08
Nitrotoluene, p-	99990	8.00E-02	8.00E-08	2.77E-03	3.99E-08	3.17E-07	3.99E-08
Nitrotoluene, m-	99081	8.00E-02	8.00E-08	2.77E-03	3.99E-08	3.17E-07	3.99E-08

PM10 Emission Calculations

TSP (Total Suspended Particulate) Emission Rate = County Emission Factor (lb/acre/yr) * Erodible Area (acre)

PM_{10} Emission Rate = TSP Emission Rate * 0.5

Inyo County Emission Factor (lb/acre/yr) =	1,778	(From Table 2 in reference source)
Erodible Area (acre) =	39	
TSP Emission Rate (lb/yr) =	69,342	
PM_{10} Emission Rate (lb/yr) =	34,671	

Source:

1. Windblown Dust from Unpaved Roads (Section 7.13 - Updated August 1997), Almanac Emission Projection Data by EIC, CARB 2005
http://www.arb.ca.gov/ei/areasrc/fullpdf/full7-13.pdf
2. Erodible Area from China Lake

SECTION 7.13

WINDBLOWN DUST - UNPAVED ROADS

(Updated August 1997)

EMISSION INVENTORY SOURCE CATEGORY
Miscellaneous Processes / Fugitive Windblown Dust

EMISSION INVENTORY CODES (CES CODES) AND DESCRIPTION
650-652-5400-0000 (83352) Windblown Dust - Unpaved Roads

METHODS AND SOURCES

This source category provides estimates of the fugitive dust emissions resulting from wind erosion of soil from unpaved roads. The emissions are estimated for each county based on the unpaved road mileage and local parameters that affect wind erosion. Table 1 summarizes TSP and PM_{10} emissions for windblown dust from unpaved roads.

OVERVIEW OF ESTIMATION METHODOLOGY

Windblown dust emissions from unpaved roads are computed by using an equation which estimates the overall wind related soil erosion from the road. The results from this equation are then scaled to estimate the portion of the eroded soil that is entrained to the air. The soil erosion and emissions calculations are based on the estimated number of unpaved road miles in each county. The mileage data are based on reports compiled by Caltrans.

EMISSIONS ESTIMATION METHODOLOGY

Emission Factor. The emission factor used for our estimates of geologic dust emissions from wind erosion of unpaved road material is based on an equation developed by the U.S. Department of Agriculture.[1] The equation was originally derived in the 1960's to predict topsoil losses from agricultural fields. In 1974, the equation was modified by Midwest Research Institute (MRI)[2] to estimate the quantity of the eroded soil that is entrained to the air. This was done by simplifying the original equation somewhat, and scaling the results it provides to estimate the total particulate emissions suspended to the air. The total suspended particulate (TSP) emission factor equation is as follows:

$$E_s = a I C K L' V'$$

where: Es = the quantity of unpaved road dust entrained to the air by wind erosion, tons TSP/acre/year
a = portion of the total roadway wind erosion losses that are assumed to be suspended into the air; estimated to be 0.038 for TSP[3] which is PM_{30}
I = soil erodibility, tons/acre/year
C = climatic factor, dimensionless
K = surface roughness factor, dimensionless
L' = unsheltered field width factor, dimensionless
V' = vegetative cover factor, dimensionless

In summary, the 'I' term in the windblown dust equation provides an estimate of the soil erosion from an area that is large, flat, bare, and highly erodible. The additional terms in the equation reduce emissions from this worst-case scenario. The climatic, C, factor helps to account for regional differences in wind and rainfall. If a surface is rough, as represented by K, soil erosion is decreased. If the length of the erodible area parallel to the wind is short, then the erosion is decreased, as represented by the L' factor. If there is crop residue on the erodible area, then erosion is further decreased by the V' factor. The following paragraphs describe each parameter in further detail.

Entrained Soil Factor - a. This factor was derived by Midwest Research Institute, and it is the estimated quantity of the total eroded material that actually gets suspended to the air. Roughly, this corresponds to the 30 micron size and smaller particles, which are know as TSP. The default 'a' value is 0.038 for unpaved roads.[3]

Soil Erodibility - I. The soil erodibility, I, of an unpaved road is related to the soil type of the road surface. Because roadway soil types are not readily available, the county specific, average soil types are used to estimate the erodibility. The county soil types are computed using a geographic information system (GIS) to average detailed county soil profile maps provided by the Natural Resources Conservation Service.[4] This approach assumes that unpaved road surfaces have the same soil characteristics as the base soils in the vicinity of the roadway. The 'I' factors used for each county are listed in Table 2.

Climatic Factor - C. The rate of soil erosion varies directly with the wind velocity and inversely with the soil surface moisture. The climatic factor is used to adjust for these parameters. ARB staff computed the county 'C' factors based on regional rainfall and windspeed data measured in California.[5] The 'C' factors used for each county are provided in Table 2.

Surface Roughness - K. Surface roughness can help to reduce soil erosion. The 'K' factor is used to account for ridges or furrows that help to minimize wind related erosion. Because most unpaved roads are flat, the surface roughness factor is assumed to be 1.0,

indicating no reduction in emissions due to surface texture.

Unsheltered Field Width Factor - L'. Soil erosion is directly related to the unprotected width of the area in the prevailing wind direction. For unpaved roads, depending on the wind direction, the width of the erosive area parallel to the wind direction could be very narrow, very long, or somewhere in between. For an effective L' factor, it may be assumed that wind direction is equally distributed for all roads. Based on an EPA report[3], the average value of L' for a specified erodibility ranges from 0.29 to 0.34. For this category, the approximate midpoint of 0.32 is used for the L' factor.

Vegetative Cover Factor - V'. Vegetative cover reduces soil erosion. For unpaved roads, it is assumed that there is no vegetative cover, therefore a value of 1.0 is used.

By applying the listed parameters to the windblown dust emission factor equation, emission factors for each California county are computed. The county input parameters and the resulting emission factors are listed in Table 2. Table 2 also includes TSP and PM_{10} emission factors. Based on analysis of resuspended California soil samples[6], it was estimated that 50% of the total suspended particulates (TSP) from unpaved road windblown dust is PM_{10} or less.

Activity Data. Activity data for the windblown dust emission factor equation is based on the acreage of erodible land. Using estimates of unpaved road mileage in each county and an average unpaved road width of 20 feet, the acres of unpaved roads in each county are computed. The unpaved road mileage was developed from the Caltrans, "Assembly of Statistical Reports" documents.[7] The ARB's unpaved road dust background document[8] describes how the road mileages were derived from the Caltrans data. Table 2 summarizes the road mileage and the resulting acreage for each county. This methodology does not include windblown dust from agricultural unpaved roads. It is assumed that windblown emissions from agricultural unpaved roads are included in the source category for windblown dust from agricultural lands.

TEMPORAL ACTIVITY AND GROWTH

Windblown dust emissions may occur 24 hours per day, 7 days per week. Monthly activity varies by county and is based on the climatic factors for each county. The fraction of estimated monthly windblown dust for each county is provided in Table 3. In general, emissions are smaller when there is less wind and when there is more rain. Future projections of unpaved road windblown dust emissions are related to the miles of unpaved road. Because this information is not readily available, forecasts are based on population increases or other factors.

ASSUMPTIONS AND LIMITATIONS

1. It is assumed that the unpaved road soil characteristics are approximately the same as the soils in the vicinity of the unpaved road that are not used for vehicular travel. This implies that no additional gravel or other treatments have been applied to the unpaved roads.

2. This methodology assumes that the soil wind erosion equation may be reasonably applied to estimate windblown dust from unpaved roads. Because of the large differences between unpaved road surfaces and agricultural lands, the validity of this assumption is questionable.

3. Using the soil erosion equation, it is assumed that 3.8% of the total eroded material is entrained to the air. ('a' factor = 0.038)

4. It is assumed that the county average soil erodibility, 'I', and climatic, 'C', factors are representative (on average) of the overall county conditions.

5. It is assumed that a value of 0.32 for the unsheltered width factor, L', is valid.

6. It is assumed that unpaved roads have no vegetative cover and are essentially flat.

7. The typical unpaved road width is 20 feet.

8. This methodology assumes no extraordinary windstorm activity; only average annual conditions are estimated.

CHANGES IN THE METHODOLOGY

There were several changes made to the unpaved road windblown dust methodology for this update. They are:

- Update of the unpaved road mileage to reflect 1993 conditions.
- Incorporation of new county climatic, 'C', factors based on improved region specific data.
- Use of updated, region specific, erodibility factors, 'I', based on analysis of digitized soil characteristic data.
- The average unpaved road width was changed from 25 to 20 feet based on review of Caltrans data.
- The seasonal profile was updated to reflect the expected changes in windblown dust emissions based on average winds and precipitation.

COMMENTS AND RECOMMENDATIONS

The methodology for estimating windblown dust is built on a foundation of dubious

assumptions. Because of the differences between unpaved roads and agricultural lands, it is unlikely that the agricultural soil erosion equation provides very accurate estimates of windblown road dust. The emissions estimates could be improved by performing limited wind tunnel tests on unpaved roads, and then extrapolating the resulting emission factors to the remainder of the State. With the use of geographic information systems, it is also possible to incorporate localized climatological and soil texture properties into the emission estimates. In addition, the mileage of unpaved roads could be improved using available digital maps which include public, as well as private unpaved roads.

SAMPLE CALCULATIONS

The instructions and associated table below provide an example of estimating the windblown dust from unpaved roads in Inyo county.

Step 1: Emission Factor. Using the wind erosion equation, compute the emission factor. Table 2 summarizes the input parameters and the TSP and PM_{10} emission factors for each county in California.

Step 2: Miles of Road. From Table 1 or Table 2, find the county road mileage.

Step 3: Acres of Road. Convert the miles of road to acres of erodible road surface by multiplying the miles of road by 2.42. The conversion factor is computed by first converting the road mileage to square feet per mile. In this case, each mile of road is 105,600 ft^2/mile *(i.e., 20 feet x 5280 feet/mile = 105,600 ft^2/mile)*. Next, converting to acres *(i.e., 105,600 ft^2/mile x 1 acre/43,560 ft^2 = 2.42 acres/mile)*, produces the conversion factor of 2.42 acres/mile of road.

Step 4: Compute Emissions. Multiply the county emission factor by miles of road to compute the emissions, then divide by 2000 lbs/ton to compute the annual tons. *Emissions = (Emission Factor x Acres of Road)/2000.* Convert to PM_{10} by multiplying the TSP emissions by 0.5.

Estimating Windblown Unpaved Road Dust Emissions in Inyo County

Step 1	Emission Factor	1778
Step 2	Miles of Road	1600
Step 3	Acres of Road	3879
Step 4	TSP Emissions *(tons TSP/year)*	3448
	PM_{10} Emissions *(tons PM_{10}/year)*	1724

REFERENCES

1. Woodruff, N.P., Siddoway, F.H. A Wind Erosion Equation. Soil Science Society of America Proceedings, Vol. 29, No. 5, September-October 1965, pages 602-608, Madison, Wisconsin. (Report provided in: Investigation of Fugitive Dust - Sources, Emissions, and Control. PEDCo- Environmental Specialists. Prepared for EPA. Contract No. 68-02-0044, OAQPS. May 1993.)

2. Cowherd, Chatten, et al. Development of Emission Factors for Fugitive Dust Sources. Midwest Research Institute for U.S. EPA, OAQPS, Contract No. 68-02-0619. EPA-450/3-74-037. June 1974.

3. EPA. Guideline for Development of Control Strategies in Areas With Fugitive Dust Problems. EPA 450/2-77-029. U.S. Environmental Protection Agency, Research Triangle Park. October 1977. L' factor from Table 3-7 (L' value from previous 1989 methodology, not verified.)

4. Soil Analysis performed by Skip Campbell, California Air Resources Board, using STATSGO data layers from the NRCS. 1997.

5. Climatic Factor derivation by Steve Francis, California Air Resources Board, using California regional meteorological data. 1997. See also Section 7.12 of this document, Windblown Dust from Agricultural Lands, for further information.

6. Houck, J.E., Chow, J.C., Watson, J.G., et al. Determination of Particle Size Distribution and Chemical Composition of Particulate Matter from Selected Sources in California, Final Report. Desert Research Institute & OMNI Environmental. Prepared for California Air Resources Board. Agreement No. A6-175-32. June 30, 1989.

7. California Department of Transportation. Assembly of Statistical Reports, 1992, and Assembly of Statistical Reports, 1993. California Public Road Data Including Highway Performance Monitoring System (HPMS) Data. February 1994 and January 1995.

8. Gaffney, Patrick. Entrained Dust from Unpaved Road Travel, Emission Estimation Methodology, Background Document. California Air Resources Board. September 1997.

UPDATED BY

Patrick Gaffney
August 1997

Table 1
1993 Windblown Dust from Unpaved Roads

AB	CO	County	Unpaved Road Mileage	Unpaved Road Acreage	TSP Emissions (tons/year)	PM_{10} Emissions (tons/year)
GBV	2	ALPINE	115.4	279.8	14.6	7.3
	14	INYO	1600.0	3878.8	3447.8	1723.9
	26	MONO	1696.6	4113.0	560.2	280.1
LC	17	LAKE	468.3	1135.3	59.4	29.7
LT	9	EL DORADO	71.2	172.7	9.0	4.5
	31	PLACER	40.1	97.2	5.1	2.5
MC	3	AMADOR	258.9	627.6	32.8	16.4
	5	CALAVERAS	442.7	1073.2	56.1	28.1
	9	EL DORADO	522.4	1266.4	66.2	33.1
	22	MARIPOSA	480.5	1164.9	60.9	30.5
	29	NEVADA	587.7	1424.7	74.5	37.3
	31	PLACER	244.7	593.1	31.0	15.5
	32	PLUMAS	965.1	2339.6	122.3	61.2
	46	SIERRA	768.9	1864.0	97.5	48.7
	55	TUOLUMNE	336.8	816.5	42.7	21.4
NC	8	DEL NORTE	301.9	731.9	38.3	19.1
	12	HUMBOLDT	897.3	2175.3	113.7	56.9
	23	MENDOCINO	974.9	2363.4	123.6	61.8
	49	SONOMA	44.0	106.6	3.6	1.8
	53	TRINITY	1180.7	2862.3	149.7	74.8
NCC	27	MONTEREY	309.0	749.1	104.2	52.1
	35	SAN BENITO	413.7	1002.9	137.4	68.7
	44	SANTA CRUZ	362.3	878.3	17.5	8.7
NEP	18	LASSEN	1368.8	3318.3	173.5	86.8
	25	MODOC	1107.7	2685.3	421.2	210.6
	47	SISKIYOU	953.8	2312.2	120.9	60.5
SC	19	LOS ANGELES	716.5	1736.8	110.8	55.4
	30	ORANGE	24.3	58.9	2.5	1.2
	33	RIVERSIDE	231.3	560.7	486.5	243.2
	36	SAN BERNARDINO	157.4	381.6	508.4	254.2
SCC	40	SAN LUIS OBISPO	647.0	1568.5	93.5	46.8
	42	SANTA BARBARA	154.2	373.8	10.2	5.1
	56	VENTURA	120.0	290.9	18.6	9.3
SD	37	SAN DIEGO	1329.0	3221.8	133.8	66.9
SED	13	IMPERIAL	1333.7	3233.2	4307.6	2153.8
	15	KERN	453.8	1100.1	189.8	94.9
	19	LOS ANGELES	337.2	817.3	52.1	26.1
	33	RIVERSIDE	658.3	1595.9	1384.5	692.3
	36	SAN BERNARDINO	2466.1	5978.4	7965.0	3982.5
SF	1	ALAMEDA	43.3	105.0	2.1	1.0
	7	CONTRA COSTA	65.9	159.8	3.2	1.6
	21	MARIN	88.6	214.8	4.3	2.1
	28	NAPA	24.9	60.4	5.4	2.7
	38	SAN FRANCISCO	0.2	0.5	0.0	0.0
	39	SAN MATEO	122.7	297.5	5.9	3.0
	43	SANTA CLARA	482.1	1168.7	160.1	80.1
	48	SOLANO	28.8	69.8	3.2	1.6
	49	SONOMA	28.1	68.2	2.3	1.2
SJV	10	FRESNO	1742.2	4223.5	851.3	425.6
	15	KERN	964.3	2337.7	342.4	171.2
	16	KINGS	76.6	185.7	40.0	20.0
	20	MADERA	291.3	706.2	126.8	63.4
	24	MERCED	608.6	1475.4	336.8	168.4
	39	SAN JOAQUIN	398.3	965.6	75.6	37.8
	50	STANISLAUS	60.1	145.7	21.5	10.7
	54	TULARE	391.5	949.1	79.5	39.8
SV	4	BUTTE	568.8	1378.9	29.1	14.6
	6	COLUSA	319.6	774.8	50.2	25.1
	11	GLENN	215.2	521.7	31.6	15.8
	31	PLACER	116.3	282.0	14.7	7.4
	34	SACRAMENTO	556.7	1349.6	36.3	18.1
	45	SHASTA	1140.0	2763.6	150.3	75.1
	48	SOLANO	115.1	279.1	12.6	6.3
	51	SUTTER	144.8	351.0	18.0	9.0
	52	TEHAMA	600.1	1454.8	80.6	40.3
	57	YOLO	137.1	332.4	25.7	12.9
	58	YUBA	213.0	516.4	15.7	7.8
		Totals	34686	84088	23872	11936

PM Fraction: PM_{10} = TSP x 0.5 (TSP Emissions = PM_{10}/0.5)

Table 2
Emission Factors for Windblown Dust from Unpaved Roads*

Air Basin	CO #	County	Unpaved Road Miles	Unpaved Road Acres	Emission Factor Terms** (a)	(I)	©	(K)	('L)	(V)	TSP Ems Fctr (lbs/acre/yr)	TSP Emissions (tons/year)	PM_{10} Ems Fctr (lbs/mile)	PM_{10} Emissions (tons/year)
GBV	2	ALPINE	115	280	0.038	86	0.050	1.00	0.32	1.00	105	14.6	127	7.3
	14	INYO	1600	3879	0.038	86	0.850	1.00	0.32	1.00	1778	3447.8	2155	1723.9
	26	MONO	1697	4113	0.038	56	0.200	1.00	0.32	1.00	272	560.2	330	280.1
LC	17	LAKE	468	1135	0.038	86	0.050	1.00	0.32	1.00	105	59.4	127	29.7
LT	9	EL DORADO	71	173	0.038	86	0.050	1.00	0.32	1.00	105	9.0	127	4.5
	31	PLACER	40	97	0.038	86	0.050	1.00	0.32	1.00	105	5.1	127	2.5
MC	3	AMADOR	259	628	0.038	86	0.050	1.00	0.32	1.00	105	32.8	127	16.4
	5	CALAVERAS	443	1073	0.038	86	0.050	1.00	0.32	1.00	105	56.1	127	28.1
	9	EL DORADO	522	1266	0.038	86	0.050	1.00	0.32	1.00	105	66.2	127	33.1
	22	MARIPOSA	481	1165	0.038	86	0.050	1.00	0.32	1.00	105	60.9	127	30.5
	29	NEVADA	588	1425	0.038	86	0.050	1.00	0.32	1.00	105	74.5	127	37.3
	31	PLACER	245	593	0.038	86	0.050	1.00	0.32	1.00	105	31.0	127	15.5
	32	PLUMAS	965	2340	0.038	86	0.050	1.00	0.32	1.00	105	122.3	127	61.2
	46	SIERRA	769	1864	0.038	86	0.050	1.00	0.32	1.00	105	97.5	127	48.7
	55	TUOLUMNE	337	816	0.038	86	0.050	1.00	0.32	1.00	105	42.7	127	21.4
NC	8	DEL NORTE	302	732	0.038	86	0.050	1.00	0.32	1.00	105	38.3	127	19.1
	12	HUMBOLDT	897	2175	0.038	86	0.050	1.00	0.32	1.00	105	113.7	127	56.9
	23	MENDOCINO	975	2363	0.038	86	0.050	1.00	0.32	1.00	105	123.6	127	61.8
	49	SONOMA	44	107	0.038	56	0.050	1.00	0.32	1.00	68	3.6	83	1.8
	53	TRINITY	1181	2862	0.038	86	0.050	1.00	0.32	1.00	105	149.7	127	74.8
NCC	27	MONTEREY	309	749	0.038	86	0.133	1.00	0.32	1.00	278	104.2	337	52.1
	35	SAN BENITO	414	1003	0.038	86	0.131	1.00	0.32	1.00	274	137.4	332	68.7
	44	SANTA CRUZ	362	878	0.038	86	0.019	1.00	0.32	1.00	40	17.5	48	8.7
NEP	18	LASSEN	1369	3318	0.038	86	0.050	1.00	0.32	1.00	105	173.5	127	86.8
	25	MODOC	1108	2685	0.038	86	0.150	1.00	0.32	1.00	314	421.2	380	210.6
	47	SISKIYOU	954	2312	0.038	86	0.050	1.00	0.32	1.00	105	120.9	127	60.5
SC	19	LOS ANGELES	716	1737	0.038	86	0.061	1.00	0.32	1.00	128	110.8	155	55.4
	30	ORANGE	24	59	0.038	56	0.061	1.00	0.32	1.00	83	2.5	101	1.2
	33	RIVERSIDE	231	561	0.038	56	1.274	1.00	0.32	1.00	1735	486.5	2103	243.2
	36	SAN BERNARDINO	157	382	0.038	86	1.274	1.00	0.32	1.00	2665	508.4	3230	254.2
SCC	40	SAN LUIS OBISPO	647	1568	0.038	86	0.057	1.00	0.32	1.00	119	93.5	145	46.8
	42	SANTA BARBARA	154	374	0.038	56	0.040	1.00	0.32	1.00	54	10.2	66	5.1
	56	VENTURA	120	291	0.038	86	0.061	1.00	0.32	1.00	128	18.6	155	9.3
SD	37	SAN DIEGO	1329	3222	0.038	56	0.061	1.00	0.32	1.00	83	133.8	101	66.9
SED	13	IMPERIAL	1334	3233	0.038	86	1.274	1.00	0.32	1.00	2665	4307.6	3230	2153.8
	15	KERN	454	1100	0.038	86	0.165	1.00	0.32	1.00	345	189.8	418	94.9
	19	LOS ANGELES	337	817	0.038	86	0.061	1.00	0.32	1.00	128	52.1	155	26.1
	33	RIVERSIDE	658	1596	0.038	56	1.274	1.00	0.32	1.00	1735	1384.5	2103	692.3
	36	SAN BERNARDINO	2466	5978	0.038	86	1.274	1.00	0.32	1.00	2665	7965.0	3230	3982.5
SF	1	ALAMEDA	43	105	0.038	86	0.019	1.00	0.32	1.00	40	2.1	48	1.0
	7	CONTRA COSTA	66	160	0.038	86	0.019	1.00	0.32	1.00	40	3.2	48	1.6
	21	MARIN	89	215	0.038	86	0.019	1.00	0.32	1.00	40	4.3	48	2.1
	28	NAPA	25	60	0.038	56	0.131	1.00	0.32	1.00	178	5.4	216	2.7
	38	SAN FRANCISCO	0	0	0.038	86	0.019	1.00	0.32	1.00	40	0.0	48	0.0
	39	SAN MATEO	123	297	0.038	86	0.019	1.00	0.32	1.00	40	5.9	48	3.0
	43	SANTA CLARA	482	1169	0.038	86	0.131	1.00	0.32	1.00	274	160.1	332	80.1
	48	SOLANO	29	70	0.038	47	0.079	1.00	0.32	1.00	90	3.2	109	1.6
	49	SONOMA	28	68	0.038	56	0.050	1.00	0.32	1.00	68	2.3	83	1.2
SJV	10	FRESNO	1742	4224	0.038	65	0.255	1.00	0.32	1.00	403	851.3	489	425.6
	15	KERN	964	2338	0.038	73	0.165	1.00	0.32	1.00	293	342.4	355	171.2
	16	KINGS	77	186	0.038	75	0.236	1.00	0.32	1.00	430	40.0	522	20.0
	20	MADERA	291	706	0.038	69	0.214	1.00	0.32	1.00	359	126.8	435	63.4
	24	MERCED	609	1475	0.038	76	0.247	1.00	0.32	1.00	457	336.8	553	168.4
	39	SAN JOAQUIN	398	966	0.038	74	0.087	1.00	0.32	1.00	157	75.6	190	37.8
	50	STANISLAUS	60	146	0.038	70	0.173	1.00	0.32	1.00	295	21.5	357	10.7
	54	TULARE	392	949	0.038	65	0.106	1.00	0.32	1.00	168	79.5	203	39.8
SV	4	BUTTE	569	1379	0.038	56	0.031	1.00	0.32	1.00	42	29.1	51	14.6
	6	COLUSA	320	775	0.038	86	0.062	1.00	0.32	1.00	130	50.2	157	25.1
	11	GLENN	215	522	0.038	86	0.058	1.00	0.32	1.00	121	31.6	147	15.8
	31	PLACER	116	282	0.038	86	0.050	1.00	0.32	1.00	105	14.7	127	7.4
	34	SACRAMENTO	557	1350	0.038	47	0.047	1.00	0.32	1.00	54	36.3	65	18.1
	45	SHASTA	1140	2764	0.038	86	0.052	1.00	0.32	1.00	109	150.3	132	75.1
	48	SOLANO	115	279	0.038	47	0.079	1.00	0.32	1.00	90	12.6	109	6.3
	51	SUTTER	145	351	0.038	86	0.049	1.00	0.32	1.00	102	18.0	124	9.0
	52	TEHAMA	600	1455	0.038	86	0.053	1.00	0.32	1.00	111	80.6	134	40.3
	57	YOLO	137	332	0.038	86	0.074	1.00	0.32	1.00	155	25.7	188	12.9
	58	YUBA	213	516	0.038	86	0.029	1.00	0.32	1.00	61	15.7	74	7.8
		TOTALS	34686	84088								23872		11936

*Emission factors are provided both in units of pounds per acre for TSP and pounds per mile for PM_{10}. This was done just to provide flexibility in estimating emissions. The TSP emission factor can be converted to a PM_{10} emission factor by multiplying it by 0.5.

**For further information about these parameters, refer to the section of this methodology about the emission factor.

Table 3
Seasonal Profile for Unpaved Road Windblown Dust Emissions

Basin	Co #	County	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
GBV	2	ALPINE	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	14	INYO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	26	MONO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
LC	17	LAKE	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
LT	9	EL DORADO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	31	PLACER	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
MC	3	AMADOR	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	5	CALAVERAS	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	9	EL DORADO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	22	MARIPOSA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	29	NEVADA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	31	PLACER	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	32	PLUMAS	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	46	SIERRA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	55	TUOLUMNE	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
NC	8	DEL NORTE	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	12	HUMBOLDT	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	23	MENDOCINO	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	49	SONOMA	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	53	TRINITY	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
NCC	27	MONTEREY	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
	35	SAN BENITO	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	44	SANTA CRUZ	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
NEP	18	LASSEN	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	25	MODOC	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	47	SISKIYOU	0.024	0.022	0.023	0.084	0.093	0.151	0.151	0.151	0.151	0.082	0.040	0.031
SC	19	LOS ANGELES	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
	30	ORANGE	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
	33	RIVERSIDE	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
	36	SAN BERNARDINO	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
SCC	40	SAN LUIS OBISPO	0.020	0.023	0.022	0.071	0.069	0.126	0.159	0.159	0.132	0.104	0.078	0.036
	42	SANTA BARBARA	0.015	0.020	0.020	0.087	0.066	0.127	0.137	0.128	0.145	0.130	0.087	0.037
	56	VENTURA	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
SD	37	SAN DIEGO	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
SED	13	IMPERIAL	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
	15	KERN	0.042	0.044	0.029	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.087	0.057
	19	LOS ANGELES	0.010	0.012	0.015	0.100	0.120	0.081	0.135	0.135	0.135	0.134	0.100	0.024
	33	RIVERSIDE	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
	36	SAN BERNARDINO	0.052	0.088	0.084	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.074
SF	1	ALAMEDA	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	7	CONTRA COSTA	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	21	MARIN	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	28	NAPA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	38	SAN FRANCISCO	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	41	SAN MATEO	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	43	SANTA CLARA	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	48	SOLANO	0.014	0.017	0.025	0.046	0.059	0.169	0.228	0.224	0.046	0.115	0.044	0.013
	49	SONOMA	0.021	0.029	0.032	0.074	0.087	0.151	0.166	0.178	0.080	0.106	0.050	0.025
SJV	10	FRESNO	0.030	0.033	0.026	0.099	0.121	0.121	0.121	0.121	0.121	0.104	0.058	0.046
	15	KERN	0.042	0.044	0.029	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.087	0.057
	16	KINGS	0.039	0.035	0.028	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.093	0.060
	20	MADERA	0.030	0.033	0.026	0.099	0.121	0.121	0.121	0.121	0.121	0.104	0.058	0.046
	24	MERCED	0.029	0.023	0.026	0.110	0.094	0.110	0.110	0.110	0.110	0.110	0.110	0.055
	39	SAN JOAQUIN	0.024	0.026	0.025	0.080	0.096	0.138	0.138	0.138	0.138	0.103	0.051	0.043
	50	STANISLAUS	0.028	0.028	0.029	0.092	0.080	0.121	0.121	0.121	0.121	0.115	0.098	0.047
	54	TULARE	0.028	0.032	0.021	0.104	0.115	0.121	0.121	0.121	0.121	0.121	0.058	0.039
SV	4	BUTTE	0.024	0.029	0.026	0.069	0.078	0.099	0.209	0.209	0.115	0.075	0.037	0.030
	6	COLUSA	0.020	0.022	0.025	0.077	0.099	0.153	0.153	0.153	0.133	0.105	0.034	0.027
	11	GLENN	0.017	0.025	0.023	0.074	0.060	0.147	0.147	0.147	0.133	0.123	0.075	0.029
	31	PLACER	0.009	0.022	0.023	0.054	0.090	0.170	0.170	0.170	0.170	0.050	0.032	0.041
	34	SACRAMENTO	0.023	0.021	0.022	0.086	0.105	0.153	0.153	0.153	0.153	0.074	0.035	0.024
	45	SHASTA	0.024	0.022	0.023	0.084	0.093	0.151	0.151	0.151	0.151	0.082	0.040	0.031
	48	SOLANO	0.023	0.026	0.023	0.068	0.076	0.185	0.185	0.185	0.096	0.079	0.030	0.024
	51	SUTTER	0.023	0.021	0.022	0.086	0.105	0.153	0.153	0.153	0.153	0.074	0.035	0.024
	52	TEHAMA	0.023	0.026	0.023	0.068	0.076	0.185	0.185	0.185	0.096	0.079	0.030	0.024
	57	YOLO	0.016	0.020	0.021	0.076	0.086	0.155	0.155	0.155	0.149	0.108	0.039	0.021
	58	YUBA	0.021	0.020	0.021	0.055	0.067	0.144	0.178	0.178	0.178	0.069	0.045	0.023

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Emission from Diesel Combustion during OB Activities

Constituent Name	CAS Number	Emission Factor (lb/1000gal)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Diesel PM	9901	96.5	5.00E+03	7.19E-02	-	-
Acetaldehyde	75070	0.3506	-	-	4.98E-02	6.27E-03
Acrolein	107028	0.3506	-	-	4.98E-02	6.27E-03
Arsenic	7440382	0.0016	-	-	2.27E-04	2.86E-05
Benzene	71432	0.0044	-	-	6.25E-04	7.87E-05
Benzo(A)pyrene	50328	0.0445	-	-	6.32E-03	7.96E-04
Butadiene-1,3	106990	0.0148	-	-	2.10E-03	2.65E-04
Cadmium	7440439	0.0015	-	-	2.13E-04	2.68E-05
Chlorobenzene	108907	0.0002	-	-	2.84E-05	3.58E-06
Chromium (hex.)	18540299	0.0001	-	-	1.42E-05	1.79E-06
Chromium III	16065831	0.0005	-	-	7.10E-05	8.95E-06
Copper	7440508	0.0041	-	-	5.82E-04	7.34E-05
Ethylbenzene	100414	0.0002	-	-	2.84E-05	3.58E-06
Formaldehyde	50000	0.3506	-	-	4.98E-02	6.27E-03
Hexane, n-	110543	0.0035	-	-	4.97E-04	6.26E-05
Hydrogen chloride	7647010	0.1863	-	-	2.65E-02	3.33E-03
Lead	7439921	0.0083	-	-	1.18E-03	1.49E-04
Manganese	7439965	0.0031	-	-	4.40E-04	5.55E-05
Mercury	7439976	0.002	-	-	2.84E-04	3.58E-05
Naphthalene	91203	0.0053	-	-	7.53E-04	9.48E-05
Nickel and compounds	7440020	0.0039	-	-	5.54E-04	6.98E-05
Propylene (Propene)	115071	0.01	-	-	1.42E-03	1.79E-04
Selenium	7782492	0.0022	-	-	3.12E-04	3.94E-05
Toluene	108883	0.0044	-	-	6.25E-04	7.87E-05
Xylenes	1330207	0.0016	-	-	2.27E-04	2.86E-05
Zinc	7440666	0.0224	-	-	3.18E-03	4.01E-04

Diesel Emission Calculations

Diesel Emission Rate = Diesel Usage (gal) * Diesel Emission Factor (lb/1000 gal) / 1000

Diesel Usage (gal/event) = 142

Events per year = 365

Diesel Usage (gal/yr) = 51830

Source:

1. Ventura County, May 2001 (all EFs except Diesel PM) (External Combustion - Diesel Combustion Factors Table)
2. Diesel PM: Source Test Report for Open Burn Simulator, URS January 2000 (JP-5 PM EF in Table 1-1 used to represent diesel

VENTURA COUNTY AIR POLLUTION CONTROL DISTRICT
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AB 2588 COMBUSTION EMISSION FACTORS

Emission factors for combustion of natural gas and diesel fuel were developed for use in AB 2588 emission inventory reports in 1990 and updated in 1991, 1992 and 1995. These factors have been updated again based on new data available from the USEPA (1) (10).

These emission factors are to be used where source testing or fuel analysis are not required by the AB 2588 Criteria and Guidelines Regulations, Appendix D. The factors are divided into external combustion sources (boilers, heaters, flares) and internal combustion sources (engines, turbines). Natural gas combustion factors are further divided into a number of sub-categories, based on equipment size and type.

If better source specific data such as manufacturer's data, source tests, or fuel analysis is available, it should be used rather than these emission factors.

Natural Gas Combustion Factors

Natural gas combustion factors were developed for listed substances identified by the California Air Resources Board (CARB) as significant components of natural gas combustion emissions (2) and for some federal HAPs.

In the past, the VCAPCD has included emission factors for natural gas fired internal combustion equipment in this document. In 2000, the USEPA published air toxics emission factors for natural gas fired turbines and engines. For natural gas fired internal combustion equipment, the emission factors from the USEPA publication AP-42 (1) should be used.

For natural gas fired turbines, emission factors from Table 3.1-3 of AP-42, dated April 2000 should be used. For natural gas fired internal combustion engines, emission factors from Tables 3.2-1, 3.2-2, and 3.2-3 of AP-42, dated August 2000, as applicable, should be used.

Natural Gas Fired External Combustion Equipment

	<10 MMBTUh	10-100 MMBTUh	>100 MMBTUh	flare
Pollutant	Emissions (lb/MMcf)			
benzene	0.0080	0.0058	0.0017	0.159
formaldehyde	0.0170	0.0123	0.0036	1.169
PAH's (including naphthalene)	0.0004	0.0004	0.0004	0.014
naphthalene	0.0003	0.0003	0.0003	0.011
acetaldehyde	0.0043	0.0031	0.0009	0.043
acrolein	0.0027	0.0027	0.0008	0.010
propylene	0.7310	0.5300	0.01553	2.440
toluene	0.0366	0.0265	0.0078	0.058
xylenes	0.0272	0.0197	0.0058	0.029
ethyl benzene	0.0095	0.0069	0.0020	1.444
hexane	0.0063	0.0046	0.0013	0.029

External combustion equipment includes boilers, heaters, and steam generators.

Derivation of Factors

The emission factors for boilers, heaters, and steam generators were based on the results of source tests performed mostly on units rated at between 10 and 100 million BTU per hour. The following test data was used: benzene (3) (6) (16) (19); formaldehyde (3) (6) (19); PAH, naphthalene, toluene, xylenes, ethyl benzene (16) (19); acetaldehyde, acrolein, and propylene (19); and hexane (20).

The test results listed above were used directly to determine the emission factors for boilers, heaters, and steam generators with heat input ratings of 10-100 MMBTU/hr. For units <10 MMBTU/hr and >100 MMBTU/hr, were calculated by scaling the factors for 10-100 MMBTU/hr equipment by the ratios of their TOC emission factors (7).

For flares, the factors were developed by applying the CARB species profiles (8) to the USEPA TOC emission factor for flares (1). The internal combustion species profile was used as CARB stated that they had very little confidence in the external combustion profile, and they use only the internal combustion profile (9). Information on acrolein was not contained in the species profile used. It was therefore assumed that the ratio of acrolein to formaldehyde is the same for flares as for turbines. The PAH emission factor is from EPA (10)

Diesel Combustion Factors

Diesel (#1, #2 fuel oil) combustion factors were developed for listed substances identified by the CARB as significant components of diesel fuel combustion emissions (2) and for federal HAPs for which data was available.

Diesel Combustion Factors

	external combustion	internal combustion
Pollutant	Emissions (lb/1000 gal)	
benzene	0.0044	0.1863
formaldehyde	0.3506	1.7261
PAH's (including naphthalene)	0.0498	0.0559
naphthalene	0.0053	0.0197
acetaldehyde	0.3506	0.7833
acrolein	0.3506	0.0339
1,3-butadiene	0.0148	0.2174
chlorobenzene	0.0002	0.0002
dioxins	ND	ND
furans	ND	ND
propylene	0.0100	0.4670
hexane	0.0035	0.0269
toluene	0.0044	0.1054
xylenes	0.0016	0.0424
ethyl benzene	0.0002	0.0109
hydrogen chloride	0.1863	0.1863
arsenic	0.0016	0.0016
beryllium	ND	ND
cadmium	0.0015	0.0015
total chromium	0.0006	0.0006
hexavalent chromium	0.0001	0.0001
copper	0.0041	0.0041
lead	0.0083	0.0083
manganese	0.0031	0.0031
mercury	0.0020	0.0020
nickel	0.0039	0.0039
selenium	0.0022	0.0022
zinc	0.0224	0.0224

ND - not detected

Derivation of Factors

For external combustion equipment, formaldehyde, PAH, and naphthalene emission factors for were developed using source test data (17). Based on information from CARB it was assumed that acetaldehyde and acrolein emissions would be the same as formaldehyde (14). Emission factors for toluene, xylenes, propylene, ethyl benzene, and hexane were based on USEPA emission factors for total organic compounds and CARB species profile (8) for substances identified by CARB as significant.

For internal combustion engines, emission factors for formaldehyde, PAH's, naphthalene, and metals were based on source testing (4), (5), (6), (18). Benzene, acetaldehyde, acrolein, toluene and xylenes emission factors were based on sources (4), (5), and (18). Propylene factors were based on source tests (4) and (5). 1,3-butadiene was based on (4). Ethyl benzene and hexane emission factors were based on (18).

For all oil combustion equipment, emission factors for chlorobenzene, hydrogen chloride, and metals were based on stack testing and fuel analyses (4), (5), (6), (12), (13), (18). It was assumed that 99.9% of the chlorine contained in the fuel was converted to hydrogen chloride (15), with the remainder converted to chlorobenzene. 5% of the chromium in the fuel samples was assumed to be emitted as hexavalent chromium (15).

Dioxins (PCDD's), furans (PCDF's), and beryllium were identified as potentially significant components of diesel combustion exhaust (2). However, the only test results for diesel combustion found (11) reported "not detected" for dioxins and furans. Beryllium has not been detected in any of the diesel fuel analyses reviewed (4), (5), (6), (12), (13), (18). For emission inventory reporting purposes, facilities should report these compounds on for PRO using an emission estimation code of "99" and writing "ND" for the emissions.

References

(1) USEPA, Compilation of Air Pollutant Emission Factors, Volume I, Fifth Edition, AP-42, January 1995, and Supplement F, 2000

(2) Gary Agid, California Air Resources Board, Letter to Air Pollution Control District, September 12, 1989

(3) CARNOT, Emission Inventory Testing at Southern California Edison Company Long Beach Auxiliary Boiler, May 1990

(4) CARNOT, Emissions of Air Toxic Species: Test Conducted Under AB 2588 for the Western States Petroleum Association, May 1990

(5) South Coast Environmental, Compliance Report: Hydraulic Dredge "Ollie Riedel", Report Number T1238C, March 8, 1991

(6) ENSR Consulting and Engineering, Western States Petroleum Association, Pooled Source Report: Oil and Gas Production Combustion Sources, Fresno and Ventura Counties, California, Document Number 7230-007-700, January 1991

(7) Ventura County Air Pollution Control District, Emission Factors and Calculation Procedures, July 1985

(8) State of California Air Resources Board, Identification of Volatile Organic Compound Species Profiles, August 1991, as updated November 29, 2000, profiles 504 and 719

(9) Paul Allen, California Air Resources Board, Telephone conversation, February 1, 1990

(10) United States Environmental Protection Agency, Locating and Estimating Air Emissions From Sources of Polycyclic Organic Matter, EPA-454/R-98-014, July 1998

(11) United States Environmental Protection Agency, Toxic Air Pollutant Emission Factors-A Compilation for Selected Air Toxic Compounds and Sources, EPA-450/2-88-006a, October 1988

(12) BTC Environmental, Inc., Ventura Port District Dredge: Air Toxics Emissions Retesting, January 29, 1991

(13) Shell Western E & P, Emission Inventory Report for Ventura Avenue Field, June 11, 1990

(14) Muriel Strand, California Air Resources Board, Telephone conversation, February 6, 1990

(15) State of California Air Resources Board, Technical Guidance Document to the Criteria and Guidelines Regulation for AB 2588, August 1989

(16) Shell Western E&P, Emission Measurements for Speciated PAH's and BTXE Compounds on a Gas fired Turbine and Steam Generator, June 24-27, 1991

(17) Marine Corps Base Camp Pendleton, California: Draft Final Air Toxics Emissions Inventory Report, May 1, 1991

(18) Entropy Environmentalists, Inc., Pooled Source Testing of a Rig Diesel-Fired Internal Combustion Engine, conducted for Western States Petroleum Association, July 29-31, 1992

(19) Radian Corporation, Source Test Report for the Texaco Heater Treater, the Mobil Steam Generator, and the SWEPI Gas Turbine in the San Joaquin Valley Unified Air Pollution Control District, September 1992

(20) AIRx Testing, Emissions Testing OLS Energu Natural Gas Fired Turbine, and Two Auxiliary Boilers, Job Number 22030, April 21, 1994

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SOURCE TEST REPORT

EMISSION TESTING OF THE OPEN BURN SIMULATOR FOR THE MARINE CORPS AIR STATION MIRAMAR, SAN DIEGO

FINAL

Prepared under Contract No. N68711-94-D-1634
Delivery Order No. 0011
Modification #5

Prepared for:

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11 January 2000

Table of Contents

1.0 Program Results Summary 1-1

2.0 Project Description 2-1

3.0 Source Descriptions and Test Operating Conditions 3-1

3.1 Description of the Open Burn Simulator 3-1
3.2 Simulator Operating Conditions 3-3

4.0 Technical Approach 4-1

4.1 NO_x, CO, CO_2 and O_2 Test Methods 4-1
4.2 THC Test Method 4-2
4.3 Particulate Matter Test Method 4-3
4.4 The PAH Test Method 4-4
4.5 The BTEX, Propylene, and 1,3-Butadiene Test Method 4-6
4.6 Formaldehyde, Acetaldehyde, and Acrolein Test Method 4-6
4.7 Description of the Vent Gas Sampling Locations 4-7
4.8 Measurement of Stack Gas Volumetric Flow Rate, Molecular Weight, and Moisture Content 4-7
4.9 Metals and Sulfur – Fuel Analysis Method 4-8

5.0 Quality Assurance/Quality Control Program 5-1

5.1 QA/QC Procedures – NO_x, CO, THC, CO_2, and O_2 Emission Testing (CEM) 5-2
5.2 QA/QC Procedures – Particulate Matter and PAH Emission Testing 5-2
5.3 QA/QC Procedures – BTEX, Propylene, and 1,3-Butadiene Emission Testing 5-3
5.4 QA/QC Procedures – Aldehyde Emission Testing 5-4
5.5 QA/QC Procedures – Volumetric Flow Rate, Moisture Content, and Molecular Weight Determinations 5-5

6.0 Results and Discussion 6-1

6.1 Review of the NO_x, CO, and THC Emission Data 6-1
6.2 Review of the Particulate Matter Emission Data 6-1
6.3 Review of the PAH Emission Data 6-2
6.4 Review of the BTEX, 1,3-Butadiene, and Propylene Emission Data 6-3
6.5 Review of the Aldehyde Emission Data 6-4
6.6 Review of the Metals and SO_2 Emission Estimates 6-4
6.7 Review of the QA/QC Data 6-5
6.7.1 Review of the Field Sampling QA/QC Data 6-5
6.7.2 Sample Storage, Shipment, and Analytical Schedules 6-7
6.7.3 Analytical QA/QC Measures 6-7

Table of Contents (Continued)

Appendix A: Simulator Operating Data
Appendix B: Supporting Calculations and Field Data Sheets
Appendix C: Laboratory Data
Appendix D: Calibration Data

List of Figures

2-1 Site Map of the Fire-training Facility at MCAS Miramar, San Diego.....2-2

3-1 Schematic Diagram of the Open Burn Simulator.....3-5

3-2 Photograph of the Open Burn Simulator 3-6

4-1 Schematic Depiction of the Sample Collection Schedule 4-9

4-2 Schematic Diagram of the NO_x, CO, O_2, and CO_2 Sampling Train [SDCAPCD Method 100].....4-10

4-3 Schematic Diagram of the THC Sampling Train [EPA Method 25A] 4-11

4-4 Schematic Diagram of the Particulate Matter Sampling Train [CARB Method 5].....4-12

4-5 Schematic of the PAH Sampling Train [CARB Method 429].....4-13

4-6 Schematic Diagram of the BTEX, Propylene, and 1,3-Butadiene Sampling Train [EPA Method TO-14] 4-14

4-7 Schematic Diagram of the Aldehyde Sampling Train [EPA Method TO-5].....4-15

4-8 Schematic Diagram of the Simulator Vent Test Port and Traverse Point Locations.....4-16

4-9 Photograph of the Open Burn Simulator Exhaust Duct and Sample Collection Locations 4-17

List of Tables

1-1 Summary of Results – JP5 and Tekflame Emission Data for the MCAS Miramar Open Burn Simulator 1-3

2-1 Overview of the MCAS Miramar Open Burn Test Program 2-3

3-1 Summary of the Test Schedule and Operating Conditions 3-7

4-1 Summary of the Sampling and Analytical Methods 4-18

4-2 List of Target PAH Compounds (CARB Method 429) and Metals (Fuel Analysis) 4-19

6-1 Summary of Results – NO_x, CO, and THC Emissions from the MCAS Miramar Open Burn Simulator 6-9

6-2 Summary of Results – Particulate Matter Emissions from the MCAS Miramar Open Burn Simulator 6-10

6-3 Summary of Results – PAH Emissions from the MCAS Miramar Open Burn Simulator 6-11

6-4 Summary of Results – BTEX, Propylene, and 1,3-Butadiene Emissions from the MCAS Miramar Open Burn Simulator 6-15

6-5 Summary of Results – Aldehyde Emissions from the MCAS Miramar Open Burn Simulator 6-17

6-6 Summary of Results – Metals and SO_2 Emissions Estimates from the MCAS Miramar Open Burn Simulator 6-18

6-7 Summary of the Sample Collection and Analytical Schedule 6-19

List of Acronyms

ARFF	Aircraft Rescue Fire-Fighting
ASTM	American Society of Testing and Materials
BACT	Best Available Control Technology
BTEX	benzene, toluene, ethylbenzene, xylene
BTU	British thermal unit
CARB	California Air Resources Board
CEM	continuous emission monitor
cfm	cubic feet per minute
CO	carbon monoxide
COC	chain of custody
CO_2	carbon dioxide
DI	distilled
DNPH	2,4-dinitrophenylhydrazine
EPA	U.S. Environmental Protection Agency
GC/FID	gas chromatograph coupled with a flame ionization detector
GFAAS	graphite furnace atomic absorption spectroscopy
HPLC	high performance liquid chromatography
HRGC/HRMS	high-resolution gas chromatograph/high resolution mass spectrometer
ID	induced draft
lb/hr	pounds per hour
MCAS	Marine Corps Air Station
MSDS	Material Safety Data Sheet
NA	not applicable
NDIR	non-dispersive infrared radiation
NO_x	nitrogen oxides

List of Acronyms (Continued)

O_2	oxygen
PAH	polycyclic aromatic hydrocarbon
ppmv	parts per million by volume
QA/QC	quality assurance/quality control
SDCAPCD	San Diego County Air Pollution Control District
SO_2	sulfur dioxide
TECO	Thermo Environmental Company
THC	total hydrocarbon compound
UHP	ultra-high purity
UVA	ultraviolet absorption
VOC	volatile organic compound

1.0 Program Results Summary

Source emission testing was conducted to determine emissions of both criteria and air toxic pollutants from 'open burning' of jet fuel. The objective of the test program was to develop emission data for two fuels, JP-5 and Tekflame, on a system that was designed to simulate the open burning activities at the Marine Corps Air Station (MCAS) Miramar Aircraft Rescue Fire-Fighting (ARFF) training facility. The testing was conducted from 5 to 8 October 1999 by Radian International (Radian), under Contract No. N68711-94-D-1634, Delivery Order No. 0011 (Modification #5) with Southwest Division, Naval Facilities Engineering Command. The data will be used to perform a Best Available Control Technology (BACT) analysis for this facility.

Table 1-1 presents a summary of the results of the testing. The results indicate that JP-5 emissions were generally higher than Tekflame emissions for nearly all of the parameters evaluated. For example, particulate matter emissions from the burning of JP-5 averaged 96.5 pounds per thousand gallons of fuel (lb/(1,000 gal), nearly three times the particulate matter emissions generated by Tekflame (i.e., 33.3 lb/(1,000 gal)). Similarly, total hydrocarbon compound (THC) emissions from JP-5 averaged 198 lb/(1,000 gal), approximately four times higher than the corresponding Tekflame emissions (i.e., 49.6 lb/(1,000 gal)). Carbon monoxide (CO) emissions from JP-5 (i.e., 124 lb/(1,000 gal)) were nearly two times higher than Tekflame (i.e., 68.4 lb/(1,000 gal)).

The sulfur content of JP-5 is also significantly higher than Tekflame. Sulfur dioxide (SO_2) emissions from JP-5 were estimated to be 0.015 lb/(1,000 gal), approximately 270 times higher than SO_2 emissions estimated from Tekflame (5.3×10^{-5} lb/(1,000 gal))[1]. Of the criteria pollutants, only nitrogen oxide (NO_x) emissions during the Tekflame condition (3.8 lb/(1,000 gal)) were higher than the JP-5 condition (2.7 lb/(1,000 gal)). NO_x emissions from burning of both fuels were significantly less than the corresponding CO and THC emissions.

Review of the emission data for specific organic compounds revealed the same trend. For example:

- JP-5 benzene emissions [i.e., 5.85 lb/(1,000 gal)] were more than five times Tekflame benzene emissions [0.94 lb/(1,000 gal)];
- JP-5 formaldehyde emissions [4.11 lb/(1,000 gal)] were more than two times the corresponding Tekflame emissions [2.00 lb/(1,000 gal)]; and

[1] The Table 1-1 SO_2 emission estimates are based on the fuel sulfur content, assuming complete conversion to SO_2, and average fuel burn rates attained during the testing. Exhaust gas SO_2 emissions were not monitored.

- Benzo(a)pyrene emissions during the JP-5 condition [9.3 lb x 10^{-3} lb/(1,000 gal)] were more than six times the Tekflame condition [1.4 x 10^{-3} lb/(1,000 gal)].

Nearly all of the metals in both fuels were below detection limits. Trace levels of copper and zinc were observed in both fuels.

The quality assurance/quality control (QA/QC) data indicate that the quality of the test data was acceptable. The test results and QA/QC data are discussed in Section 6.0.

Table 1-1. Summary of Results -– JP-5 and Tekflame Emission Data for the MCAS Miramar Open Burn Simulator

Parameter	JP-5			Tekflame		
	Concentration	Mass Rate (lb/hr)	Mass Ratio (lb/(1,000 gal))	Concentration	Mass Rate (lb/hr)	Mass Ratio (lb/(1,000 gal))
Criteria Pollutants:						
NO_x	1.8 ppmv	0.0088	2.7	2.4 ppmv	0.014	3.8
CO	147 ppmv	0.43	124	71 ppmv	0.26	68.4
THC	158 ppmv[1]	0.71	198	32.9 ppmv[1]	0.19	49.6
Particulate Matter	0.055 gr/dscf	0.32	96.5	0.018 gr/dscf	0.13	33.3
Sulfur Dioxide[2]	NA	0.051	0.015	NA	2.0×10^{-4}	5.3×10^{-5}
Lead[2]	NA	$< 2.3 \times 10^{-7}$	$< 6.8 \times 10^{-5}$	NA	$< 2.5 \times 10^{-7}$	$< 6.6 \times 10^{-5}$
Air Toxics (VOCs):	**(ppmv)**	**(lb/hr) x 10^{-3}**	**(lb/(1,000 gal))**	**(ppmv)**	**(lb/hr) x 10^{-3}**	**(lb/(1,000 gal))**
Benzene	2.22	18.2	5.85	0.32	3.3	0.94
Toluene	0.54	5.27	1.69	0.078	0.94	0.27
Ethylbenzene	0.11	1.24	0.40	0.016	0.22	0.063
Xylene(s)	0.39	4.37	1.41	0.060	0.83	0.24
1,3-Butadiene	1.37	7.80	2.50	0.29	2.05	0.59
Propylene	6.45	28.6	9.21	1.34	7.32	2.11
Formaldehyde	5.08	15.4	4.11	2.10	8.20	2.00
Acetaldehyde	0.88	3.97	1.08	0.43	2.49	0.61
Acrolein	0.14	0.80	0.21	0.036	0.27	0.065
Air Toxics (PAHs):	**(ug/dscm)**	**(lb/hr) x 10^{-6}**	**(lb/(1,000 gal) x 10^{-3})**	**(ug/dscm)**	**(lb/hr) x 10^{-6}**	**(lb/(1,000 gal) x 10^{-3})**
Naphthalene	1,698	4,296	1,241	216	679	180
2-Methylnaphthalene	495	1,247	360	37.3	117	31.1
Acenaphthene	30.1	76.1	22.0	2.1	6.6	1.7
Acenaphthylene	160	400	114	54.5	171	45.3
Fluorene	96.9	244	70.3	8.8	27.6	7.4
Phenanthrene	193	501	147	40.9	128	34.1
Anthracene	45.8	119	34.7	3.4	10.5	2.8

[1] As propane.
[2] Data are based on fuel analysis, assuming that 100% of these fuel components are emitted to the atmosphere.

Table 1-1 (Continued)

	JP-5			Tekflame		
Parameter	**Concentration**	**Mass Rate**	**Mass Ratio**	**Concentration**	**Mass Rate**	**Mass Ratio**
Air Toxics (PAHs):	**(ug/dscm)**	**(lb/hr) x 10^{-6}**	**(lb/(1,000 gal) x 10^{-3})**	**(ug/dscm)**	**(lb/hr) x 10^{-6}**	**(lb/(1,000 gal) x 10^{-3})**
Fluoranthene	56.0	140	40.2	10.3	32.4	8.6
Pyrene	55.7	140	39.9	10.0	31.5	8.3
Benzo(a)anthracene	12.9	32.2	9.1	1.3	4.8	1.3
Chrysene	12.0	29.7	8.4	1.5	4.0	1.0
Benzo(b)fluoranthene	20.8	51.8	14.7	2.5	7.9	2.1
Benzo(k)fluoranthene	2.8	7.1	2.0	0.41	1.3	0.34
Benzo(e)pyrene	6.3	15.7	4.5	1.0	3.2	0.83
Benzo(a)pyrene	12.8	32.3	9.3	1.7	5.3	1.4
Perylene	3.6	9.1	2.6	0.31	1.0	0.25
Indeno(1,2,3-cd)pyrene	8.3	20.8	5.9	0.88	2.8	0.73
Dibenz(a,h)anthracene	1.1	2.8	0.81	0.11	0.35	0.092
Benzo(ghi)perylene	9.5	24.0	6.9	1.4	4.4	1.2
Air Toxics (Metals):						
Copper[3]	NA	4.7 x 10^{-7} lb/hr	1.4 x 10^{-4} lb/1,000 gal	NA	5.0 x 10^{-7} lb/hr	1.3 x 10^{-4} lb/1,000 gal
Zinc	NA	7.0 x 10^{-7} lb/hr	2.1 x 10^{-4} lb/1,000 gal	NA	14.9 x 10^{-7} lb/hr	4.0 x 10^{-4} lb/1,000 gal

Note:

- The values in the table are to be multiplied by the exponential factor indicated in the column header. For example, JP-5 benzene emissions averaged 18.2 x 10^{-3} lb/hr.
- Data represent three-test average values, with the exception of SO_2, lead, copper, and zinc (one analyses).
- Definitions of acronyms are included in Acronym List in Table of Contents.

[3] Data are based on fuel analysis, assuming that 100% of the copper and zinc in the fuel is emitted to the atmosphere. Copper and zinc were the only metals above the analytical detection limit. Data for the other metals (i.e., detection limits) are presented in Section 5.

2.0 Project Description

Southwest Division, Naval Facilities Engineering Command contracted Radian International (Radian) to evaluate emissions associated with the operation of the Marine Corps Air Station (MCAS) Miramar Aircraft Rescue Fire-Fighting (ARFF) training facility in San Diego, California. Specifically, Radian conducted emission testing on a pilot-scale, open-burn simulator to determine emissions from the burning of two different fuels, JP-5 and Tekflame. JP-5 has been used during previous fire-training activities at this facility. Tekflame is an alternate fuel that is being considered to reduce emissions of criteria and air toxic pollutants from the facility. Radian has used the emission data from the simulator testing to perform a Best Available Control Technology (BACT) analysis for the facility. Figure 2-1 presents a map of the base showing the location of the fire-fighting training facility.

The objective of the test program was to develop emission data for JP-5 and Tekflame under burn conditions that simulate the MCAS Miramar fire-fighting training facility.

Table 2-1 provides a summary of the test program. The testing was conducted according to the Test Protocol that was approved by the San Diego County Air Pollution Control District (SDCAPCD) in August of 1999[2].

This report contains the following information:

- Brief descriptions of the MCAS Miramar fire-fighting training facility and the pilot-scale, open burn simulator (Section 3.0);
- The scope of the test program including a discussion of the test methods (Section 4.0);
- The quality assurance and quality control (QA/QC) program (Section 5.0); and
- Presentation and discussion of the test results, including a review of the QA/QC data collected (Section 6.0).

Supporting information presented in the appendices includes the open-burn simulator operating data (Appendix A), supporting calculations and field data sheets (Appendix B), analytical data (Appendix C), and the equipment calibration data (Appendix D).

[2] *Protocol for Source Emission Testing of the [Marine Corps Air Station Miramar] Open Burn Facility*; Radian Document No. 99.67505011.05; 25 August 1999.

Figure 2-1

Table 2-1. Overview of the MCAS Miramar Open Burn Test Program

Source Owner/Operator	Marine Corps Air Station (MCAS) Miramar San Diego, CA 92145-2013
Source Location	MCAS Miramar San Diego, CA 92145-2013
Type of Unit to be Tested	Pilot-Scale Simulator of the Fire-fighting Training Open Burn Pit
Unit Identification and Permit No. (Permit or Permit Application Numbers)	The Open Burn Facility is located south of the runways at MCAS Miramar. A permit is not required for the Open Burn Facility under the San Diego County Air Pollution Control District (SDCAPCD) Rules and Regulations. The pilot-scale open burn simulator was fabricated and installed in Radian's combustion research facility in Santa Ana, CA.
Test Objective(s)	Determine criteria and air toxic pollutant emissions from open burning of JP-5 and Tekflame fuels.
Test Period	October 5-8, 1999
Testing Contractor	Radian International Project Manager: Jeff Davis (714) 433-7720 Technical Contact: Mark Ludwiczak (916) 857-7421 (Note: Analytical laboratories are identified in Section 4.0.)
Measurements and Test Methods	• Nitrogen Oxides (NO_x), Carbon Monoxide (CO) – SDCAPCD Method 100 • Total Hydrocarbon Compounds (THC) – U.S. Environmental Protection Agency (EPA) Method 25A • Particulate Matter Emissions – CARB Method 5 • Formaldehyde, Acetaldehyde, Acrolein – EPA Method TO-5 • Polycyclic Aromatic Hydrocarbons (PAHs) – California Air Resources Board (CARB) Method 429 • Benzene, Toluene, Ethylbenzene, Xylene (BTEX), Propylene, 1,3-Butadiene – EPA Method TO-14 • Gas Flow Rate, Molecular Weight, Moisture Content – SDCAPCD Methods 1-4 • Metals, Sulfur – Fuel Analysis
Source Owner/Operator Contact	Sarah Ann Moore, Southwest Division, Naval Facilities Engineering Command (619) 532-1235 Si Le, MCAS Miramar, (619) 577-1137
Air Pollution Control District	San Diego County Air Pollution Control District Contact: Clinton Cooney (858) 694-3349 Dan Speer (858) 694-3311

3.0 Source Description and Test Operating Conditions

The fire-fighting training facility at MCAS Miramar consists of a 75-foot diameter 'pit' that is lined with gravel. The pit has a maximum depth of approximately 18 inches. A section of an airplane fuselage is mounted near the center of the pit.

Prior to fire-training activities, water is introduced into the pit until it covers the gravel. Approximately 200 gallons of JP-5 are then dispersed on the water; the depth of the fuel layer is estimated to be approximately 1/8-inch. The fuel is then ignited using a torch. The fire is typically allowed to burn for approximately 2 to 3 minutes before several trainees extinguish it. The remaining fuel is then re-ignited and the training activities are repeated. A typical training session lasts from 1 to 3 hours. After the training exercises are completed, the pit is again ignited to burn off any excess fuel. The water is then pumped to a nearby oil/water separator and eventually recycled to the pit for future training activities.

As noted, JP-5 has typically been used at the pit for fire-training exercises. The JP-5 is brought to the facility in a tanker truck and stored in a storage tank near the fire pit. The fuel is transferred from the storage tank to the pit prior to training activities.

In an effort to reduce visible, criteria, and air toxic pollutants to the atmosphere, MCAS Miramar is considering use of an alternative fuel formulated by Exxon USA, identified as Tekflame. Comparison of the Tekflame and JP-5 properties reveal that the fuel characteristics (e.g., flash point, vapor pressure) are similar; hence, the Tekflame would provide a similar flame source for the fire pit training activities. Appendix A contains Material Safety Data Sheets (MSDS) for both JP-5 and Tekflame.

3.1 Description of the Open Burn Simulator

To characterize potential emissions from the open burn pit during use of both fuels, a pilot-scale open burn simulator was designed and fabricated. The simulator was designed so that emissions from the fuel burning can be determined in a controlled environment. Its primary components are the fuel pan (or burn pit), the ventilation hood, and the ventilation ductwork system. Figure 3-1 provides a schematic diagram of the system. Figure 3-2 presents a photograph of the system. The configuration and operation of the simulator are described below.

The fuel pan was a square 2-foot x 2-foot metal tray, with a depth of 6 inches. The pan was placed in the center of a similar 3-foot x 3-foot metal tray; both trays were positioned under

a 5-foot x 5-foot ventilation hood. The inlet to the hood was approximately 2 feet above the pans. Exhaust gases from the pan were collected through the hood by a 7.5-horsepower induced draft (ID) fan. The air flow at the hood was adjusted to minimize fugitive emissions (i.e., visible smoke) from the vent hood.

Emissions from the hood were vented through a 10-inch diameter duct to a fabric filter dust collection system and ID fan. Five sets of test ports were installed in the duct (i.e., *upstream* of the baghouse and ID fan) for collecting exhaust gas samples. Section 4.7 provides descriptions of specific test port locations.

During the preliminary use of the simulator, it was determined that operating the simulator in a 'batch-mode', as described in the Test Protocol, would not be feasible based on the burn rates observed for both fuels. Therefore, a fuel supply system was installed so that fuel could be continuously added to the fuel pan during the burn interval. The fuel was introduced to the pan through a stainless steel tube mounted below the surface of the water. Two variable-speed peristaltic pumps were used to pump fuel from the supply tank to the burn pan.

Prior to each burn, approximately 12 gallons of water were placed in the fuel pan yielding a water depth of approximately 5 inches. In addition, approximately 12 gallons of water were placed in the larger (i.e., 3-foot x 3-foot) pan, yielding a depth of approximately 4 inches. The ID fan was then activated to induce air flow into the hood. The fuel pumps were turned on for approximately 1 minute, introducing approximately 0.2 liters (i.e., 0.05 gallons) of fuel to the fuel pan. A propane torch was then used to heat and ignite the fuel in the fuel pan. Once the fuel was lit, the fuel pumps were restarted. The pumps were operated at a relatively constant rate throughout the burn intervals, providing a continuous flow of fuel to the fuel pan. An optimal fuel rate of approximately 225 milliliters per minute (i.e., 0.06 gallons per minute) was determined during pre-test operation of the simulator. This fuel rate yielded a relatively stable flame over an extended time period (i.e., 1 to 2 hours), based on visual observations and flame temperature measurements. Figure 3-2 illustrates the operation of the simulator.

3.2 Simulator Operating Conditions

A total of six tests (per parameter) were conducted during steady-state simulator burn operations. Three tests were performed during each of the two fuel (i.e., JP-5 and Tekflame) burning conditions. In addition to the steady-state burn tests, two additional tests (one test per fuel) were performed during simulation of the fire-extinguishing activities. Table 3-1 presents a schedule of the testing activities.

In general, the simulator operating conditions were relatively uniform and testing proceeded without interruption. Test #6 was interrupted for approximately 25 minutes (i.e., from 16:52 to 17:17), when it was observed that the flame in the simulator was becoming more intense and unstable. This was thought to be due to an accumulation of unburned fuel in the fuel pan. During the sampling interruption, the flame was extinguished and fresh water was added to the fuel pan. The testing was resumed when steady-state simulator operations were re-established.

At the mid-point of each test, sampling was interrupted and the samplers were re-positioned to traverse the second diameter (refer to Section 4.7). This typically required between 15 and 30 minutes to complete. During this interval, fuel flow to the fuel pan was terminated and fresh water was added to the fuel pan. Sampling was resumed (i.e., the second traverse) after the simulator was re-started and operating conditions had equilibrated.

For each fuel condition, nitrogen oxides (NO_x), carbon monoxide (CO), and total hydrocarbon compound (THC) concentrations (i.e., the continuous emission monitor [CEM] parameters) were monitored during a simulation of fire-extinguishing activities at the fuel pan. During these tests, the simulator was operated in a normal burning mode for approximately 5 minutes to establish ‘baseline’ concentrations. The fuel flow was then terminated and the flame was extinguished with water. Monitoring was continued for several minutes after the flame was extinguished. This was repeated three times.

The following simulator operating conditions were monitored and recorded during the tests:

- Fuel type and quantity (gallons);
- Burn time (minutes);
- Flame temperature (°F);
- Ambient (air) temperature (°F);

- Water temperature (°F); and
- Hood draft (in. H_2O).

These data were recorded at approximately 10-minute intervals during the test periods. Appendix A contains the operating data records.

Fuel burn rates were determined by measuring the fuel level in the storage tank (a 55-gallon drum) before and after each test. From these data, the volume of fuel burned during each test was determined. Fuel burn rates were calculated by dividing the fuel volume by the elapsed time of each burn interval. The flame temperature was monitored by installing a Type K thermocouple in the center of the fuel pan, approximately 4 inches above the water/fuel surface.

Figure 3-1

Figure 3-2

Table 3-1. Summary of the Test Schedule and Operating Conditions

Test #	Date	Parameters	Times	Fuel Type	Operating Mode
1	10/5/99	NO_x, CO, THC, PM, PAHs	1146-1451	JP-5	Steady-State
		Aldehydes	1146-1246		
		BTEX, Propylene, 1,3-Butadiene	1350-1500		
2	10/6/99	NO_x, CO, THC, PM, PAHs	1010-1249	Tekflame	Steady-State
		Aldehydes	1011-1116		
		BTEX, Propylene, 1,3-Butadiene	1146-1257		
3	10/6/99	NO_x, CO, THC, PM, PAHs	1418-1658	Tekflame	Steady-State
		Aldehydes	1419-1519		
		BTEX, Propylene, 1,3-Butadiene	1554-1703		
4	10/7/99	NO_x, CO, THC, PM, PAHs	0926-1158	Tekflame	Steady-State
		Aldehydes	0927-1027		
		BTEX, Propylene, 1,3-Butadiene	1055-1205		
5	10/7/99	NO_x, CO, THC	1236-1316	Tekflame	Fire-Extinguishing
6	10/7/99	NO_x, CO, THC, PM, PAHs	1441-1752	JP-5	Steady-State
		Aldehydes	1631-1744		
		BTEX, Propylene, 1,3-Butadiene	1418-1727		
7	10/8/99	NO_x, CO, THC, PM, PAHs	0947-1251	JP-5	Steady-State
		Aldehydes	0946-1046		
		BTEX, Propylene, 1,3-Butadiene	1146-1255		
8	10/8/99	NO_x, CO, THC	1412-1502	JP-5	Fire-Extinguishing
NA	10/20/99	Metals (11), Sulfur (Fuel Sample)	NA	JP-5	NA
NA	10/20/99	Metals (11), Sulfur (Fuel Sample)	NA	Tekflame	NA

Notes:

- Test times are approximate; refer to the field data sheets (Appendix B) for specific NO_x, CO, THC, PM, and PAH test times.
- Definitions of acronyms are included in Acronym List in Table of Contents.

4.0 Technical Approach

Emission testing was performed according to reference methods published by the U.S. Environmental Protection Agency (EPA), the SDCAPCD, and the California Air Resources Board (CARB). Table 4-1 identifies the test methods. Figure 4-1 shows the sampling schedule (i.e., per test).

Sections 4.1 and 4.8 provide descriptions of the test methods. The sampling and analytical procedures described in these sections provided exhaust gas concentration data (e.g., parts per million by volume [ppmv]) for each parameter[3]. Supporting test data (i.e., gas stream flow rate, moisture content, composition) were collected in conjunction with the concentration data so that emissions could be reported on a mass rate basis (i.e., lb/hr). Section 4.7 includes descriptions of the methods for determining vent gas flow rate, moisture content, and gas composition. Section 5.0 presents descriptions of QA/QC aspects of the methods.

4.1 NO_x, CO, CO_2, and O_2 Test Methods

NO_x, CO, oxygen (O_2), and carbon dioxide (CO_2) concentrations in the simulator vent gas stream were determined according to SDCAPCD Method 100. The monitoring system, as depicted in Figure 4-2, consisted of the following components:

- A 1/4-inch stainless steel probe/particulate filter (i.e., glass wool plug) assembly;
- A sample conditioner consisting of two impingers (dry) immersed in ethylene glycol-water (on dry ice);
- A heated Teflon® line to transport the gas sample from the stack to the sample conditioning system; and
- A leak-free, non-reactive pump to induce sample flow from the exhaust duct to the monitors.

The following CEMs were used:

- Thermo Environmental Company (TECO) Model 42B Chemiluminescent NO_x analyzer;
- A TECO Model 48 non-dispersive infrared radiation (NDIR) absorption CO analyzer;

[3] With the exception of the parameters that were quantified based on fuel analysis data (metals, sulfur dioxide).

- A CEA CO_2 analyzer (NDIR); and
- A Servomex O_2 analyzer (paramagnetic).

CEM output data were transmitted to a data acquisition system.

Prior to the testing, the monitors were calibrated with standard calibration gas mixtures of known concentration. The response of the monitors to the sample gas concentrations (e.g. ppmv) was continuously recorded during the test; the sample gas was collected from a single point in the duct. Monitoring was performed continuously for a 45-minute interval (i.e., concurrent with the first half of the particulate matter and polycyclic aromatic hydrocarbon [PAH] tests). The monitoring was then interrupted for approximately 45 minutes to perform instrument calibrations. The monitoring was resumed for a 45-minute interval during the second-half of the particulate/PAH testing. Instrument calibrations were again performed following the test. The NO_x monitor continuously measures both NO_x and nitrogen dioxide (NO_2) concentrations.

Sampling system conditions were maintained according to method specifications (refer to Section 5.0).

4.2 THC Test Method

Concentrations of THC in the simulator vent gas stream were determined according to EPA Method 25A. The monitoring system, as depicted in Figure 4-3, consisted of the following components:

- A 1/4-inch stainless steel probe/particulate filter (i.e., glass wool plug) assembly;
- A heated Teflon® line to transport the gas sample from the duct to the THC monitor; and
- A TECO Model 51 heated, flame ionization detector.

THC monitor output data were transmitted to the data acquisition system.

Like the CEM testing described in Section 4.1, THC concentrations were continuously monitored at a single point in the duct. Monitoring was conducted throughout the other testing activities (e.g., PAH, particulate matter testing). Calibration of the THC monitor was performed at 45-minute intervals (as described above) using certified standard mixtures of propane. Sampling system conditions were maintained according to method specifications (refer to Section 5.0).

4.3 Particulate Matter Test Method

Particulate matter emission testing was performed according to CARB Method 5. Figure 4-4 presents a schematic diagram of the sampling train. In this method, sample gas is drawn through a nozzle and heated[4] glass-lined probe; a tared glass fiber filter (heated); an impinger train; and an orifice meter, dry gas meter, and vacuum pump assembly (for monitoring the sampling rate and gas volume). The impinger train consists of two impingers containing 100 milliliters (each) of deionized (DI) distilled water, an empty impinger, and an impinger containing 200 grams of indicating-type silica gel.

The exhaust gas sample was collected isokinetically using multiple-point traverses. The traverse points were positioned as per CARB Method 1 specifications. Eight-point sampling traverses (i.e., four points per diameter) were conducted during each test. Sampling was performed for 15 minutes (per point) yielding a two hour test duration.

As described in the Test Protocol, the Method 5 procedure was modified slightly to minimize blockage effects associated with the pitot tube and nozzle assembly in the relatively small diameter exhaust duct (10 inches). Specifically, the velocity measurements were performed in a separate plane of the exhaust duct, eight diameters upstream of the particulate matter sampling location. The velocity traverse was conducted immediately prior to sampling. Isokinetic sampling rates were established based on these measurements. Review of the velocity data reveals that the flow rate in the exhaust duct did not change significantly (less than 10%) during the sampling period.

Following the test, a leak-check of the sampling train was performed. The sampling train components were then disassembled and transferred to the on-site laboratory for recovery. The samples were recovered, as described in Sections 2.2, 3.2, and 4.2 of CARB Method 5. The sampling nozzle, probe, and glassware upstream of the filter were rinsed and brushed with acetone. The rinse was collected in a sample bottle. The filter was transferred to a petri dish. The volume of solution in Impingers 1, 2, and 3 was measured in a graduated cylinder to determine the total amount of condensate collected. The solution was transferred to a sample bottle. The impingers and connecting glassware were then rinsed with water and methylene chloride and the rinses were added to the impinger solution sample bottle. The sample bottles were sealed and stored on ice, prior to shipment to the laboratory for analysis.

[4] Sampling probe and filter are heated to 248°F, +/- 25°F.

In the laboratory, the filters were placed in a dessicator for conditioning (24 hours) and were weighed on an analytical balance. The acetone rinse samples were transferred to tared beakers and evaporated to dryness. The impinger solution (and rinse) samples were transferred to separatory funnels and extracted with methylene chloride. The aqueous and organic fractions from the extractions were collected separately in tared beakers. These solutions were evaporated to dryness and placed in the dessicator for conditioning. The beakers and residue were weighed using an analytical balance.

The total particulate quantity collected was reported as the sum of the material collected in the probe and nozzle (i.e., acetone) rinse, the filter, and the impinger solutions (i.e., both aqueous and organic fractions). In addition to the total particulate emissions, data for the solid fraction (i.e., front-half) and condensible fractions (i.e., back-half) were reported.

4.4 The PAH Test Method

PAH emission testing was conducted according to CARB Method 429. The samples were analyzed for the specific PAH compounds listed in Table 4-2. As depicted in Figure 4-5, the sampling train consists of a glass nozzle and glass-lined probe (heated), followed by a Teflon® coated, glass fiber filter (heated). After passing through the filter, the sample gas passes through a condenser, followed by the XAD-2 resin trap, and the impinger train. The temperature of the condenser and silica gel exit gas is maintained at less than 68°F. The second impinger contains 100 milliliters of a sodium bicarbonate/sodium carbonate solution, while the first and third impingers are empty. The fourth impinger contains approximately 300 grams of indicating-type silica gel. Following the fourth impinger, the gas stream passes through tubing, a vacuum pump, a dry gas meter, and an orifice meter.

Like the particulate matter tests, the PAH sampling was performed isokinetically using eight point traverses. The PAH traverse was performed in a separate plane of the exhaust duct, 16 diameters downstream of the particulate sampling train. The configuration of the test ports is further described in Section 4.7. As described in Section 4.3, the PAH (isokinetic) sampling rates were established based on the pre-test velocity traverse conducted upstream of the particulate sampling plane. The duration of each test was two hours (i.e., 15 minutes per point).

Following the test, a leak-check of the sampling train was performed. The sampling train was then disassembled and transferred to the on-site laboratory for recovery. The samples were recovered in the following fractions:

Fraction ID	**Contents**
A	The nozzle, probe, and filter glassware (front-half) were brushed and rinsed sequentially with acetone, hexane, and methylene chloride.
B	The filter was transferred to a petri dish.
C	The XAD-2 resin.
D	The filter glassware (back-half), Teflon® tube, condenser, and connecting glassware were rinsed with acetone, hexane, and methylene chloride.
E	The Impinger 1 (knock-out), 2, and 3 solutions were combined and the impingers and connecting glassware were rinsed with the above-noted solvents. Before the impinger solutions were recovered, the impinger weights were recorded so that the total amount of condensate collected could be determined.

The samples were stored at method-specified conditions (refer to Section 5.0) prior to delivery to the laboratory for analysis.

In the laboratory, the Container #1 and #3 solutions were concentrated to approximately 5 milliliters using a nitrogen blowdown apparatus. These solutions were combined with the filter sample (Container #2) and the XAD-2 resin in a soxhlet apparatus. The sample was soxhlet-extracted for 16 hours. A liquid-liquid extraction of the impinger solution (i.e., Container #4) was performed in a separatory funnel. The extract was then combined with the Container #1-3 extract and concentrated in a Kuderna-Danish apparatus. The concentrated extract was then passed through a silica gel column, concentrated, and injected onto a high-resolution gas chromatograph/high resolution mass spectrometer (HRGC/HRMS) to identify and quantify the PAH compounds of interest.

The front-half (solid) and back-half (condensible) fractions were combined prior to analysis. Analytical results were reported in units of nanograms per sample (per PAH compound).

4.5 The BTEX, Propylene, and 1,3-Butadiene Test Method

Benzene, toluene, ethylbenzene, xylene(s) (BTEX); propylene; and 1,3-butadiene emissions were determined according to EPA Method TO-14. Vapor samples were collected in 6-liter Summa® canisters. Figure 4-6 shows the sampling train. It consists of a probe (i.e., a short length of stainless steel tubing with a glass wool plug for particulate matter removal), a sample line purge valve and pump assembly, a flow controller, stainless steel tubing, vacuum gauge, and a 6-liter Summa® canister. Samples were collected at a constant rate of approximately 80 milliliters per minute. The sampling intervals were approximately 70 minutes (per test). The canister vacuum was recorded at the beginning and end of the test, and at 10-minute intervals throughout the test.

Prior to testing, a leak-check of the sampling train was performed as follows. A leak-free plug was inserted in the inlet of the sampling probe, while the canister valve was in the closed position. The purge pump was activated to draw a vacuum of approximately 20 inches of mercury (minimum) on the sampling train. The purge line valve was then closed and the purge pump was turned off. The vacuum in the system was allowed to equilibrate for approximately 15 seconds. The vacuum gauge indication was then observed for one minute. The leak-check was considered acceptable if the gauge indication did not change over the 1-minute period.

Following the testing, the sampling train was again leak-checked, as described above. The canister sample was then disassembled from the train, sealed, and prepared for shipment to the laboratory. In the laboratory, sample concentrations of BTEX, propylene, and 1,3-butadiene were determined using a gas chromatograph coupled with a flame ionization detector (GC/FID), as per EPA Method TO-14. Concentrations were quantified using compound-specific response factors. The analytical results were reported in concentration units (e.g., ppmv).

4.6 Formaldehyde, Acetaldehyde, and Acrolein Test Method

Formaldehyde, acetaldehyde, and acrolein emission testing was performed according to EPA Method TO-5. The sampling train, as depicted in Figure 4-7, consisted of:

- A short section of Teflon® tubing (the sampling probe) with a glass wool plug;
- Two midget impingers containing 10 milliliters of 2,4-dinitrophenylhydrazine (DNPH) solution immersed in an ice bath;
- An empty impinger;
- An impinger containing approximately 20 grams of indicating-type silica gel; and

- A vacuum pump/dry gas meter assembly for controlling the sampling rate and monitoring the sample volume.

Sampling was performed continuously throughout the 60-minute period at a sampling rate of approximately 1 liter per minute.

Following the test, a leak-check was performed on the sampling train. The sampling train was then disassembled and the impinger solutions were transferred to a sample container. The impingers and connecting glassware were rinsed with DI water and added to the sample. The impinger solutions were combined prior to analysis.

The samples were stored on ice prior to shipment to the laboratory for analysis. In the laboratory, the solution volume was measured. The solution was extracted with a mixture of hexane and methylene chloride. The extract was then concentrated and analyzed using high performance liquid chromatography (HPLC) coupled with an ultraviolet absorption (UVA) detector. Sample quantities were determined using compound-specific response factors. Analytical results were reported in units of micrograms per sample.

4.7 Description of the Vent Gas Sampling Locations

Vent gas sampling for all of the parameters (refer to Sections 4.1 through 4.6) was performed in the 10-inch diameter exhaust duct. Five sets of test ports were used to perform the testing. Figure 4-8 presents a schematic diagram depicting the duct and test port locations. Figure 4-9 provides a photograph of the duct. Each set of ports was positioned with a minimum of eight diameters of disturbance-free flow upstream of the port and a minimum of two diameters of disturbance-free flow downstream of the port.

4.8 Measurement of Stack Gas Volumetric Flow Rate, Molecular Weight, and Moisture Content

Stack gas velocity and volumetric flow rates were determined during each test according to CARB Methods 1 and 2. Multiple point velocity traverses were conducted with a standard-type pitot tube and a thermocouple. The exhaust gas molecular weight was determined during each test according to CARB Method 3. O_2 and CO_2 levels in the vent gas stream were based on the results of the continuous monitoring (i.e., SDCAPCD Method 100) activities discussed in Section 4.1.

The moisture content of the vent gas stream was determined according to CARB Method 4. The moisture quantities collected in the particulate matter (i.e., CARB Method 5) and PAH

(i.e., CARB Method 429) impinger trains were determined by weighing the impingers before and after each test.

4.9 Metals and Sulfur - Fuel Analysis Method

Emissions of 11 metals and SO_2 from the open burn simulator were determined by measuring the concentrations of the metals and sulfur in the fuels. A sample of each fuel type was collected in a glass bottle and submitted to the laboratory for analysis. The fuels were analyzed for the 11 metals using graphite furnace atomic absorption spectroscopy (GFAAS), according to EPA Method 6010. Table 4-2 provides a list of these metals. The sulfur content of the fuels was determined according to American Society of Testing and Materials (ASTM) Method D-4294. In addition to these analyses, an elemental analysis (e.g., carbon, hydrogen, O_2, nitrogen) of the fuels was performed. The heat content (i.e., British Thermal Units [BTUs] per gallon) and F-factor (cubic feet per BTU) were also determined to characterize the two fuels.

The fuel usage rate data (i.e., gallons per minute [refer to Section 3.2]) were used in conjunction with the fuel metals and sulfur content data to estimate potential emission rates (i.e., lb/hr) of these parameters from the simulator.

Figure 4-1

Figure 4-2

Figure 4-3

Figure 4-4

Figure 4-5

Figure 4-6

Figure 4-7

Figure 4-8

Figure 4-9

Table 4-1. Summary of the Sampling and Analytical Methods

Parameter	Test Method	Test Duration	Sample Collection	Analytical Technique	Laboratory
NO_x, CO	SDCAPCD M-100	90 min	CEM	NO_x: Chemiluminescence CO: NDIR	NA
THC	EPA M-25A	90 min	CEM	FID	NA
BTEX, Propylene, 1,3-Butadiene	EPA TO-14	60 min.	Summa Canister	GC/FID	AtmAA Laboratory (Calabasas, CA)
Formaldehyde Acetaldehyde Acrolein	EPA TO-5	60 min.	Impinger Train (DNPH)	HPLC-UV	AtmAA Laboratory (Calabasas, CA)
PAHs	CARB M-429	120 min.	Filter, XAD-2, Impinger Train	HRGC/HRMS	Alta Analytical Laboratory; (El Dorado Hills, CA)
Particulate Matter	CARB M-5	120 min	Filter, Impinger Train	Gravimetric	Radian (Sacramento, CA)
Metals (11)	EPA 6010 (Fuel Analysis)	NA	Fuel Sample	GFAAS	Zalco Laboratories (Bakersfield, CA)
SO_2	ASTM D 4294 (Fuel Analysis)	NA	Fuel Sample	XRF	Zalco Laboratories (Bakersfield, CA)

Note: Definitions of acronyms are included in Acronym List in Table of Contents.

Table 4-2. List of Target PAH Compounds (CARB Method 429) and Metals (Fuel Analysis)

PAHs:

Naphthalene	Chrysene
2-Methylnaphthalene	Benzo(b)fluoranthene
Acenaphthene	Benzo(k)fluoranthene
Acenaphthylene	Benzo(e)pyrene
Fluorene	Benzo(a)pyrene
Phenanthrene	Perylene
Anthracene	Indeno(1,2,3-c,d)pyrene
Fluoranthene	Dibenz(a,h)anthracene
Pyrene	Benzo(g,h,i)perylene
Benzo(a)anthracene	

Metals:

Arsenic	Cadmium
Beryllium	Copper
Chromium	Manganese
Lead	Nickel
Mercury	Zinc
Selenium	

5.0 Quality Assurance/Quality Control Program

The overall QA/QC objectives of the test program were to ensure the precision, accuracy, completeness, comparability, and representativeness of the data generated during the project. These objectives were attained by adhering to the procedures specified in the test methods. General QA/QC procedures are summarized below:

- All sampling data were recorded on standard data forms (refer to Appendix B).

- In general, the analytes were either collected on filters, in impinger solutions, solid sorbents (e.g., XAD-2), or in Summa® canisters. All reagents and material used for sample collection, recovery, and analysis adhered to method requirements. The sampling equipment, media, and reagents were packaged and handled to prevent contamination during transit to the sampling site and preparation for the source tests. Sample recovery was performed using equipment and procedures that prevented sample loss or contamination.

- The sampling equipment (e.g., dry gas meters, orifice meters, nozzles) was calibrated prior to testing according to method specifications. The equipment was inspected for damage during field use. Post-test calibration checks were also performed.

- Field blank samples were collected and submitted for analysis with the test samples. The field blank samples consisted of sampling media that were representative of the materials used to collect the test samples. The field blank samples were transported to the sampling locations and subjected to the same handling conditions as the test samples.

- The analytical instrumentation was calibrated with analyte standards of known concentration that bracket the sample quantities. Laboratory duplicate analyses were performed to provide an indicator of analytical precision. Laboratory blank samples were analyzed to evaluate potential background contamination. Matrix spike samples were also prepared and analyzed (as appropriate) to evaluate matrix interferences. Matrix spike analyses were not performed on the vapor (canister) samples (i.e., BTEX, propylene, 1,3-butadiene).

- Strict chain-of-custody (COC) procedures were adhered to throughout the test program to ensure that sample integrity was maintained. Each sample was assigned a unique identification number that was placed on a label affixed to the sample container. The label also identified the source, sampling date and time, sample composition, and identification of the sampling personnel. Sample IDs were logged on sample submittal/COC forms, which accompanied the samples. Prior to shipment, sampling personnel signed off on the COC forms. Upon receipt of the samples, laboratory personnel also signed off on the COC forms. The signed COC forms are included in Appendix C.

- Close communications were maintained between the operator of the open burn simulator and test personnel to ensure that representative operating conditions were maintained during the testing.

Method-specific QA/QC measures are outlined in Sections 5.1 through 5.5 for each of the parameters of interest in this test program.

5.1 QA/QC Procedures – NO_x, CO, THC, CO_2, and O_2 Emission Testing (CEM)

The QA/QC requirements specified in SDCAPCD Method 100 and EPA Method 25A were implemented during the NO_x, CO, THC, CO_2, and O_2 monitoring. Specific QA/QC measures are highlighted below:

- CEM calibrations were performed as described in SDCAPCD Method 100 and EPA Method 25A. Pre- and post-test calibrations were performed on each of the CEMs using zero, mid-level (40-60% of the analyzer operating range), and span (80-100% of the analyzer operating range). All calibration gases were EPA Protocol 1 mixtures. Calibration records and gas certifications are presented in Appendix D.

- System bias checks were performed for each of the CEMs by subjecting calibration gases to the entire conditioning system.

- Pre- and post-test leak-checks of the sampling system were performed according to method requirements.

- The linearity of each of the CEMs was demonstrated over their respective operating ranges.

- The efficiency of the NO_2-to-NO converter was documented.

- The sample conditioning system was operated at method-specified conditions.

5.2 QA/QC Procedures – Particulate Matter and PAH Emission Testing

The QA/QC requirements specified in CARB Method 5 (particulate matter) and CARB Method 429 (PAH) were implemented during the test program. Specific QA/QC measures are highlighted below:

- On-site accuracy checks of the gas metering system were performed prior to testing according to CARB Method 5, Section 4.4.1.

- Sampling train leak-checks and pitot tube leak-checks were performed prior to and following each test.

- Sampling train components were sealed with glass plugs, caps, or Teflon® tape prior to use.

- Prior to the PAH testing, the XAD-2 resin and the Teflon® coated glass-fiber filters were pre-cleaned according to CARB Method 429 procedures. A filter and a representative quantity of the XAD-2 were then re-extracted and prepared for analysis to determine background levels. Both the XAD-2 and filters were sealed in glass containers, stored at 0°C, and protected from light. Prior to testing, the XAD-2 resin was loaded into individual, pre-cleaned traps, spiked with the surrogate standard solution, sealed with ground-glass caps and plugs, placed into a Ziploc® bag, packed on ice in a cooler, and express-shipped to the sampling crew. The filters accompanied the XAD-2.

- The Method 429 sampling train glassware (i.e., from the nozzle through the impinger train) was pre-cleaned and rinsed with acetone, hexane, and methylene chloride. After cleaning, the glassware was sealed with pre-cleaned ground-glass caps, plugs, and/or Teflon® tape.

- Isotopically-labeled standard compounds (i.e., spike solutions) were added to the PAH samples at several different steps during sample preparation to account for potential matrix effects and losses. Spike solutions were added to the XAD-2 prior to sampling, prior to extraction (soxhlet, liquid-liquid), and prior to injection on the mass spectrometer.

- Field blank samples for both the particulate matter and PAH sampling systems were prepared and analyzed in conjunction with the test samples following Test 7 (i.e., on 8 October 1999). The field blank samples, identified as MMAR-PM-8 and MMAR-PAH-8, were prepared using the same materials and procedures that were used to collect the test samples.

5.3 QA/QC Procedures – BTEX, Propylene, and 1,3-Butadiene Emission Testing

The QA/QC requirements specified in EPA Method TO-14 were implemented for the sampling and analysis of BTEX, propylene, and 1,3-butadiene. Specific QA/QC measures are highlighted below:

- Sampling train leak-checks were performed prior to and following each test.

- The canisters were pre-cleaned to ensure that minimal background quantities were present prior to use.

- One pair of duplicate canister samples was prepared and collected during Test 6 on 7 October; two canisters were connected in parallel with the probe. The duplicate samples, identified as MMAR-VOC-6A and -6B, were collected to serve as an indicator of the sampling and analytical precision. The test period for the duplicate samples was extended to approximately two hours to accommodate the larger sample

volume collected (i.e., 12 liters vs. 6 liters)[5]. All other VOC (i.e., canister) sampling intervals were approximately one hour.

- A field blank sample was collected for the VOC parameters by introducing ultra-high purity (UHP) air into a clean (unused) Tedlar bag. The bag was then connected to the VOC canister and flow control/metering manifold with a short section of Teflon® tubing. The canister valve was then opened and the UHP air was drawn into the canister from the bag. The blank sample, identified as MMAR-VOC-8, was collected following Test 7 on 8 October 1999. This sample was subjected to the same sampling and analytical conditions as the test samples. It was collected to serve as an indicator of background quantities.

5.4 QA/QC Procedures – Aldehyde Emission Testing

The QA/QC requirements specified in EPA Method TO-5 for formaldehyde, acetaldehyde, and acrolein testing were implemented during the test program. Specific QA/QC measures are highlighted below:

- Sampling train leak-checks were performed prior to and following each test.

- The sampling train components were pre-rinsed with DI water, methanol, and oven-dried. Sampling train components were sealed with glass plugs or caps prior to use.

- The impinger solution (i.e., DNPH) was prepared within 48 hours of use and express-shipped to the test site. The solution was sealed and refrigerated during storage and shipment. The solution was analyzed prior to shipment to the test site to ensure that background levels were sufficiently low.

- A total of three field blank samples were prepared and analyzed during the test program. One blank sample, identified as MMAR-ALD-5, was collected during Test 5 (7 October 1999). The other samples, identified as MMAR-ALD-8, and –9, were collected following Test 7 (8 October 1999). The blank samples were subjected to the same sampling and analytical conditions as the test samples. They were collected to serve as indicators of background quantities.

- The aldehyde impinger solutions were collected and analyzed separately for two of the tests, Test 3 (JP-5) and Test 7 (Tekflame). These data were collected to verify that the impinger solution's collection capacity was not exceeded. The samples were identified as MMAR-ALD-3A (front impinger), -3B (back-up impinger) and MMAR-ALD-7A (front impinger), -7B (back-up impinger). As noted in Section 4.6, the impinger solutions for the other aldehyde samples were combined during recovery.

[5] The sampling rate controller was an orifice-type (i.e., fixed rate) controller.

5.5 QA/QC Procedures – Volumetric Flow Rate, Moisture Content, and Molecular Weight Determinations

- The simulator vent system was designed with an adequate length of disturbance-free ductwork so that multiple sets of sampling ports could be positioned, yielding optimal flow conditions. A schematic diagram of the test port locations and a photograph of the ductwork are presented in Figures 4-8 and 4-9, respectively. Measurements of the angles of cyclonic flow were performed in the vent stream to document that the sampling locations were suitable. These data are presented in Appendix D.

- Leak-checks of the pitot tube/manometer assemblies and the moisture sampling trains (i.e., impinger trains) were performed prior to and following each test. The silica gel (final impinger) was examined following each test to ensure that the train's moisture collection capacity was not expended during the test.

- QA/QC procedures associated with the CO_2 and O_2 measurements are discussed in Section 5.2.

6.0 Results and Discussion

Results of the test program are summarized in Tables 6-1 through 6-6 and are discussed below. Emission data are expressed in concentration (e.g., ppmv), mass rate (lb/hr), and mass ratio (lb/(1,000 gal)) units. Supporting calculations are presented in Appendix B; laboratory data are presented in Appendix C.

6.1 Review of the NO_x, CO, and THC Emission Data

As presented in Table 6-1, the CO and THC emission data were most closely correlated with the fuel type. Specifically, THC emissions during the burning of JP-5 averaged 198 lb/(1,000 gal); emissions decreased to 49.6 lb/(1,000 gal) during the burning of Tekflame. CO emissions yielded a similar trend, decreasing from 124 lb/(1,000 gal) while burning JP-5, to 68.4 lb/(1,000 gal) while burning Tekflame. The correlation of the THC with CO emissions from the fuel burning is expected as both pollutants are products of incomplete combustion.

In contrast, the THC and CO data were inversely correlated with the flame temperature. That is, the highest THC and CO emissions were observed during the lowest flame temperature condition. Referring to the simulator operating data presented in Appendix A, note that flame temperatures during the JP-5 and Tekflame tests averaged 1,103°F and 1,237°F, respectively. In fact, the test-to-test variability in the JP-5 emission data can also be inversely correlated with differences in the flame temperature. Higher THC and CO emissions are generally expected to accompany lower combustion temperatures.

NO_x emissions during the JP-5 tests averaged 2.7 lb/(1,000 gal); higher NO_x emissions were observed during the Tekflame condition (3.8 lb/(1,000 gal.)). The majority of the NO_x generated from burning of both fuels was nitric oxide (NO); NO_2 levels typically accounted for approximately 10 to 20% of the NO_x during the JP-5 tests and approximately 30% of the NO_x during the Tekflame tests. NO_2 concentration data are presented in Appendix B.

The values for each test, as summarized in Table 6-1, represent the averages of two sub-tests (i.e., the first and second halves of the test periods). In general, the first- and second-half data for each test were comparable; the JP-5 test data were more variable. The concentration data for each sub-test are presented in Appendix B.

6.2 Review of the Particulate Matter Emission Data

Referring to Table 6-2, particulate emissions during the burning of JP-5 averaged 96.5 lb/(1,000 gal), nearly three times greater than the corresponding Tekflame particulate emissions

(i.e., 33.3 lb/(1,000 gal)). As was noted above, emissions during the three Tekflame tests were relatively consistent; more variability was noted in the JP-5 tests. The majority of the particulate material collected was in the solid particulate fraction (i.e., front-half, or filterable portion) for both fuels.

Relatively large amounts of solid particulate matter were collected in the samples during both test conditions. Over 200 milligrams of material were collected during Test 6, the highest particulate quantity present in the samples. To put this in perspective, the particulate analytical detection limit is 0.1 milligrams. The material collected during both fuel conditions was similar in appearance (i.e., sooty, black). For two of the JP-5 tests (Tests 1 and 7), a supplementary filter was used to facilitate handling of the sample material. These filter weights are included in the analytical report (refer to Appendix C).

The impinger solutions collected during the JP-5 tests were cloudy (i.e., milky white), indicating the presence of condensible material (e.g., unburned hydrocarbons). The impinger solutions from the Tekflame tests were relatively clear. Referring to the sampling train diagram in Figure 4-4, the impingers are *downstream* of the filters.

A minor problem was noted in the recovery of the Test 1 sample. The impingers and connecting glassware were inadvertently rinsed with acetone, rather than methylene chloride, as specified by CARB Method 5. The substitution of acetone for methylene chloride would only have a potential effect on the condensible fraction of particulate matter. As noted above, the condensible fraction is a relatively small fraction of the total particulate material collected. It is doubtful that the substitution had a significant effect on the samples, as most organic species present in the samples would likely be soluble in either solvent. The condensible particulate concentration data for Test 1 are comparable to Tests 6 and 7, suggesting that the solvent substitution had a minimal effect on the results.

6.3 Review of the PAH Emission Data

PAH emission data for the two fuel conditions are summarized in Table 6-3. The PAH compound present at the highest levels in the samples was naphthalene. Levels of naphthalene are generally greater than all of the other compounds for these types of samples because it is a known artifact of the sampling media (XAD-2). It is not a good ‘indicator compound’ for these samples.

Benzo(a)pyrene is a good indicator compound for reviewing the PAH data because it has a relatively high toxicity and it is generally not present in the samples as an artifact of the

sampling media. Benzo(a)pyrene emissions during the JP-5 and Tekflame conditions averaged 9.3 x 10^{-3} lb/(1,000 gal) and 1.4 x 10^{-3} lb/(1,000 gal), respectively. Emissions of all of the other PAH compounds exhibit this same trend; that is, JP-5 emissions are generally between three and ten times higher than the corresponding Tekflame emissions. Emissions ranged from 0.087 x 10^{-3} lb/(1,000 gal) to 1,482 x 10^{-3} lb/(1,000 gal). PAH quantities in all of the samples were well above the reporting limits (refer to Appendix C). PAH compounds, like CO and THC emissions, are products of incomplete combustion. It is expected that the trend in emissions of these parameters would be correlated.

The PAH samples presented an additional challenge to the analytical laboratory (i.e., ALTA). Method 429 is intended for measurement of relatively low levels of PAH compounds (hence, the use of ***high resolution*** gas chromatography and mass spectrometry). Sample PAH quantities collected for both fuel conditions were well above the normal working range of the analytical instrumentation. In addition to the high PAH levels observed, elevated quantities of other sample components (i.e., matrix constituents) hindered the resolution of the analytical signal corresponding to the PAH compounds. As a result, multiple dilutions were required[6] to accommodate the 19 compounds of interest and the surrogate standards that are added to the samples for quantification purposes. Provisions for performing dilutions (i.e., increasing the upper range of analytical quantification) are not included in Method 429. However, the method-specified QA/QC criteria were attained for the samples and no adverse effects were noted in the quality of the data. Reporting limits were between one and two orders of magnitude higher than normal because of the dilutions. As noted, sample quantities were well above reporting limits, even with the dilutions.

6.4 Review of the BTEX, 1,3-Butadiene, and Propylene Emission Data

Of the six VOCs quantified, propylene and benzene emissions were the highest, averaging 9.21 lb/(1,000 gal) and 5.85 lb/(1,000 gal), respectively, during the JP-5 testing. The Tekflame tests yielded significantly lower emissions for each of these compounds; specifically, propylene and benzene emissions averaged 2.11 lb/(1,000 gal) and 0.94 lb/(1,000 gal), respectively. The same trends that were observed in the review of the THC emission data (Section 6.1) can be noted in the VOC data. The compounds listed in Table 6-4 are a sub-set of the group of compounds reported as THC emissions.

[6] Dilutions were performed on all six PAH samples; dilutions were not required for the analysis of the field blank sample.

6.5 Review of the Aldehyde Emission Data

The formaldehyde, acetaldehyde, and acrolein emission data are presented in Table 6-5. Formaldehyde emissions were the highest of the three compounds for both fuel conditions, averaging 4.11 lb/(1,000 gal) during the JP-5 tests and 2.00 lb/(1,000 gal) during the Tekflame tests. As discussed above in the THC and VOC data review, emissions of each of the aldehydes were notably lower during the Tekflame tests.

An interesting aspect of the Table 6-5 data is the Test 7 results, in which emissions of all three aldehydes were significantly lower than the Tests 1 and 6 (all JP-5 tests) data. In contrast, the Test 7 THC emissions were not significantly less than Tests 1 and 6 (refer to Table 6-1). However, the aldehyde samples were collected over a one-hour period (i.e., from 0946 to 1046 during Test 7), while the THC data presented in Table 6-1 were collected over a longer time period (i.e., between 1022 and 1235). Referring to Appendix B (Table B-7), the low THC concentration data collected during Test 7A (i.e., 24.5 ppmv, as propane)[7] are closely correlated with the low Test 7 aldehyde values.

As noted in Section 4.6, the acrolein data should be used with caution. The acrolein derivative is well documented to be more unstable than the other aldehydes; hence, the acrolein data may be biased downward (i.e., true emissions may be higher than reported emissions). For comparison purposes, the JP-5 and Tekflame acrolein data follow the same trend as the other aldehydes (and VOCs); specifically, JP-5 emissions are substantially higher than Tekflame emissions. However, acrolein emissions are much lower than both formaldehyde and acetaldehyde emissions (for both fuel conditions). We cannot definitively say if this is due to lower acrolein generation rates (from the burning activities) or the (potential) instability of the acrolein derivative (i.e., method limitation).

6.6 Review of the Metals and SO_2 Emission Estimates

As presented in Table 6-6, SO_2 emissions from JP-5 were estimated to be 0.015 lb/(1,000 gal), while Tekflame SO_2 emissions were estimated to be significantly lower (5.3×10^{-5} lb/(1,000 gal)). The metals analysis of the fuel samples revealed that nearly all of the metals of interest were below detection limits. For example, lead emissions during both fuel conditions were estimated to be less than 69×10^{-6} (lb/1,000 gal). Only two of the eleven metals monitored (i.e., copper and zinc) were above detection limits. Comparable quantities of these metals were present in both fuels.

[7] The Test 7A THC monitoring was performed from 10:22 to 10:48, during the majority of the aldehyde testing. The Test 7A THC concentration was the lowest observed during all of the JP-5 tests. The THC concentration increased to 184 ppmv during Test 7B (i.e., from 11:50 to 12:35), ***after*** the aldehyde testing was completed.

The Table 6-6 data differ from the results discussed previously in that the SO_2 and metals emissions are *estimates*, based on the fuel composition and burn rate data (i.e., emission testing of the vent gas stream was *not* performed for these parameters). These estimates represent the upper limit of expected emissions. It is conceivable that a portion of the sulfur and/or metals may remain in the ash (i.e., within the fuel pan water). It is also possible that the sulfur may be oxidized to form sulfate-based salts that are emitted as part of the particulate matter (non-SO_2).

6.7 Review of the QA/QC Data

Review of the field and laboratory QA/QC data revealed that the quality of the data was generally acceptable as per method-specified criteria. No significant problems were encountered and no limitations, other than discussed above, are placed on the test data.

The test program QA/QC data are reviewed in three sections (below): the field sampling activities; the sample storage, shipment, and analytical schedules; and the analytical QA/QC data.

6.7.1 Review of the Field Sampling QA/QC Data

In general, the sample collection activities progressed without significant problems. The CEM (i.e., NO_x, CO, O_2, CO_2) calibration records (refer to Appendix D) indicate that these data were within method requirements. Specifically, zero and span gas drift values were less than 3% of span; system bias values were less than 5% of span; and CEM linearity values were within 1% of span. The NO_2 converter check data were within method tolerances. The sampling system leak-checks confirmed the integrity of the sampling system.

Pre- and post-test calibrations performed on the dry gas meters and orifice meters were also within method-specified tolerances. These data are presented in Appendix D. The on-site nozzle diameter calibration and dry gas meter calibration check data are also provided in Appendix D. A standard type pitot tube was used for the velocity measurements. It was assigned a pitot tube coefficient of 0.99, as per CARB Method 2 specifications. An inclined oil manometer was used for measuring velocity pressure. Angles of cyclonic flow were determined with an S-type pitot tube and a protractor at representative traverse points. These data yielded average angles of approximately 5° (PAH location) and 6° (particulate matter location), well below the 10° recommended limit. This confirms that cyclonic flow conditions were not present in the duct and that flow conditions were suitable for sampling.

The results of other field sampling QA/QC measures are summarized below:

- With the exception of Test 1 (PAH), post-test leak-checks conducted on the sampling systems were satisfactory, as per method requirements. The leak rate observed for the PAH train following the first traverse was 0.026 cubic feet per minute (cfm), slightly above the 0.02 cfm limit. The sampling train was leak-checked at a vacuum of 12 inches of mercury; this likely overstated the leak-rate because the *maximum* vacuum attained during the test was 7 inches of mercury (refer to the field data sheet in Appendix B). Nonetheless, a leak-rate correction was applied to the sample volume, according to method recommendations. The leak rate correction is relatively minor (i.e., approximately 2.5%). Leak-check data were recorded on the field data sheets (refer to Appendix B).

- Isokinetic sampling conditions were maintained during the particulate matter and PAH testing. Isokinetic percentages, which ranged from 98 to 102%, were well within method requirements (i.e., 90 to 110%). Isokinetic percentages are presented for each test in Tables B-1 and B-2 (refer to Appendix B).

- As described in Section 4.0, a velocity traverse was performed immediately prior to the test to minimize probe blockage effects in the relatively small diameter duct. A second velocity traverse was performed prior to the second traverse. Comparisons of the first- and second-half traverse data confirm that vent gas velocities were relatively constant throughout the test (refer to the field data sheets in Appendix B).

- Sampling train conditions (e.g., probe and filter housing temperatures, impinger outlet temperatures) were maintained within method requirements; sampling train temperature data were recorded on the field data sheets throughout each test run (refer to Appendix B).

- A duplicate canister sample was prepared and collected concurrently with the Test 6 (i.e., JP-5) sample; the two canisters were connected in parallel with the probe. Referring to the analytical data (Appendix C), results of the duplicate analyses[8] were in agreement (i.e., typically within 10%) for each of the VOCs, indicating that the precision (i.e., repeatability) of the data was acceptable.

- Separate analyses of four of the aldehyde impinger solutions (i.e., Test 3 [Tekflame] and Test 7 [JP-5]) were performed to provide data that would indicate whether sample breakthrough occurred. Formaldehyde and acrolein quantities in the back-up impingers (i.e., 'B' fractions) typically accounted for less than 5% of the quantities collected in the primary impinger (i.e., 'A' fraction), indicating that sample breakthrough was not significant (refer to Appendix C). The acetaldehyde content of the back-up impingers accounted for approximately 25 to 30% of the primary impingers. The quantities collected in the back-up solutions were still well below the primary impingers, indicating that the collection capacity of the second impinger was not exceeded (i.e., no effect on the data).

[8] The duplicate samples are identified as 'MMAR-VOC-6A' and 'MMAR-VOC–6B'.

6.7.2 Sample Storage, Shipment, and Analytical Schedules

All of the samples collected during the test program were stored at method-specified conditions in the field, during shipment, and at the laboratories. The majority of samples were stored on ice (i.e., in a cooler). The XAD-2 resin traps and filters collected during the PAH tests were stored on dry ice. The XAD-2 traps were pre-spiked with a surrogate standard solution prior to use. The traps were express-shipped on ice to the project site and stored on dry ice prior to use.

The aldehyde samples were stored on ice in a separate cooler. The DNPH (i.e., aldehyde) reagent was prepared immediately prior to shipment to the test site. The reagent was couriered to the test site and used within 48 hours of preparation. The reagent was shipped and stored on ice prior to usage. The aldehyde samples corresponding to Tests 1 through 4 were collected with the same reagent batch; Tests 6 and 7 were collected with a second batch of the reagent (i.e., from the same source).

The Summa®-polished canisters were prepared and evacuated by the analytical laboratory (AtmAA) prior to shipment to the test site. The vacuum in all of the canisters was determined on site prior to testing. These data indicated that the canisters retained their vacuum during shipment (i.e., no leakage occurred); initial canister vacuum levels were typically -29 to -30 inches of mercury. Following the test, the canister samples were sealed with compression-type fittings and stored at room temperature. The vacuum levels in the canisters were measured at the laboratory prior to analysis. These data were in close agreement with the post-test vacuum measurements recorded in the field, indicating that leakage did not occur during shipment.

All samples were either express-shipped or hand-delivered to the laboratories. The temperature and condition of the samples were noted upon receipt by the laboratories in their COC documentation. Copies of the signed COC forms for all of the samples are presented in Appendix C. No breakage or storage/shipment problems were encountered.

The samples were analyzed within method-specified hold times. The sample collection and analysis dates for each of the test parameters are summarized in Table 6-7.

6.7.3 Analytical QA/QC Measures

As described in Section 5.0, rigorous QA/QC measures are included in the analytical protocols for each of the five different types of analyses performed. The analysis of each group of samples typically included one (or more) of the following: duplicate analyses; matrix spike analyses; matrix spike duplicate analyses; analyses of surrogate compounds (PAH); laboratory

control sample analyses; and laboratory (internal) blank samples. The results of these QA/QC measures for this test program were within method requirements.

Results of the field blank and laboratory blank samples are of particular interest when reviewing emission data from low level sources. As described in Section 5.0, blank samples (field and laboratory blanks) were prepared and submitted during this test program. In general, blank quantities were either near detection limits or much lower than sample quantities. The blank sample data are presented in Appendix C.

As noted in Section 5.4, a total of three field blank samples were prepared and submitted for the aldehyde analyses (Sample IDs: 'MMAR-ALD-5, -8, -9'). As expected, the first two blank samples yielded relatively low quantities of the aldehydes (typically less than 1% of the sample quantities). However, aldehyde quantities in the third blank sample (i.e., MMAR-ALD-9) were significantly higher (i.e., two orders of magnitude) than the two low-level blank samples. Review of the chromatograms for each of these blank samples reveals a distinct difference in the characteristics of the third blank sample. Specifically, it contains other components that are only present in the test samples. This suggests that the blank sample was somehow mislabeled or incurred significant contamination during preparation either at the test site or in the laboratory. The results of this sample analysis are considered suspect.

Referring to the PAH analytical report in Appendix B, note that several of the PAH compounds were present in the field blank sample (Sample ID: 'MMAR-PAH-8'); blank quantities ranged from less than 5 nanograms (e.g., perylene) to 720 nanograms (phenanthrene). These quantities were small in comparison to the sample quantities, which ranged from approximately 1,000 to 700,000 nanograms for the majority of compounds. The blank quantities did not have a significant impact on the test data.

The analytical QA/QC data are summarized in Appendix C.

Table 6-1. Summary of Results – NO_x, CO, and THC Emissions from the MCAS Miramar Open Burn Simulator

Parameter	JP-5				Tekflame			
	Test #	ppmv	lb/hr	lb/(1,000 gal)	Test #	ppmv	lb/hr	lb/(1,000 gal)
NO_x	1	1.1	0.0048	1.2	2	2.7	0.017	4.0
	6	2.6	0.0125	4.0	3	2.2	0.014	3.7
	7	1.6	0.0091	2.8	4	2.3	0.013	3.7
	Average	1.8	0.0088	2.7	Average	2.4	0.014	3.8
CO	1	211	0.55	143	2	82.8	0.31	75.3
	6	136	0.40	130	3	62.0	0.23	63.5
	7	92.5	0.32	99.5	4	68.3	0.23	66.4
	Average	147	0.43	124	Average	71.0	0.26	68.4
THC (as propane)	1	308	1.26	326	2	45.3	0.27	64.8
	6	57.7	0.27	86.5	3	28.9	0.17	46.5
	7	107	0.59	182	4	24.6	0.13	37.6
	Average	158	0.71	198	Average	32.9	0.19	49.6

Note: Definitions of acronyms are included in Acronym List in Table of Contents.

Table 6-2. Summary of Results – Particulate Matter Emissions from the MCAS Miramar Open Burn Simulator

Parameter	JP-5				Tekflame			
	Test #	gr/dscf	lb/hr	lb/(1,000 gal)	Test #	gr/dscf	lb/hr	lb/(1,000 gal)
PM (Total)	1	0.053	0.27	70.4	2	0.020	0.15	35.3
	6	0.067	0.39	124	3	0.016	0.12	32.7
	7	0.045	0.31	94.8	4	0.017	0.11	32.0
	Average	0.055	0.32	96.5	Average	0.018	0.13	33.3
PM (Solid)	1	0.042	0.21	55.0	2	0.018	0.14	32.3
	6	0.058	0.33	106	3	0.014	0.10	28.5
	7	0.033	0.23	69.8	4	0.015	0.10	29.2
	Average	0.044	0.26	77.1	Average	0.016	0.11	30.0
PM (Condensible)	1	0.012	0.060	15.5	2	0.0017	0.012	2.9
	6	0.0097	0.056	18.0	3	0.0021	0.015	4.1
	7	0.012	0.081	25.0	4	0.0015	0.010	2.8
	Average	0.011	0.066	19.5	Average	0.0017	0.012	3.3

Note: Definitions of acronyms are included in Acronym List in Table of Contents.

Table 6-3. Summary of Results – PAH Emissions from the MCAS Miramar Open Burn Simulator

PAH	JP-5				Tekflame			
	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})
Naphthalene	1	2,549	5,743	1,482	2	221	723	173
	6	1,185	3,057	985	3	180	581	160
	7	1,359	4,089	1,257	4	249	733	207
	Average	1,698	4,296	1,241	Average	216	679	180
2-Methyl-naphthalene	1	753	1,697	438	2	38.9	127	30.6
	6	366	944	304	3	33.1	107	29.4
	7	366	1,101	338	4	40.0	118	33.3
	Average	495	1,247	360	Average	37.3	117	31.1
Acenaphthene	1	45.2	102	26.3	2	2.0	6.7	1.6
	6	22.2	57.1	18.4	3	1.8	5.8	1.6
	7	23.0	69.2	21.3	4	2.4	7.2	2.0
	Average	30.1	76.1	22.0	Average	2.1	6.6	1.7
Acenaphthylene	1	272	613	158	2	56.2	184	44.1
	6	87.6	226	72.8	3	44.9	145	39.9
	7	120	362	111	4	62.3	183	51.9
	Average	160	400	114	Average	54.5	171	45.3

Table 6-3 (Continued)

PAH	JP-5				Tekflame			
	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})
Fluorene	1	151	339	87.6	2	8.0	26.3	6.3
	6	67.0	173	55.7	3	8.2	26.4	7.3
	7	73.2	220	67.7	4	10.2	30.1	8.5
	Average	96.9	244	70.3	Average	8.8	27.6	7.4
Phenanthrene	1	238	535	138	2	40.1	131	31.5
	6	149	385	124	3	38.0	123	33.7
	7	193	582	179	4	44.5	131	37.0
	Average	193	501	147	Average	40.9	128	34.1
Anthracene	1	57.9	131	33.7	2	2.5	8.1	2.0
	6	33.0	85.1	27.4	3	3.8	12.3	3.4
	7	46.5	140	43.0	4	3.8	11.1	3.1
	Average	45.8	119	34.7	Average	3.4	10.5	2.8
Fluoranthene	1	92.7	209	53.9	2	11.2	36.8	8.8
	6	33.0	85.1	27.4	3	9.0	29.1	8.0
	7	42.3	127	39.2	4	10.7	31.4	8.9
	Average	56.0	140	40.2	Average	10.3	32.4	8.6
Pyrene	1	92.7	209	53.9	2	11.2	36.8	8.8
	6	32.0	82.4	26.6	3	8.2	26.4	7.3
	7	42.3	127	39.2	4	10.7	31.4	8.9
	Average	55.7	140	39.9	Average	10.0	31.5	8.3

Table 6-3 (Continued)

PAH	JP-5				Tekflame			
	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})
Benzo(a)-anthracene	1	23.2	52.2	13.5	2	1.5	5.0	1.2
	6	6.2	15.9	5.1	3	1.3	4.1	1.1
	7	9.4	28.3	8.7	4	1.8	5.4	1.5
	Average	12.9	32.2	9.1	Average	1.5	4.8	1.3
Chrysene	1	22.6	50.9	13.1	2	1.7	5.6	1.4
	6	5.7	14.6	4.7	3	1.0	3.2	0.9
	7	7.8	24	7.3	4	1.1	3.1	0.9
	Average	12.0	29.7	8.4	Average	1.3	4.0	1.0
Benzo(b)-fluoranthene	1	37.1	83.5	21.6	2	2.8	9.2	2.2
	6	10.8	27.9	9.0	3	2.1	6.9	1.9
	7	14.6	44.0	13.5	4	2.6	7.7	2.2
	Average	20.8	51.8	14.7	Average	2.5	7.9	2.1
Benzo(k)-fluoranthene	1	4.6	10.4	2.7	2	0.39	1.3	0.31
	6	1.8	4.5	1.5	3	0.41	1.3	0.36
	7	2.1	6.4	2.0	4	0.43	1.3	0.36
	Average	2.8	7.1	2.0	Average	0.41	1.3	0.34
Benzo(e)pyrene	1	10.4	23.5	6.1	2	1.2	3.9	0.95
	6	3.9	10.0	3.2	3	0.82	2.6	0.73
	7	4.5	13.7	4.2	4	0.98	2.9	0.81
	Average	6.3	15.7	4.5	Average	1.0	3.2	0.83

Table 6-3 (Continued)

PAH	JP-5				Tekflame			
	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})	Test #	µg/dscm	(lb/hr) x 10^{-6}	(lb/(1,000 gal) x 10^{-3})
Benzo(a)pyrene	1	20.9	47.0	12.1	2	1.9	6.3	1.5
	6	7.2	18.6	6.0	3	1.3	4.1	1.1
	7	10.5	31.5	9.7	4	1.9	5.6	1.6
	Average	12.8	32.3	9.3	Average	1.7	5.3	1.4
Perylene	1	5.8	13.1	3.4	2	0.38	1.2	0.30
	6	2.1	5.3	1.7	3	0.21	0.69	0.19
	7	3.0	9.0	2.8	4	0.33	1.0	0.27
	Average	3.6	9.1	2.6	Average	0.31	1.0	0.25
Indeno(1,2,3-c,d)pyrene	1	13.9	31.3	8.1	2	0.88	2.9	0.69
	6	4.2	10.8	3.5	3	0.78	2.5	0.69
	7	6.8	20.4	6.3	4	0.98	2.9	0.81
	Average	8.3	20.8	5.9	Average	0.88	2.8	0.73
Dibenz(a,h) anthracene	1	1.9	4.2	1.1	2	0.11	0.37	0.088
	6	0.51	1.3	0.42	3	0.10	0.32	0.087
	7	1.0	3.0	0.92	4	0.12	0.35	0.10
	Average	1.1	2.8	0.81	Average	0.11	0.35	0.092
Benzo(g,h,i)-perylene	1	15.1	33.9	8.8	2	1.6	5.4	1.3
	6	5.7	14.6	4.7	3	1.2	3.8	1.1
	7	7.8	23.6	7.3	4	1.3	3.9	1.1
	Average	9.5	24.0	6.9	Average	1.4	4.4	1.2

Note:

- The values in the table are to be multiplied by the exponential factor indicated in the column header. For example, JP-5 benzo(a)pyrene emissions averaged 32.3 x 10^{-6} lb/hr.
- Definitions of acronyms are included in Acronym List in Table of Contents.

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Table 6-4. Summary of Results – BTEX, Propylene, and 1,3-Butadiene Emissions from the MCAS Miramar Open Burn Simulator

VOC	JP-5				Tekflame			
	Test #	ppmv	(lb/hr) x 10^{-3}	(lb/(1,000 gal))	Test #	ppmv	(lb/hr) x 10^{-3}	(lb/(1,000 gal))
Benzene	1	3.47	25.3	7.02	2	0.33	3.5	0.90
	6	1.10	9.07	2.93	3	0.30	3.1	0.93
	7	2.09	20.4	7.60	4	0.33	3.1	0.98
	Average	2.22	18.2	5.85	Average	0.32	3.3	0.94
Toluene	1	0.86	7.44	2.07	2	0.078	0.97	0.25
	6	0.26	2.50	0.80	3	0.080	0.98	0.29
	7	0.51	5.87	2.19	4	0.077	0.87	0.27
	Average	0.54	5.27	1.69	Average	0.078	0.94	0.27
Ethylbenzene	1	0.17	1.71	0.48	2	0.016	0.23	0.059
	6	0.039	0.44	0.14	3	0.016	0.23	0.068
	7	0.12	1.58	0.59	4	0.015	0.20	0.061
	Average	0.11	1.24	0.40	Average	0.016	0.22	0.063
Xylene(s)	1	0.60	5.92	1.64	2	0.057	0.82	0.21
	6	0.15	1.68	0.54	3	0.067	0.95	0.28
	7	0.42	5.51	2.05	4	0.056	0.73	0.23
	Average	0.39	4.37	1.41	Average	0.060	0.83	0.24

Table 6-4 (Continued)

VOC	JP-5				Tekflame			
	Test #	**ppmv**	**(lb/hr) x 10^{-3}**	**(lb/(1,000 gal))**	**Test #**	**ppmv**	**(lb/hr) x 10^{-3}**	**(lb/(1,000 gal))**
1,3-Butadiene	1	2.05	10.4	2.88	2	0.31	2.27	0.58
	6	0.81	4.66	1.55	3	0.27	1.94	0.58
	7	1.24	8.40	3.13	4	0.29	1.95	0.61
	Average	1.37	7.80	2.50	Average	0.29	2.05	0.59
Propylene	1	9.46	37.1	10.3	2	1.36	7.71	1.98
	6	3.84	17.1	5.50	3	1.29	7.23	2.16
	7	6.04	31.7	11.8	4	1.36	7.01	2.20
	Average	6.45	28.6	9.21	Average	1.34	7.32	2.11

Note:

- The values in the table are to be multiplied by the exponential factor indicated in the column header. For example, JP-5 propylene emissions averaged 28.6 x 10^{-3} lb/hr.
- Definitions of acronyms are included in Acronym List in Table of Contents.

Table 6-5. Summary of Results – Aldehyde Emissions from the MCAS Miramar Open Burn Simulator

Aldehyde	JP-5				Tekflame			
	Test #	ppmv	(lb/hr) x 10^{-3}	lb/(1,000 gal)	Test #	ppmv	(lb/hr) x 10^{-3}	lb/(1,000 gal)
Formaldehyde	1	7.69	21.5	5.13	2	2.30	9.33	2.08
	6	6.29	20.0	5.97	3	1.59	6.35	1.62
	7	1.20	4.50	1.17	4	2.39	8.79	2.28
	Average	5.06	15.3	4.09	Average	2.09	8.16	1.99
Acetaldehyde	1	1.10	4.51	1.08	2	0.48	2.83	0.63
	6	1.27	5.90	1.77	3	0.34	2.00	0.51
	7	0.26	1.43	0.37	4	0.48	2.59	0.67
	Average	0.88	3.95	1.07	Average	0.43	2.47	0.60
Acrolein	1	0.24	1.27	0.30	2	0.033	0.25	0.056
	6	0.17	1.03	0.31	3	0.043	0.32	0.081
	7	0.012	0.083	0.022	4	0.033	0.23	0.059
	Average	0.14	0.80	0.21	Average	0.036	0.26	0.065

Note:
- The values in the table are to be multiplied by the exponential factor indicated in the column header. For example, JP-5 formaldehyde emissions averaged 15.4 x 10^{-3} lb/hr.
- Definitions of acronyms are included in Acronym List in Table of Contents.

Table 6-6. Summary of Results – Metals and SO_2 Emission Estimates[1] from the MCAS Miramar Open Burn Simulator

Parameter	JP-5		Tekflame	
	(lb/hr) x 10^{-3}	**(lb/1,000 gal)**	**(lb/hr) x 10^{-3}**	**(lb/1,000 gal)**
SO_2	50.7	0.015	0.20	0.000053
	(lb/hr) x 10^{-6}	**(lb/1,000 gal) x 10^{-6}**	**(lb/hr) x 10^{-6}**	**(lb/1,000 gal) x 10^{-6}**
Arsenic	< 0.12	< 34	< 0.12	< 33
Beryllium	< 0.05	< 14	< 0.05	< 13
Cadmium	< 0.05	< 14	< 0.05	< 13
Chromium	< 0.23	< 68	< 0.25	< 66
Copper	0.47	137	0.50	132
Lead	< 0.23	< 68	< 0.25	< 66
Manganese	< 0.23	< 68	< 0.25	< 66
Mercury	< 0.01	< 3	< 0.012	< 3
Nickel	< 0.23	< 68	< 0.25	< 66
Selenium	< 0.23	< 68	< 0.25	< 66
Zinc	0.70	205	1.49	395

Note:

- The values in the table are to be multiplied by the exponential factor indicated in the column header. For example, JP-5 SO_2 emissions averaged 50.7 x 10^{-3} lb/hr.
- Definitions of acronyms are included in Acronym List in Table of Contents.

[1] The Table 6-6 data represent emission *estimates*, based on the fuel composition and corresponding burn rates.

Table 6-7. Summary of the Sample Collection and Analytical Schedule

Test Parameters	Sample Collection Date(s)	Extraction Date	Analysis Date
VOCs	October 5-8, 1999	NA	October 12-14, 1999
Particulate Matter	October 5-8, 1999	NA	October 12 – November 12, 1999
PAHs	October 5-8, 1999	October 26, 1999	November 9 - 17, 1999
Aldehydes	October 5-8, 1999	October 11, 1999	October 13, 1999
Sulfur, Metals (Fuel Samples)	October 20, 1999	NA	October 29, 1999

Appendix A

Simulator Operating Data

Table A-1. Summary of the Open Burn Simulator Operating Data

Run No. (Date)	Fuel Type	Times	Fuel Burned (gal)	Burn Interval (min)	Burn Rate (gpm)	Flame Temperature (°F)	Fuel Pan Water Temperature (°F)[1]	Hood Pressure (In. H_2O)[2]
1 (10/5/99)	JP-5	1135-1248	5.1	73	0.070	1,095	72	0.013
		1335-1500	5.1	85	0.060	1,020	---	0.013
		Average	---	---	0.065	1,058	72	0.013
6 (10/7/99)	JP-5	1410-1547	4.7	97	0.048	1,157	85	0.017
		1611-1744[3]	4.7	84	0.056	1,107	---	0.014
		Average	---	---	0.052	1,132	85	0.016
7 (10/8/99)	JP-5	0937-1050	4.7	73	0.064	1,213	73	0.008
		1138-1254	3.4	76	0.045	1,023	---	0.013
		Average	---	---	0.054	1,118	73	0.010
Average	JP-5	---	---	---	0.057	1,103	77	0.013
2 (10/6/99)	Tekflame	1002-1116	5.5	74	0.075	1,250	72	0.013
		1141-1306	5.5	85	0.065	1,212	---	0.014
		Average	---	---	0.070	1,231	72	0.014
3 (10/6/99)	Tekflame	1407-1525	5.1	78	0.065	1,238	---	0.012
		1548-1704	4.3	76	0.056	1,254	---	0.014
		Average	---	---	0.061	1,246	---	0.013
4 (10/7/99)	Tekflame	0903-1029	5.5	86	0.064	1,262	70	0.013
		1047-1207	4.3	80	0.053	1,205	---	0.012
		Average	---	---	0.059	1,234	70	0.013
Average	Tekflame	---	---	---	0.063	1,237	71	0.013

[1] The water temperature was measured immediately prior to the test.
[2] The static pressure within the hood was slightly positive (relative to local barometric pressure) during all tests.
[3] Simulator was off-line from 1706 to 1715 to change out water (unstable flame conditions were observed).

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Appendix B

Supporting Calculations and Field Data Sheets

Table B-1. Sampling Data and Calculations - Particulate Matter Emission Data for the MCAS Miramar Open Burn Simulator

Fuel Condition:			JP-5				TekFlame			
Test Number:			1	6	7	Average	2	3	4	Average
Date:			10/5/1999	10/7/1999	10/8/1999		10/6/1999	10/6/1999	10/7/1999	
Time:			1147-1451	1441-1734	0947-1250		1010-1247	1418-1656	0926-1155	
DGMCF (	---	)=	1.003	1.003	1.003	---	1.003	1.003	1.003	---
Dry Gas Meter Volume (	cu. ft.	)=	53.88	60.31	69.75	---	76.72	76.45	68.28	---
PTCF (	---	)=	0.99	0.99	0.99	---	0.99	0.99	0.99	---
Barometric Pressure (	" Hg	)=	29.82	29.91	29.82	---	29.95	29.95	29.91	---
Impinger Weight Gain (	grams	)=	61	55	45	---	74	69	55	---
Percent Oxygen (	% O2	)=	19.1	18.6	19.5	---	18.6	19.0	19.1	---
Percent Carbon Dioxide (	% CO2	)=	1.5	1.7	1.1	---	1.7	1.5	1.4	---
Average Delta H (	" H2O	)=	0.67	0.80	1.10	---	1.35	1.29	1.07	---
Pressure at Meter (	" Hg	)=	29.87	29.97	29.90	---	30.05	30.04	29.99	---
Static Pressure (	" H2O	)=	-0.28	-0.40	-0.32	---	-0.45	-0.45	-0.40	---
Temp at Meter (	deg F	)=	87	99	92	---	86	93	85	---
Temp in Stack (	deg F	)=	416	404	320	---	412	389	386	---
Nozzle Diameter (	inches	)=	0.268	0.267	0.267	---	0.267	0.267	0.267	---
Total Sampling Time (	minutes	)=	120	120	120	---	120	120	120	---
Sq Rt Stack Gas Vel Press (	(a)	)=	0.37	0.41	0.46	---	0.53	0.52	0.48	---
Standard Temp (	deg F	)=	68	68	68	---	68	68	68	---
Standard Pressure (	" Hg	)=	29.92	29.92	29.92	---	29.92	29.92	29.92	---
Diameter of Stack (	feet	)=	0.83	0.83	0.83	---	0.83	0.83	0.83	---
Fuel Burn Rate (	gpm	)=	0.065	0.052	0.054	---	0.070	0.061	0.059	---
Volume of Gas Sampled (	dscf	)=	52.08	57.18	66.85	---	74.75	73.47	66.46	---
Vent Gas Moisture Content (	% H2O	)=	5.2%	4.4%	3.1%	---	4.4%	4.2%	3.8%	---
Gas Molecular Weight, Wet Basis (	1b/1b-mole	)=	28.43	28.53	28.62	---	28.53	28.53	28.58	---
Stack Gas Velocity (	ft/sec	)=	32.0	35.0	37.5	---	45.7	43.5	40.3	---
Percent Isokinetic (	%	)=	101%	100%	98%	---	101%	101%	98%	---
Volumetric Stack Gas Flow (	acfm	)=	1,047	1,146	1,227	---	1,495	1,422	1,318	---
Volumetric Stack Gas Flow (	dscfm	)=	596	669	801	689	865	847	790	834

(a) (in.H2O)**0.5

Table B-1. Sampling Data and Calculations - Particulate Matter Emission Data for the MCAS Miramar Open Burn Simulator

Fuel Condition	JP-5				TekFlame			
Test Number	1	6	7	Average	2	3	4	Average
Particulate Quantity Collected (mg)=								
Solid	140.7	213.3	143.2	---	88.1	68.1	65.7	---
Condensible	39.6	36.0	51.3	---	8.0	9.9	6.3	---
Total	180.3	249.3	194.5	---	96.1	78.0	72.0	---
Particulate Concentration (gr/dscf)=								
Solid	0.0417	0.0576	0.0331	0.0441	0.0182	0.0143	0.0153	0.0159
Condensible	0.0117	0.0097	0.0118	0.0111	0.0017	0.0021	0.0015	0.0017
Total	0.0534	0.0673	0.0449	0.0552	0.0198	0.0164	0.0167	0.0176
Particulate Emission Rate (gm/sec)=								
Solid	0.0268	0.0416	0.0286	0.03235	0.0170	0.0131	0.0130	0.01436
Condensible	0.0076	0.0070	0.0102	0.00827	0.0015	0.0019	0.0012	0.00156
Total	0.0344	0.0486	0.0388	0.04062	0.0185	0.0150	0.0143	0.01593
Particulate Emission Rate (lb/hr)=								
Solid	0.213	0.330	0.227	0.257	0.135	0.104	0.103	0.114
Condensible	0.060	0.056	0.081	0.066	0.012	0.015	0.010	0.012
Total	0.273	0.386	0.308	0.322	0.147	0.119	0.113	0.126
Particulate Emission Ratio (lb/(1,000 gal))=								
Solid	55.0	106.4	69.8	77.1	32.3	28.5	29.2	30.0
Condensible	15.5	18.0	25.0	19.5	2.9	4.1	2.8	3.3
Total	70.4	124.4	94.8	96.5	35.3	32.7	32.0	33.3

Table B-2. Sampling Data and Calculations - PAH Emission Data for the MCAS Miramar Open Burn Simulator

Fuel Condition:			JP-5				Tekflame			
Test Number:			1	6	7	Average	2	3	4	Average
Date			10/5/1999	10/7/1999	10/8/1999		10/6/1999	10/6/1999	10/7/1999	
Time			1146-1450	1444-1752	0948-1251		1012-1249	1423-1658	0928-1158	
DGMCF (	---	)=	1.014	1.014	1.014	---	1.014	1.014	1.014	---
Dry Gas Meter Volume (	cu. ft.	)=	62.46	72.03	71.31	---	89.76	90.58	81.18	---
PTCF (	---	)=	0.99	0.99	0.99	---	0.99	0.99	0.99	---
Barometric Pressure (	in. Hg	)=	29.82	29.91	29.82	---	29.95	29.95	29.91	---
Impinger Weight Gain (	grams	)=	61	55	41	---	79	77	60	---
Percent Oxygen (	% O2	)=	19.1	18.6	19.5	---	18.6	19.0	19.1	---
Percent Carbon Dioxide (	% CO2	)=	1.5	1.7	1.1	---	1.7	1.5	1.4	---
Percent Nitrogen (	% N2	)=	79.4	79.7	79.4	---	79.7	79.5	79.5	---
Average Delta H (	in. H2O	)=	0.94	1.21	1.13	---	1.93	1.91	1.55	---
Pressure at Meter (	in. Hg	)=	29.89	30.00	29.90	---	30.09	30.09	30.02	---
Static Pressure (	in. H2O	)=	-0.28	-0.40	-0.32	---	-0.45	-0.45	-0.40	---
Stack Pressure (	in. Hg	)=	29.80	29.88	29.80	---	29.92	29.92	29.88	---
Temp at Meter (	deg F	)=	99	104	105	---	89	104	90	---
Temp in Stack (	deg F	)=	416	407	321	---	412	389	387	---
Nozzle Diameter (	inches	)=	0.289	0.289	0.264	---	0.289	0.289	0.289	---
Nozzle Area (	sq.feet	)=	0.00046	0.00046	0.00038	---	0.00046	0.00046	0.00046	---
Total Sampling Time (	minutes	)=	120	120	120	---	120	120	120	---
Square Root Stack Gas Vel Press (	(a)	)=	0.37	0.42	0.46	---	0.54	0.52	0.47	---
Standard Temp (	deg F	)=	68	68	68	---	68	68	68	---
Standard Pressure (	in. Hg	)=	29.92	29.92	29.92	---	29.92	29.92	29.92	---
Diameter of Stack (	feet	)=	0.83	0.83	0.83	---	0.83	0.83	0.83	---
Area of Stack (	sq. feet	)=	0.55	0.55	0.55	---	0.55	0.55	0.55	---
Fuel Burning Rate (	gpm	)=	0.065	0.052	0.054	---	0.070	0.061	0.059	---
Volume of Gas Sampled (	dscf	)=	59.80	68.52	67.56	---	87.99	86.51	79.36	---
Gas Volume of Water Condensed (	dscf	)=	2.89	2.57	1.91	---	3.74	3.62	2.84	---
Moisture Fraction (	% H2O	)=	4.61%	3.62%	2.75%	---	4.08%	4.02%	3.45%	---
Gas Molecular Weight, Dry Basis (	lb/lb-mole	)=	29.00	29.01	28.96	---	29.02	29.00	28.99	---
Gas Molecular Weight, Wet Basis (	lb/lb-mole	)=	28.49	28.62	28.66	---	28.57	28.55	28.62	---
Stack Gas Velocity (	ft/sec	)=	32.1	35.9	37.5	---	46.0	44.2	39.9	---
Percent Isokinetic (	%	)=	99.3%	99.3%	100.6%	---	100.5%	99.9%	100.8%	---
Volumetric Stack Gas Flow (	acfm	)=	1,049	1,174	1,226	1,150	1,505	1,446	1,307	1,367
Volumetric Stack Gas Flow (	dscfm	)=	601	688	803	698	874	864	785	812

(a) (in. H2O)**0.5

Table B-2. Sampling Data and Calculations - PAH Emission Data (Cont'd)

Fuel Condition:	JP-5				Tekflame			
Test Number:	1	6	7	Average	2	3	4	Average
PAHs (ug/sample)=								
Naphthalene	4,400	2,300	2,600	---	550	440	560	---
2-Methylnaphthalene	1,300	710	700	---	97	81	90	---
Acenaphthylene	470	170	230	---	140	110	140	---
Acenaphthene	78	43	44	---	5.1	4.4	5.5	---
Fluorene	260	130	140	---	20	20	23	---
Phenanthrene	410	290	370	---	100	93	100	---
Anthracene	100	64	89	---	6.2	9.3	8.5	---
Fluoranthene	160	64	81	---	28	22	24	---
Pyrene	160	62	81	---	28	20	24	---
Chrysene	39	11	15	---	4.3	2.4	2.4	---
Benzo(a)anthracene	40	12	18	---	3.8	3.1	4.1	---
Benzo(b)fluoranthene	64	21	28	---	7.0	5.2	5.9	---
Benzo(k)fluoranthene	8.0	3.4	4.1	---	1.0	1.0	0.97	---
Benzo(a)pyrene	36	14	20	---	4.8	3.1	4.3	---
Benzo(e)pyrene	18	7.5	8.7	---	3.0	2.0	2.2	---
Perylene	10	4.0	5.7	---	0.94	0.52	0.74	---
Indeno(1,2,3-c,d)pyrene	24	8.1	13	---	2.2	1.9	2.2	---
Dibenz(a,h)anthracene	3.2	0.98	1.9	---	0.28	0.24	0.27	---
Benzo(g,h,i)perylene	26	11	15	---	4.1	2.9	3.0	---
PAHs Concentration (ug/dscm)=								
Naphthalene	2,598	1,185	1,359	1,714	325	227	293	281
2-Methylnaphthalene	768	366	366	500	57.3	41.7	47.0	48.7
Acenaphthylene	278	87.6	120	162	82.7	56.7	73.2	70.8
Acenaphthene	46.1	22.2	23.0	30.4	3.0	2.3	2.9	2.7
Fluorene	154	67.0	73.2	97.9	11.8	10.3	12.0	11.4
Phenanthrene	242	149	193	195	59.0	47.9	52.3	53.1
Anthracene	59.0	33.0	46.5	46.2	3.7	4.8	4.4	4.3
Fluoranthene	94.5	33.0	42.3	56.6	16.5	11.3	12.5	13.5
Pyrene	94.5	32.0	42.3	56.3	16.5	10.3	12.5	13.1
Chrysene	23.0	5.7	7.8	12.2	2.5	1.2	1.3	1.7
Benzo(a)anthracene	23.6	6.2	9.4	13.1	2.2	1.6	2.1	2.0
Benzo(b)fluoranthene	37.8	10.8	14.6	21.1	4.1	2.7	3.1	3.3
Benzo(k)fluoranthene	4.7	1.8	2.1	2.9	0.57	0.52	0.51	0.53
Benzo(a)pyrene	21.3	7.2	10.5	13.0	2.8	1.6	2.2	2.2
Benzo(e)pyrene	10.6	3.9	4.5	6.3	1.8	1.0	1.1	1.3
Perylene	5.9	2.1	3.0	3.6	0.56	0.27	0.39	0.40
Indeno(1,2,3-c,d)pyrene	14.2	4.2	6.8	8.4	1.3	1.0	1.1	1.1
Dibenz(a,h)anthracene	1.9	0.51	1.0	1.1	0.17	0.12	0.14	0.14
Benzo(g,h,i)perylene	15.4	5.7	7.8	9.6	2.4	1.5	1.6	1.8

Table B-2. Sampling Data and Calculations - PAH Emission Data (Cont'd)

Fuel Condition:	JP-5				Tekflame			
Test Number:	1	6	7	Average	2	3	4	Average
PAHs Emission Rate (lb/hr x 10-3)=								
Naphthalene	5,850	3,057	4,089	4,332	1,063	734	861	886
2-Methylnaphthalene	1,728	944	1,101	1,258	188	135	138	154
Acenaphthylene	625	226	362	404	271	183	215	223
Acenaphthene	104	57.1	69.2	76.7	9.9	7.3	8.5	8.6
Fluorene	346	173	220	246	38.7	33.4	35.4	35.8
Phenanthrene	545	385	582	504	193.3	155.1	153.8	167.4
Anthracene	133	85.1	140	119	12.0	15.5	13.1	13.5
Fluoranthene	213	85.1	127	142	54.1	36.7	36.9	42.6
Pyrene	213	82.4	127	141	54.1	33.4	36.9	41.5
Chrysene	51.8	14.6	23.6	30.0	8.3	4.0	3.7	5.3
Benzo(a)anthracene	53.2	15.9	28.3	32.5	7.3	5.2	6.3	6.3
Benzo(b)fluoranthene	85.1	27.9	44.0	52.3	13.5	8.7	9.1	10.4
Benzo(k)fluoranthene	10.6	4.5	6.4	7.2	1.9	1.7	1.5	1.7
Benzo(a)pyrene	47.9	18.6	31.5	32.6	9.3	5.2	6.6	7.0
Benzo(e)pyrene	23.9	10.0	13.7	15.9	5.8	3.3	3.4	4.2
Perylene	13.3	5.3	9.0	9.2	1.8	0.87	1.1	1.3
Indeno(1,2,3-c,d)pyrene	31.9	10.8	20.4	21.0	4.3	3.2	3.4	3.6
Dibenz(a,h)anthracene	4.3	1.3	3.0	2.8	0.54	0.40	0.42	0.45
Benzo(g,h,i)perylene	34.6	14.6	23.6	24.3	7.9	4.8	4.6	5.8
PAHs Emission Rate ((lb/1,000 gal))=								
Naphthalene	1,509	985	1,257	1,251	255	201	244	233
2-Methylnaphthalene	446	304	338	363	45.0	37.1	39.2	40.4
Acenaphthylene	161	72.8	111	115	64.9	50.4	60.9	58.7
Acenaphthene	26.8	18.4	21.3	22.2	2.4	2.0	2.4	2.3
Fluorene	89.2	55.7	67.7	70.9	9.3	9.2	10.0	9.5
Phenanthrene	141	124	179	148	46.4	42.6	43.5	44.1
Anthracene	34.3	27.4	43.0	34.9	2.9	4.3	3.7	3.6
Fluoranthene	54.9	27.4	39.2	40.5	13.0	10.1	10.4	11.2
Pyrene	54.9	26.6	39.2	40.2	13.0	9.2	10.4	10.9
Chrysene	13.4	4.7	7.3	8.4	2.0	1.1	1.0	1.4
Benzo(a)anthracene	13.7	5.1	8.7	9.2	1.8	1.4	1.8	1.7
Benzo(b)fluoranthene	22.0	9.0	13.5	14.8	3.2	2.4	2.6	2.7
Benzo(k)fluoranthene	2.7	1.5	2.0	2.1	0.45	0.46	0.42	0.44
Benzo(a)pyrene	12.3	6.0	9.7	9.3	2.2	1.4	1.9	1.8
Benzo(e)pyrene	6.2	3.2	4.2	4.5	1.4	0.92	1.0	1.1
Perylene	3.4	1.7	2.8	2.6	0.44	0.24	0.32	0.33
Indeno(1,2,3-c,d)pyrene	8.2	3.5	6.3	6.0	1.02	0.87	0.96	0.95
Dibenz(a,h)anthracene	1.1	0.42	0.92	0.81	0.13	0.11	0.12	0.12
Benzo(g,h,i)perylene	8.9	4.7	7.3	7.0	1.9	1.3	1.3	1.5

Table B-3: Sampling Data and Calculations - NOx, CO, and THC Emission Data for the MCAS Miramar Open Burn Simulator

Fuel Condition:		JP-5				Tekflame			
Test #:		1	6	7	Average	2	3	4	Average
Date:		10/5/1999	10/7/1999	10/8/1999		10/6/1999	10/6/1999	10/7/1999	
Times:		1153-1437	1440-1703	1022-1235		1014-1305	1420-1643	0928-1149	
Oxygen Concentration	(% O2)=	19.1	18.6	19.5	---	18.6	19.0	19.1	---
CO2 Concentration	(% CO2)=	1.5	1.7	1.1	---	1.7	1.5	1.4	---
Stack Gas Flow Rate (a)	(dscfm)=	599	679	802	---	870	856	788	---
Stack Gas Moisture Content (a)	(%)=	4.9	4.0	2.9	---	4.3	4.1	3.6	---
Fuel Burn Rate	(gpm)=	0.065	0.052	0.054	---	0.070	0.061	0.059	---
Concentration	(ppmv)=								
NOx		1.1	2.6	1.6	1.8	2.7	2.2	2.3	2.4
CO		211	136	92.5	147	82.8	62.0	68.3	71.0
THC, Wet Basis (b)		293	55.4	104	151	43.4	27.7	23.7	31.6
THC, Dry Basis (b)		308	57.7	107	158	45.3	28.9	24.6	32.9
Emission Rate	(lb/hr)=								
NOx		0.0048	0.0125	0.0091	0.0088	0.017	0.014	0.013	0.014
CO		0.55	0.40	0.32	0.43	0.31	0.23	0.23	0.26
THC, Dry Basis		1.26	0.27	0.59	0.71	0.27	0.17	0.13	0.19
Emission Rate	(lb/(1,000 gal))=								
NOx		1.2	4.0	2.8	2.7	4.0	3.7	3.7	3.8
CO		142.5	130.2	99.5	124.1	75.3	63.5	66.4	68.4
THC, Dry Basis		326.3	86.5	181.6	198.2	64.8	46.5	37.6	49.6

(a) Flow rate and moisture data were collected during the concurrent particulate matter and PAH tests; refer to Tables B-1 and B-2, respectively.

Table B-4: Sampling Data and Calculations - BTEX, 1,3-Butadiene, and Propylene Emission Data for the MCAS Miramar Open Burn Simulator

	Fuel Condition:		JP-5				Tekflame			
	Run Number:	1	6		7	Average	2	3	4	Average
	Date:	10/5/1999	10/7/1999		10/8/1999		10/6/1999	10/6/1999	10/7/1999	
	Time:	1350-1500	1418-1727		1146-1255		1146-1257	1554-1703	1055-1205	
Test Duration	(min.)=	70	144	(a)	69	--	71	69	70	--
Stack Gas Flow Rate	(dscfm (b))=	599	679		802	--	870	856	788	--
Fuel Burn Rate	(gpm)=	0.060	0.052		0.045		0.065	0.056	0.053	
VOC Concentration	(ppmv)=									
Benzene		3.47	1.10		2.09	2.22	0.33	0.30	0.33	0.32
Toluene		0.86	0.26		0.51	0.54	0.078	0.080	0.077	0.078
Ethylbenzene		0.17	0.039		0.12	0.11	0.016	0.016	0.015	0.016
Xylene(s)		0.60	0.15		0.42	0.39	0.057	0.067	0.056	0.060
1,3-Butadiene		2.05	0.81		1.24	1.37	0.31	0.27	0.29	0.29
Propylene		9.46	3.84		6.04	6.45	1.36	1.29	1.36	1.34
VOC Emission Rate	(lb/hr x 10-3)=									
Benzene		25.27	9.07		20.38	18.24	3.50	3.13	3.13	3.26
Toluene		7.44	2.50		5.87	5.27	0.97	0.98	0.87	0.94
Ethylbenzene		1.71	0.44		1.58	1.24	0.23	0.23	0.20	0.22
Xylene(s)		5.92	1.68		5.51	4.37	0.82	0.95	0.73	0.83
1,3-Butadiene		10.36	4.66		8.40	7.80	2.27	1.94	1.95	2.05
Propylene		37.08	17.06		31.71	28.62	7.71	7.23	7.01	7.32
VOC Emission Rate	(lb/(1,000 gal))=									
Benzene		7.02	2.93		7.60	5.85	0.90	0.93	0.98	0.94
Toluene		2.07	0.80		2.19	1.69	0.25	0.29	0.27	0.27
Ethylbenzene		0.48	0.14		0.59	0.40	0.059	0.068	0.061	0.063
Xylene(s)		1.64	0.54		2.05	1.41	0.21	0.28	0.23	0.24
1,3-Butadiene		2.88	1.50		3.13	2.50	0.58	0.58	0.61	0.59
Propylene		10.30	5.50		11.82	9.21	1.98	2.16	2.20	2.11

(a) The Test 6 sample was collected in duplicate (refer to Section 5.3 of the text). Analytical data for the duplicate samples were averaged; results of the individual samples are presented in Appendix C.

(b) Flow rate data were collected during the concurrent particulate matter and PAH testing (refer to Tables B-1 and B-2, respectively). Average flow rate values were assumed.

Table B-5: Sampling Data and Calculations - Aldehyde Emission Data for the MCAS Miramar Open Burn Simulator

Fuel Condition:	JP-5				Tekflame			
Run Number:	# 1	# 6	# 7		# 2	# 3	# 4	
Date:	10/5/99	10/7/99	10/8/99		10/6/99	10/6/99	10/7/99	
Time:	1146-1246	1631-1744	0946-1046	Average	1011-1116	1419-1519	0927-1027	Average
Sampling Data:								
Sampling Duration, (minutes)	60.0	60.0	60.0	--	65.0	60.0	60.0	--
Dry Gas Meter Correction Factor	1.002	1.002	1.002	--	1.002	1.002	1.002	--
Dry Gas Meter Volume, (liters)	57.14	55.78	54.42	--	61.74	59.56	58.14	--
Barometric Pressure, (in. Hg)	29.82	29.91	29.82	--	29.95	29.95	29.91	--
Meter Back-Pressure, (in. H2O)	1.43	1.46	1.53	--	1.52	1.58	1.50	--
Meter Pressure, Absolute, (in. Hg)	29.93	30.02	29.93	--	30.06	30.07	30.02	--
Meter Temperature, (deg. C)	29	39	31	--	27	31	29	--
Meter Temperature, (deg. F)	85	101	87	--	80	87	85	--
Stack Gas Flow Rate (a), (dscfm)	599	679	802	--	870	856	788	--
Standard Temperature, (deg. F)	68	68	68	--	70	70	70	--
Standard Pressure, (in. Hg)	29.92	29.92	29.92	--	29.92	29.92	29.92	--
Fuel Burning Rate, (gpm)	0.070	0.056	0.064	--	0.075	0.065	0.064	--
Calculations:								
Corrected Volume of Gas Sampled (dscm)	0.056	0.053	0.053	--	0.061	0.058	0.057	--
Quantity Collected, (total ug)								
Formaldehyde	535	416	79	--	176	116	170	--
Acetaldehyde	112	123	25	--	53	36	50	--
Acrolein	32	22	1.5	--	4.7	5.8	4.4	--
Concentration, (ppmv)								
Formaldehyde	7.72	6.32	1.21	5.08	2.31	1.60	2.40	2.10
Acetaldehyde	1.10	1.28	0.26	0.88	0.48	0.34	0.48	0.43
Acrolein	0.24	0.18	0.012	0.14	0.033	0.043	0.033	0.036
Emission Rate, (lb/hr x 10-3)								
Formaldehyde	21.6	20.1	4.52	15.4	9.38	6.38	8.84	8.20
Acetaldehyde	4.54	5.93	1.44	3.97	2.85	2.01	2.60	2.49
Acrolein	1.28	1.04	0.084	0.80	0.25	0.32	0.23	0.27
Emission Ratio, ((lb/1,000 gal))								
Formaldehyde	5.16	6.00	1.18	4.11	2.09	1.63	2.29	2.00
Acetaldehyde	1.08	1.78	0.38	1.08	0.64	0.51	0.67	0.61
Acrolein	0.30	0.31	0.022	0.21	0.056	0.081	0.059	0.065

Table B-6: Sampling Data and Calculations - Metals (11) and SO2 Emission Estimates for the MCAS Miramar Open Burn Simulator

Fuel:	JP-5	Tekflame
Fuel Burn Rate (gpm (a))=	0.057	0.063
Fuel Density (lb/gal)=	6.84	6.59
Concentration (mg/kg)=		
Arsenic	< 0.005	< 0.005
Beryllium	< 0.002	< 0.002
Cadmium	< 0.002	< 0.002
Chromium	< 0.01	< 0.01
Copper	0.02	0.02
Lead	< 0.01	< 0.01
Manganese	< 0.01	< 0.01
Mercury	< 0.0005	< 0.0005
Nickel	< 0.01	< 0.01
Selenium	< 0.01	< 0.01
Zinc	0.03	0.06
Sulfur (mg/kg)=	1,087	4
Emission Ratio (lb/gal x 10-9)=		
Arsenic	< 34.2	< 33.0
Beryllium	< 13.7	< 13.2
Cadmium	< 13.7	< 13.2
Chromium	< 68.4	< 65.9
Copper	137	132
Lead	< 68.4	< 65.9
Manganese	< 68.4	< 65.9
Mercury	< 3.4	< 3.3
Nickel	< 68.4	< 65.9
Selenium	< 68.4	< 65.9
Zinc	205	395
Sulfur Dioxide (lb/gal x 10-6)=	14,870	53
Emission Rate (lb/hr x 10-6)=		
Arsenic	< 0.12	< 0.12
Beryllium	< 0.047	< 0.050
Cadmium	< 0.047	< 0.050
Chromium	< 0.23	< 0.25
Copper	0.47	0.50
Lead	< 0.23	< 0.25
Manganese	< 0.23	< 0.25
Mercury	< 0.012	< 0.012
Nickel	< 0.23	< 0.25
Selenium	< 0.23	< 0.25
Zinc	0.70	1.49
Sulfur Dioxide (lb/hr x 10-3)=	50.7	0.20

(a) Based on the average fuel burn rate observed during Tests 1, 6 and 7 (JP-5) and Tests 2, 3, and 4 (Tekflame).

Appendix C

Laboratory Data

Appendix D

Calibration Data

NAWS China Lake OBOD HRA Update
Indirect Source Emissions

Emissions from Wood Combustion during OB Activities

Constituent Name	CAS Number	Emission Factor (lb/ton)	Annual Emission Rate (lb/yr)	Annual Emission Rate (g/s)	Hourly Emission Rate (lb/hr)	Hourly Emission Rate (g/s)
Benzo(A)pyrene	50328	0.016	2.92E+00	4.20E-05	8.00E-03	1.01E-03
Carbon monoxide	630080	252.6	4.61E+04	6.63E-01	1.26E+02	1.59E+01
Formaldehyde	50000	2.4	4.38E+02	6.30E-03	1.20E+00	1.51E-01
Nitrogen dioxide	10102440	2.6	4.75E+02	6.83E-03	1.30E+00	1.64E-01
Sulfur dioxide	7446095	0.4	7.30E+01	1.05E-03	2.00E-01	2.52E-02

Wood Emission Calculations

Wood Constituent Emission Rate = Wood Usage (lb) * Wood Constituent Emission Factor (lb/ton) / 2000

Wood Usage (lb/event) =	1000
Events per year =	365
Wood Usage (lb/yr) =	365,000

Source:

1. US EPA AP-42 Sec 1.9, Wood Burning in Residential Fireplaces, Oct 1996 (Table 1.9-1)

1.9 Residential Fireplaces

1.9.1 General[1-2]

Fireplaces are used primarily for aesthetic effects and secondarily as supplemental heating sources in houses and other dwellings. Wood is the most common fuel for fireplaces, but coal and densified wood "logs" may also be burned. The user intermittently adds fuel to the fire by hand. Fireplaces can be divided into 2 broad categories: (1) masonry (generally brick and/or stone, assembled on site, and integral to a structure) and (2) prefabricated (usually metal, installed on site as a package with appropriate duct work).

Masonry fireplaces typically have large fixed openings to the fire bed and have dampers above the combustion area in the chimney to limit room air and heat losses when the fireplace is not being used. Some masonry fireplaces are designed or retrofitted with doors and louvers to reduce the intake of combustion air during use.

Prefabricated fireplaces are commonly equipped with louvers and glass doors to reduce the intake of combustion air, and some are surrounded by ducts through which floor level air is drawn by natural convection, heated, and returned to the room. Many varieties of prefabricated fireplaces are now available on the market. One general class is the freestanding fireplace, the most common of which consists of an inverted sheet metal funnel and stovepipe directly above the fire bed. Another class is the "zero clearance" fireplace, an iron or heavy-gauge steel firebox lined inside with firebrick and surrounded by multiple steel walls with spaces for air circulation. Some zero clearance fireplaces can be inserted into existing masonry fireplace openings, and thus are sometimes called "inserts". Some of these units are equipped with close-fitting doors and have operating and combustion characteristics similar to wood stoves. (See Section 1.10, Residential Wood Stoves.)

Masonry fireplaces usually heat a room by radiation, with a significant fraction of the combustion heat lost in the exhaust gases and through fireplace walls. Moreover, some of the radiant heat entering the room goes toward warming the air that is pulled into the residence to make up for that drawn up the chimney. The net effect is that masonry fireplaces are usually inefficient heating devices. Indeed, in cases where combustion is poor, where the outside air is cold, or where the fire is allowed to smolder (thus drawing air into a residence without producing appreciable radiant heat energy), a net heat loss may occur in a residence using a fireplace. Fireplace heating efficiency may be improved by a number of measures that either reduce the excess air rate or transfer back into the residence some of the heat that would normally be lost in the exhaust gases or through fireplace walls. As noted above, such measures are commonly incorporated into prefabricated units. As a result, the energy efficiencies of prefabricated fireplaces are slightly higher than those of masonry fireplaces.

1.9.2 Emissions And Controls[1-13]

Fireplace emissions, caused mainly by incomplete combustion, include particulate matter (PM) (mainly PM less than 10 micrometers in diameter [PM-10]), carbon monoxide (CO), sulfur oxides (SO_x), nitrogen oxides (NO_x), and volatile organic compounds (VOC). Significant quantities of unburnt combustibles are produced because fireplaces are inefficient combustion devices, with high uncontrolled excess air rates and without any sort of secondary combustion. The latter is especially important in wood burning because of its high volatile matter content, typically 80 percent by dry weight.

Hazardous air pollutants (HAPs) are a minor, but potentially important, component of wood smoke. A group of HAPs known as polycyclic organic matter (POM) includes potential carcinogens such as benzo(a)pyrene (BaP). POM results from the combination of free radical species formed in the flame zone, primarily as a consequence of incomplete combustion. Under reducing conditions, radical chain propagation is enhanced, allowing the buildup of complex organic material such as POM. The POM is generally found in or on smoke particles, although some sublimation into the vapor phase is probable.

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions are all produced during wood combustion in residential fireplaces. Most of the fuel carbon in wood is converted to CO_2 during the combustion process, but because of ineffecient combustion, low combustion temperatures, and large amounts of excess air, a much higher ratio of carbon monoxide to CO_2 is produced than for combustion of wood in airtight wood stoves or wood-fired boilers. This formation of carbon monoxide coupled with incomplete combustion acts to slightly reduce CO_2 emissions compared to other types of wood combustion.[14-19] CO_2 emitted from this source may not increase total atmospheric CO_2, however, because emissions may be offset by the uptake of CO_2 by regrowing biomass.

Formation of N_2O during the combustion process is governed by a complex series of reactions and its formation is dependent upon many factors. Although no test data were available, it is assumed that N_2O emissions from residential fireplaces would be significantly higher than either wood stoves or commercial wood-fired boilers because of the combination of low combustion temperatures and high amounts of excess air.[14-19]

Methane emissions are highest during periods of low-temperature combustion or incomplete combustion, both of which occur often in residential fireplaces. VOC emissions for residential fireplaces are high compared to other wood combustion sources. Typically, conditions that favor formation of N_2O also favor emissions of CH_4.[14-19]

Another important constituent of wood smoke is creosote. This tar-like substance will burn if the fire is hot enough, but at insufficient temperatures, it may deposit on surfaces in the exhaust system. Creosote deposits are a fire hazard in the flue, but they can be reduced if the chimney is insulated to prevent creosote condensation or if the chimney is cleaned regularly to remove any buildup.

In order to decrease PM and CO emissions from fireplaces, combustion must be improved. Combustion efficiency improves as burn rate and flame intensity increase. Noncatalytic fireplace inserts reduce emissions by directing unburned hydrocarbons and CO into an insulated secondary chamber, where mixing with fresh, preheated makeup air occurs and combustion is enhanced.[20]

Fireplace emissions are highly variable and are a function of many wood characteristics and operating practices. In general, conditions which promote a fast burn rate and a higher flame intensity enhance secondary combustion and thereby lower emissions. Conversely, higher emissions will result from a slow burn rate and a lower flame intensity. Such generalizations apply particularly to the earlier stages of the burning cycle, when significant quantities of combustible volatile matter are being driven out of the wood. Later in the burning cycle, when all volatile matter has been driven out of the wood, the charcoal that remains burns with relatively few emissions.

Emission factors and their ratings for wood combustion in residential fireplaces are given in Table 1.9-1. Table 1.9-1 presents emission factors on a weight basis (lb/ton). To convert from lb/ton to lb/MMBtu, divide by a heating value of 17.3 MMBtu/ton.

1.9.3 Updates Since the Fifth Edition

The Fifth Edition was released in January 1995. Revisions to this section since that date are summarized below. For further detail, consult the memoranda describing each supplement or the background report for this section.

Supplement A, February 1996

No changes.

Supplement B, October 1996

- References for tables were editorially corrected.
- Text was added concerning controls.
- An emission factor was added for N_2O.

Table 1.9-1. EMISSION FACTORS FOR WOOD COMBUSTION IN RESIDENTIAL FIREPLACES[a]
(SCC 21-04-008-001)

Device	Pollutant	Emission Factor (lb/ton)	EMISSION FACTOR RATING
Fireplace	PM-10[b]	34.6	B
	CO[c]	252.6	B
	SO_x[d]	0.4	A
	NO_x[e]	2.6	C
	N_2O[f]	0.3	E
	CO_2[g]	3400	C
	Total VOC[h]	229.0	D
	POM[j]	16 E-03	E
	Aldehydes[k,m]	2.4	E

[a] Units are in lb of pollutant/ton of dry wood burned. To convert lb/ton to kg/Mg, multiply by 0.5. SCC = Source Classification Code.
[b] References 2, 5, 7, 13; contains filterable and condensable PM; PM emissions are considered to be 100% PM-10.
[c] References 2, 4-6, 9, 11, 13.
[d] References 1, 8.
[e] References 4, 6, 9, 11; expressed as NO_2.
[f] Reference 21.
[g] References 5, 13.
[h] References 1, 4, 5. Data used to calculate the average emission factor were collected by various methods. While the emission factor may be representative of the source population in general, factors may not be accurate for individual sources.
[j] Reference 2.
[k] Data used to calculate the average emission factor were collected from a single fireplace and are not representative of the general source population.
[m] References 4, 11.

References For Section 1.9

1. DeAngelis, D. G., *et al.*, *Source Assessment: Residential Combustion Of Wood*, EPA-600/2-80-042b, U. S. Environmental Protection Agency, Cincinnati, OH, March 1980.

2. Snowden, W. D., *et al.*, *Source Sampling Residential Fireplaces For Emission Factor Development*, EPA-450/3-76-010, U. S. Environmental Protection Agency, Research Triangle Park, NC, November 1975.

3. Shelton, J. W., and L. Gay, *Colorado Fireplace Report*, Colorado Air Pollution Control Division, Denver, CO, March 1987.

4. Dasch, J. M., "Particulate And Gaseous Emissions From Wood-burning Fireplaces", *Environmental Science And Technology, 16*(10):643-67, October 1982.

5. *Source Testing For Fireplaces, Stoves, And Restaurant Grills In Vail, Colorado*, EPA Contract No. 68-01-1999, Pedco Environmental, Inc., Cincinnati, OH, December 1977.

6. Written communication from Robert C. McCrillis, U. S. Environmental Protection Agency, Research Triangle Park, NC, to Neil Jacquay, U. S. Environmental Protection Agency, San Francisco, CA, November 19, 1985.

7. *Development Of AP-42 Emission Factors For Residential Fireplaces*, EPA Contract No. 68-D9-0155, Advanced Systems Technology, Inc., Atlanta, GA, January 11, 1990.

8. DeAngelis, D. G., *et al*., *Preliminary Characterization Of Emissions From Wood Fired Residential Combustion Equipment*, EPA-600/7-80-040, U. S. Environmental Protection Agency, Cincinnati, OH, March 1980.

9. Kosel, P., *et al*., *Emissions From Residential Fireplaces*, CARB Report C-80-027, California Air Resources Board, Sacramento, CA, April 1980.

10. Clayton, L., *et al*., *Emissions From Residential Type Fireplaces*, Source Tests 24C67, 26C, 29C67, 40C67, 41C67, 65C67 and 66C67, Bay Area Air Pollution Control District, San Francisco, CA, January 31, 1968.

11. Lipari, F., *et al*., *Aldehyde Emissions From Wood-Burning Fireplaces*, Publication GMR-4377R, General Motors Research Laboratories, Warren, MI, March 1984.

12. Hayden, A., C. S., and R. W. Braaten, "Performance Of Domestic Wood Fired Appliances", Presented at the 73rd Annual Meeting of the Air Pollution Control Association, Montreal, Quebec, Canada, June 1980.

13. Barnett, S. G., *In-Home Evaluation Of Emissions From Masonry Fireplaces And Heaters*, OMNI Environmental Services, Inc., Beaverton, OR, September 1991.

14. L. P. Nelson, et al., *Global Combustion Sources Of Nitrous Oxide Emissions*, Research Project 2333-4 Interim Report, Sacramento: Radian Corporation, 1995.

15. R. L. Peer, et al., *Characterization Of Nitrous Oxide Emission Sources*, Prepared for the US EPA Contract 68-D1-0031, Research Triangle Park, NC: Radian Corporation, 1995.

16. S. D. Piccot, et al., *Emissions And Cost Estimates For Globally Significant Anthropogenic Combustion Sources Of* NO_x, N_2O, CH_4, *CO, And* CO_2, EPA Contract No. 68-02-4288, Research Triangle Park, NC: Radian Corporation, 1990.

17. G. Marland, and R. M. Rotty, *Carbon Dioxide Emissions From Fossil Fuels: A Procedure For Estimation And Results For 1951-1981*, DOE/NBB-0036 TR-003, Carbon Dioxide Research Division, Office of Energy Research, U.S. Department of Energy, Oak Ridge, TN, 1983.

18. G. Marland and R. M. Rotty, "Carbon Dioxide Emissions From Fossil Fuels: A Procedure For Estimation And Results For 1950-1982," *Tellus*, 36B: 232-261.

19. *Sector-Specific Issues and Reporting Methodologies Supporting the General Guidelines for the Voluntary Reporting of Greenhouse Gases under Section 1605(b) of the Energy Policy Act of 1992* (1994) DOE/PO-0028, Volume 2 of 3, U.S. Department of Energy.

20. *Guidance Document For Residential Wood Combustion Emission Control Measures,* EPA-4502-89-015, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1989.

21. Ortech Corporation, *Inventory Methods Manual for Estimating Canadian Emissions of Greenhouse Gases*, prepared for Environment Canada, 1994.

Appendix C

Dispersion Modeling Inputs

C-1 Greenpoint Meteorological Station Windroses

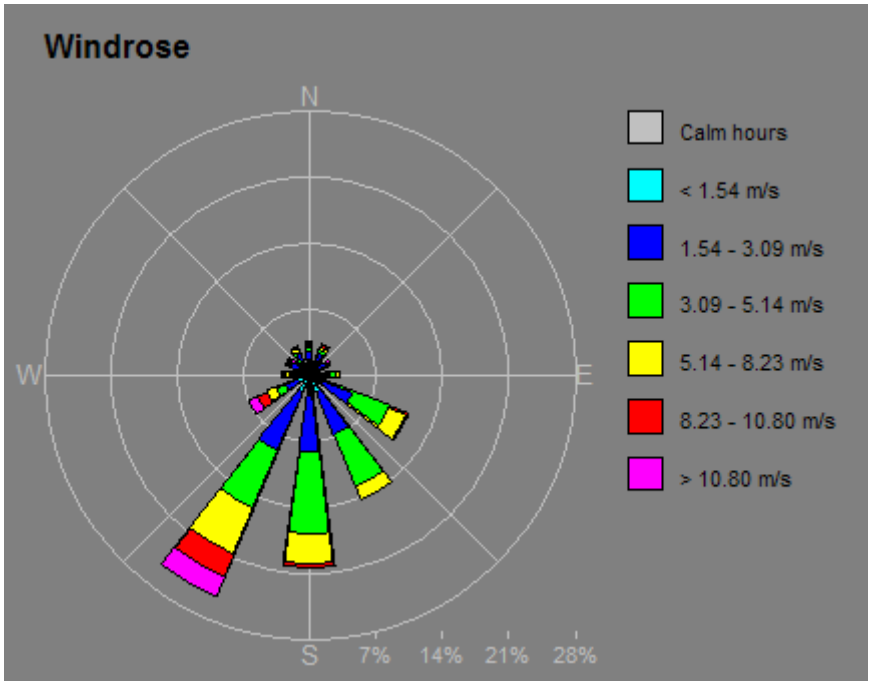
C-2 Receptor Data

C-3 Source Data

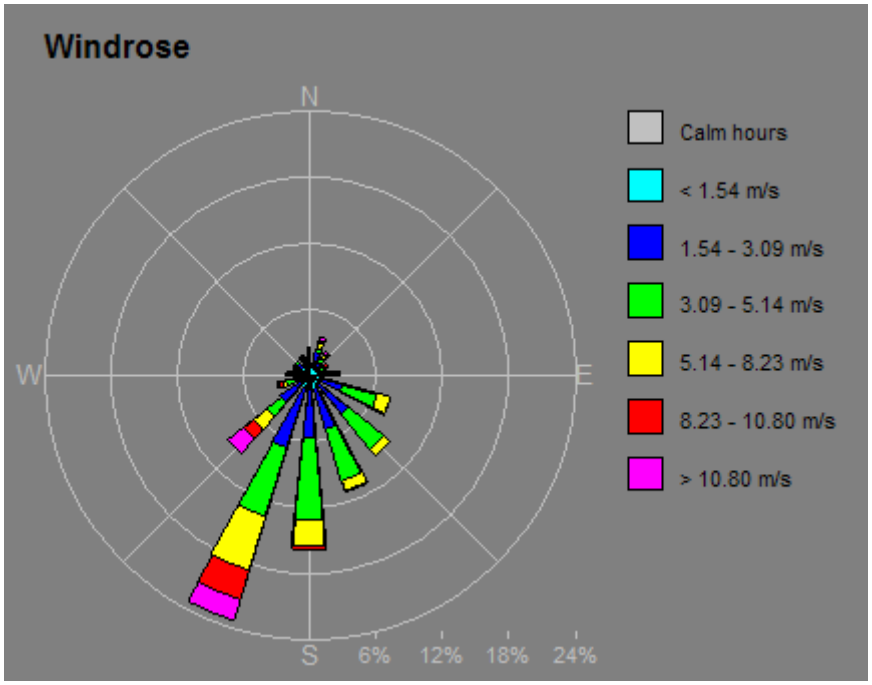
NAWS China Lake OBOD HRA

Windroses for Geographical Area by Year

1999 Greenpoint Windrose

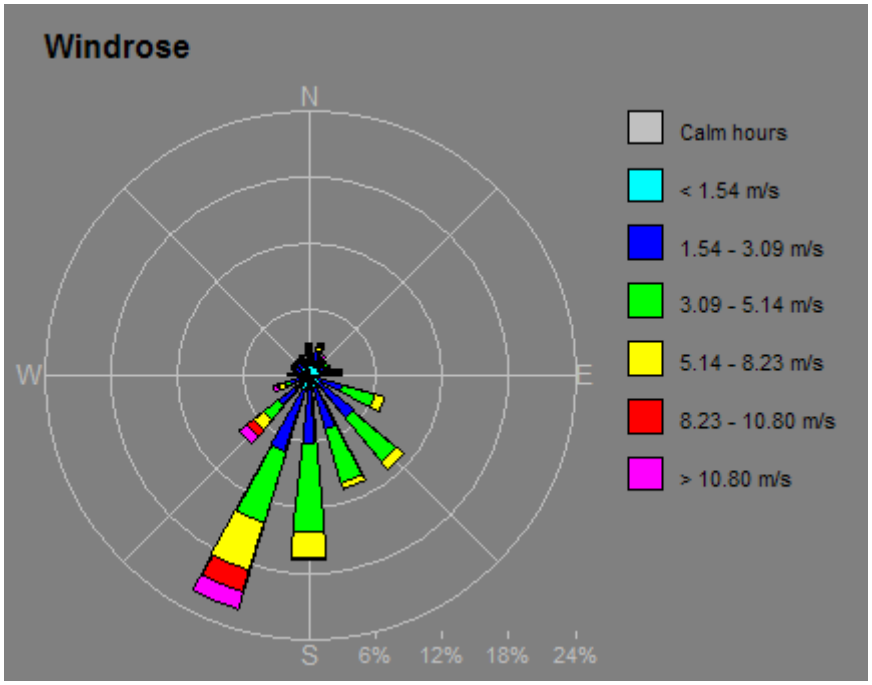


2000 Greenpoint Windrose

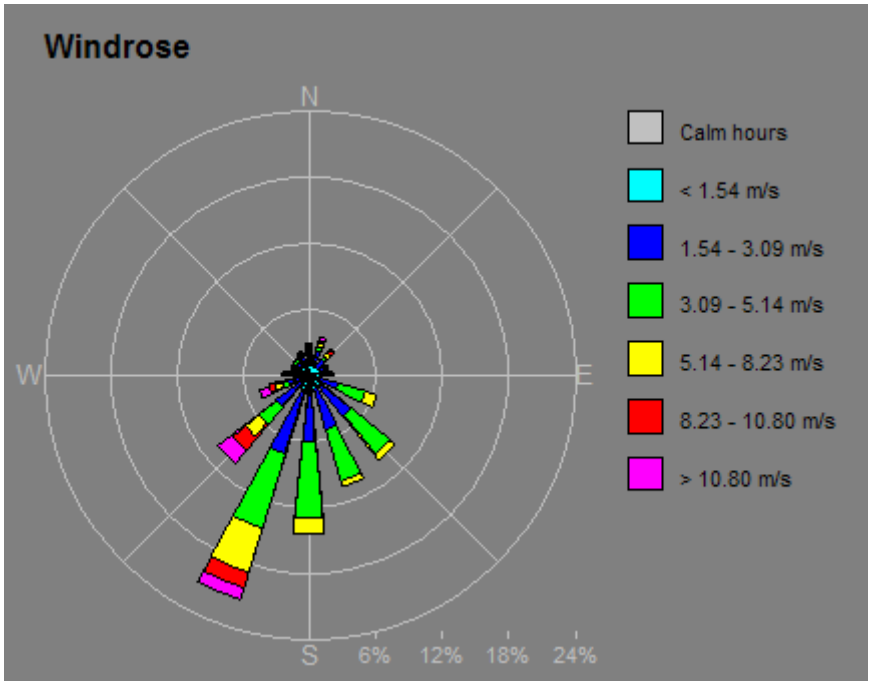


NAWS China Lake OBOD HRA
Windroses for Geographical Area by Year

2001 Greenpoint Windrose

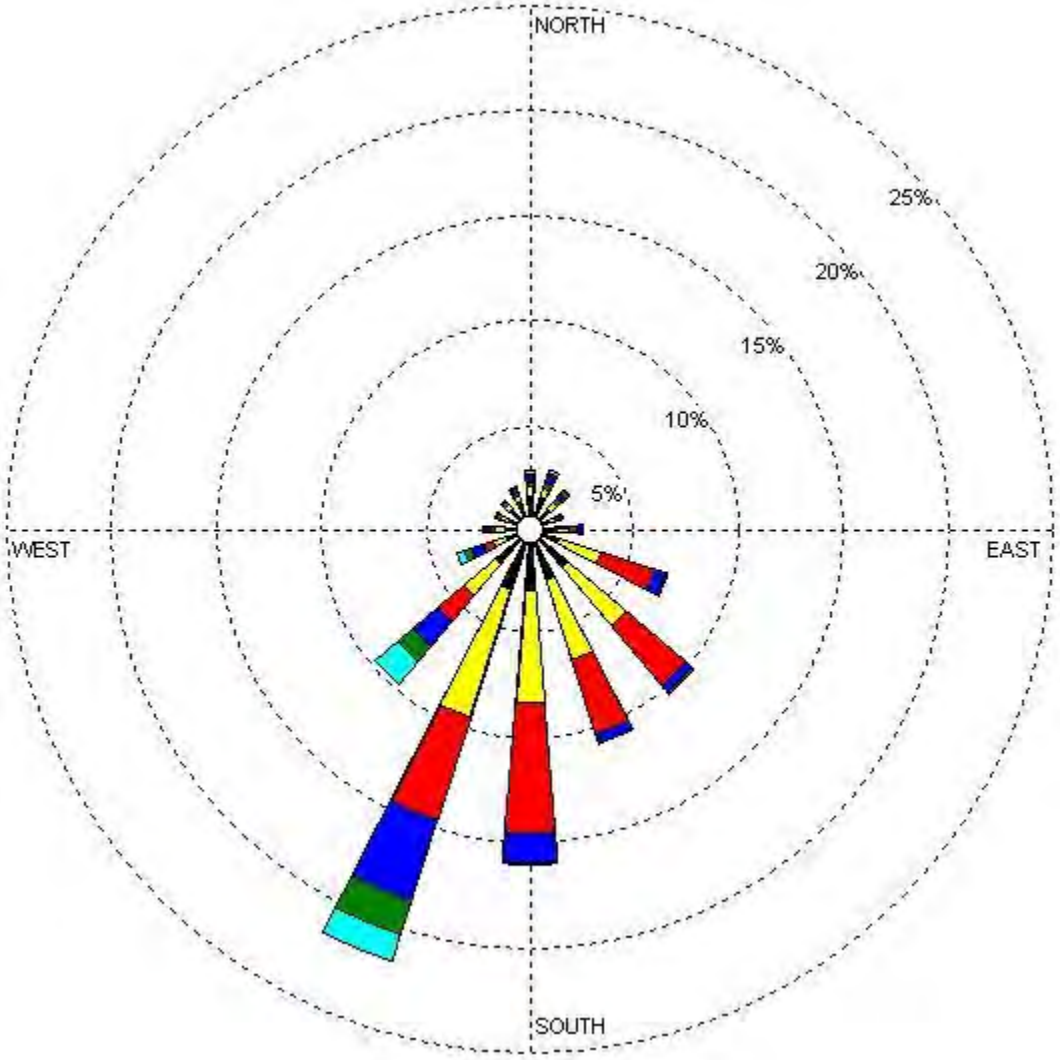


2002 Greenpoint Windrose



NAWS China Lake OBOD HRA
Windroses for Geographical Area by Year

Combined Summary (1999-2002) Windrose



NAWS China Lake OBOD HRA Update
Receptor Data

Receptor Type	UTM X (m)	UTM Y (m)	Elevation (m)	Distance from Burro Canyon (km)
Fenceline Receptors	419751	3990755	1171	42.1
	419803	3986755	1059	39.4
	419855	3982755	1042	37
	419907	3978756	1090	34.9
	419959	3974756	1131	33.2
	419997	3971792	932	32.1
	420654	3970807	893	31.2
	420759	3990738	1206	41.3
	421228	3968427	809	30.1
	422377	3964595	755	28.4
	423525	3960763	733	27.2
	424184	4000277	1686	46.4
	424197	4001881	1699	47.7
	424231	4005881	1844	51
	424266	4009881	2043	54.5
	424673	3956932	695	26.5
	424676	4000277	1688	46.1
	424710	3996277	1578	42.8
	424744	3992277	1631	39.7
	424758	3990673	1359	38.5
	425265	4009876	2246	54
	425821	3953100	689	26.5
	426969	3949268	709	27
	428042	3945689	734	28
	429265	4009856	2319	52.2
	432042	3945659	722	24.9
	433265	4009836	2049	50.7
	436041	3945630	697	22.1
	437265	4009816	1949	49.4
	439206	3942323	693	23
	439288	3945606	680	20.1
	441265	4009797	1720	48.5
	443205	3942275	686	21.3
	445265	4009777	1483	47.9
	446101	3942241	749	20.5
	447168	3943226	749	19.3
	448235	3943883	701	18.5
	449265	4009757	1308	47.6
	450370	3944539	649	17.7
	452340	3944704	619	17.6
	453265	4009737	1516	47.6
	453899	3944786	612	17.7
	455295	3945114	596	17.7
	457019	3945196	600	18.2
	457019	4000195	2379	38.5
	457122	4004193	1831	42.5
	457225	4008192	1831	46.4
	457265	4009717	1754	47.9
	458907	3945771	602	18.4
	460138	3990508	1917	29.8
	460172	3994508	1441	33.7
	460206	3998508	1660	37.5
	460220	3946263	610	18.6
	460220	3952502	858	13.6
	460220	4000113	1472	39.1
	460302	3948890	581	16.5
	460713	3954964	922	12.4
	461287	3958330	926	11.3
	461780	3973434	1356	15.8
	461780	3977434	1642	18.8
	461780	3981434	1520	22.2
	461780	3985434	1536	25.7
	461780	3989434	1464	29.4
	461780	3990591	1586	30.5
	461811	3970949	1200	14.2
	461862	3961778	1154	11.2
	461862	3965778	1338	11.8
	461862	3966949	1360	12.2
Sensitive Receptors	437728	3945278	689	21.3
	438795	3944457	692	21.4
	441832	3946509	674	18
	466458	3958001	504	16.4
	466705	3958904	498	16.4
	432228	3988702	1109	32.3

NAWS China Lake OB/OD HRA Update
Modeling Source Parameters - OBODM

Parameter	OD	OB
Release Height – meter (m)	24.2	1
Emission Strength (lb)	15000	1000
Initial Dimensions – Side (m)	--	2
Initial Dimensions – Vertical (m)	--	1
Initial Diameter (m)	48.33	--
Fuel Heat Content (calories per gram)	925	500
Fuel Burn Rate (g/s)	2721555	283.7
Fuel Burn Time (seconds)	2.5	1600
Surrogate Pollutant/Species Name	Aluminum	Styrene
Surrogate Pollutant/Species Type	Particulate	Gaseous
Molecular Weight (grams per gram mole)	27	104.2
Ratio of mass of pollutant/species per mass of fuel or explosive (grams per gram)	0.0013	0.0023

NAWS China Lake OB/OD HRA Update
Modeling Source Parameters - ISCST3

Emission Category	Modeled Emission Rate (g/s)	Release Height[1] (m)	Lateral Dimension (m)	Vertical Dimension[2] (m)	Simulation Notes
OD Crater	1226	12.1	46.5	11.26	Emission rate file based on daily activity at 1300 local
OB Ash Handling	1	1	2	1.5	Hour of day factor based on daily activity from 1100-1600 local
Grading	138.6	2	35	2	Emission rate file with 3-hour activity period per day and once per week
Windblown Dust	0-1990.5	2	100	2	Emission rate file based on AP-42 windblown dust equation and hourly meteorological data

[1]The release height is defined for these (volume) sources as the vertical height from ground level of the center point of the volume of release.

[2]The vertical dimension is defined for these (volume) sources as a statistical representation of the plume based on the expected or observed initial vertical dispersion of the plume.

Appendix D

Modeled Downwind Concentrations

D-1 Modeling X/Q Results

D-2 ISCST3 and OBODM Model Output Files (Electronic Files on CD)

NAWS China Lake OBOD HRA Update

OBODM and ISCST3 X/Q Results at MEI Locations

Source	Model	1-hr Average X/Q ($\mu g/m^3/g/s$)	Annual Average X/Q ($\mu g/m^3/g/s$)
Open Burn	OBODM	1.94E-01	7.49E-03
Open Detonation	OBODM	1.84E-01	6.58E-03
Diesel and Wood Emissions	OBODM	1.94E-01	7.49E-03
OD Crater Emissions	ISCST3	4.19E+00	1.00E+00
OB Ash Handling Emissions	ISCST3	2.29E+01	8.00E-03
Tilling and Grading Emissions	ISCST3	5.04E+00	6.10E-03
Windblown Dust Emissions	ISCST3	3.83E-01	3.95E-06

ISC and OBODM dispersion modeling files cannot be converted into pdf files from the source program. Dispersion modeling input and output files are available for view at the document repositories.

Appendix E

Constants, Substance-specific Parameters, and Applicable Exposure Pathways

E-1 Soil Concentration and Exposure by Media Equation Constants

E-2 Substance-specific Parameters

E-3 Applicable Exposure Pathways

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Concentration in Soil

Dep-rate - Vertical rate of deposition on soil, (m/sec)	0.05
T_f - End of evaluation period, (days)	25550
T_f - End of evaluation period for nursing mother in mother's milk pathway, (days)	9490
T_o - Beginning of evaluation period for all receptors impacted by soil pathway, (days)	0
SD - Soil mixing depth for soil ingestion & dermal pathways, (m)	0.01
SD - Soil mixing depth for produce & meat pathways, (m)	0.15
BD - Soil bulk density, (kg/m^3)	1333

Exposure - Inhalation

DBR - Daily breathing rate, (L/kg body weight-day)	393
A - Inhalation absorption factor	1
EF - Exposure frequency, (days/year)	350
ED - Exposure duration, (years)	70
AT - Time period over which exposure is averaged, (days)	25550

Exposure - Dermal Absorption

SA - Surface area of exposed skin, (cm^2)	5500
SL - Soil loading on skin, (mg/cm^2-d)	1
BW - Body weight, (kg)	63
EF - Exposure frequency, (days/year)	350
AT - Time period over which exposure is averaged, (days)	25550
ED - Exposure duration, (years)	70

Exposure - Soil Ingestion

SIR - Soil ingestion rate, (mg/kg body weight-day)	1.7
EF - Exposure frequency, (days/year)	350
ED - Exposure duration, (years)	70
AT - Time period over which exposure is averaged, (days)	25550

Exposure - Mother's Milk

f_1 - Fraction that partitions to mother's fat	0.8
f_2 - Fraction of mother's weight that is fat, (kg fat/kg body weight)	0.33
f_3 - Fat fraction of mother's milk, (kg fat/kg milk)	0.04
BMI_{bw} - Breast milk ingestion rate, (g/kg body weight-day)	138
F - Frequency of exposure, (days/year)	365
yr - Breast-feeding period, (yr)	1

Source: OEHHA Risk Assessment Guidelines (August 2003) & USEPA Exposure Factors Handbook (August 1997)

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Constituent Name	CAS Number	Soil Half-life $t_{1/2}$ (days)	Soil Elimination Constant K_s	Integral Function All X	Integral Function Nursing Mother X	Gastrointestinal Relative Absorption Factor GRAF	Dermal Absorption Factor ABS	Half-life in Mother $t_{1/2}$ (days)
Acenaphthene	83329		0.00E+00	25,550	9,490	1		
Acenaphthylene	208968		0.00E+00	25,550	9,490	1		
Acetaldehyde	75070		0.00E+00	25,550	9,490	1		
Acetone	67641		0.00E+00	25,550	9,490	1		
Acetonitrile	75058		0.00E+00	25,550	9,490	1		
Acetophenone	98862		0.00E+00	25,550	9,490	1		
Acetylaminofluorene, 2-	53963		0.00E+00	25,550	9,490	1		
Acrolein	107028		0.00E+00	25,550	9,490	1		
Acrylonitrile	107131		0.00E+00	25,550	9,490	1		
Allyl chloride	107051		0.00E+00	25,550	9,490	1		
Aluminum	7429905		0.00E+00	25,550	9,490	1		
Aminobiphenyl, 4-	92671		0.00E+00	25,550	9,490	1		
Aminopyridine, 4-	504245		0.00E+00	25,550	9,490	1		
Ammonia	7664417		0.00E+00	25,550	9,490	1		
Aniline	62533		0.00E+00	25,550	9,490	1		
Anthracene	120127		0.00E+00	25,550	9,490	1		
Antimony and compounds	7440360		0.00E+00	25,550	9,490	1		
Arsenic	7440382	1.00E+08	6.93E-09	2.262	0.312	1	0.04	
Azobenzene	103333		0.00E+00	25,550	9,490	1		
Barium	7440393		0.00E+00	25,550	9,490	1		
Benzaldehyde	100527		0.00E+00	25,550	9,490	1		
Benzene	71432		0.00E+00	25,550	9,490	1		
Benzidine	92875		0.00E+00	25,550	9,490	1		
Benzo(A)Anthracene	56553	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Benzo(A)pyrene	50328	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Benzo(b)fluoranthene	205992	5.70E+02	1.22E-03	24,727	8,667	1		
Benzo(k)fluoranthene	207089	5.70E+02	1.22E-03	24,727	8,667	1		
Benzo[g,h,i]perylene	191242		0.00E+00	25,550	9,490	1		
Benzofuran, 2,3-	271896		0.00E+00	25,550	9,490	1		
Benzoic acid	65850		0.00E+00	25,550	9,490	1		
Benzyl alcohol	100516		0.00E+00	25,550	9,490	1		
Benzyl chloride	100447		0.00E+00	25,550	9,490	1		
Beryllium	7440417	1.00E+08	6.93E-09	2.262	0.312	1	0.01	
Biphenyl, 1,1-	92524		0.00E+00	25,550	9,490	1		
Bis(2-chloro-1-methylethyl)ether	108601		0.00E+00	25,550	9,490	1		
Bis(2-chloroethyl)ether	111444		0.00E+00	25,550	9,490	1		
Bis(2-chloroisopropyl)ether	39638329		0.00E+00	25,550	9,490	1		
Bis(2-ethylhexyl)phthalate (DEHP)	117817		0.00E+00	25,550	9,490	1		
Bis(chloromethyl)ether	542881		0.00E+00	25,550	9,490	1		
Bromodichloromethane	75274		0.00E+00	25,550	9,490	1		
Bromoform (tribromomethane)	75252		0.00E+00	25,550	9,490	1		
Bromomethane	74839		0.00E+00	25,550	9,490	1		
Butadiene-1,3	106990		0.00E+00	25,550	9,490	1		
Butanol, 1-	71363		0.00E+00	25,550	9,490	1		
Butyl benzyl phthalate	85687		0.00E+00	25,550	9,490	1		
Butylacrylate	141322		0.00E+00	25,550	9,490	1		

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Constituent Name	CAS Number	Soil Half-life $t_{1/2}$ (days)	Soil Elimination Constant K_s	Integral Function All X	Integral Function Nursing Mother X	Gastrointestinal Relative Absorption Factor GRAF	Dermal Absorption Factor ABS	Half-life in Mother $t_{1/2}$ (days)
Butylbenzene, n-	104518		0.00E+00	25,550	9,490	1		
Butylbenzene, T-	98066		0.00E+00	25,550	9,490	1		
Cadmium	7440439	1.00E+08	6.93E-09	2.262	0.312	1	0.001	
Carbazole	86748		0.00E+00	25,550	9,490	1		
Carbon Disulfide	75150		0.00E+00	25,550	9,490	1		
Carbon Monoxide	630080		0.00E+00	25,550	9,490	1		
Carbon tetrachloride	56235		0.00E+00	25,550	9,490	1		
Chlorine	7782505		0.00E+00	25,550	9,490	1		
Chloroacetophenone, 2-	532274		0.00E+00	25,550	9,490	1		
Chloroaniline, 4-	106478		0.00E+00	25,550	9,490	1		
Chlorobenzene	108907		0.00E+00	25,550	9,490	1		
Chloroethane (Ethyl chloride)	75003		0.00E+00	25,550	9,490	1		
Chloroform	67663		0.00E+00	25,550	9,490	1		
Chloromethane (Methyl chloride)	74873		0.00E+00	25,550	9,490	1		
Chloronaphthalene	91587		0.00E+00	25,550	9,490	1		
Chloronitrobenzene, o-	88733		0.00E+00	25,550	9,490	1		
Chlorophenol, 2-	95578		0.00E+00	25,550	9,490	1		
Chloropicrin (trichloronitromethane)	76062		0.00E+00	25,550	9,490	1		
Chlorotoluene, o-	95498		0.00E+00	25,550	9,490	1		
Chromium (hex.)	18540299	1.00E+08	6.93E-09	2.262	0.312	1	0.01	
Chromium III	16065831	1.00E+08	6.93E-09	2.262	0.312	1	0.01	
Chrysene	218019	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Cobalt	7440484		0.00E+00	25,550	9,490	1		
Copper	7440508		0.00E+00	25,550	9,490	1		
Cumene (Isopropylbenzene)	98828		0.00E+00	25,550	9,490	1		
Cyclohexane	110827		0.00E+00	25,550	9,490	1		
Cyclotetramethylene Tetranitramine (HMX)	2691410		0.00E+00	25,550	9,490	1		
Diaminotoluene, 2,4-	95807		0.00E+00	25,550	9,490	1		
Diazomethane	334883		0.00E+00	25,550	9,490	1		
Dibenz[a,h]anthracene	53703	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Dibenzofuran	132649		0.00E+00	25,550	9,490	1		
Dibromochloromethane	124481		0.00E+00	25,550	9,490	1		
Dibutyl phthalate	84742		0.00E+00	25,550	9,490	1		
Dichlorobenzene, 1,2-	95501		0.00E+00	25,550	9,490	1		
Dichlorobenzene, 1,3-	541731		0.00E+00	25,550	9,490	1		
Dichlorobenzene, 1,4-	106467		0.00E+00	25,550	9,490	1		
Dichlorobenzidine, 3,3-	91941		0.00E+00	25,550	9,490	1		
Dichlorodifluoromethane	75718		0.00E+00	25,550	9,490	1		
Dichloroethane, 1,1-	75343		0.00E+00	25,550	9,490	1		
Dichloroethane, 1,2-	107062		0.00E+00	25,550	9,490	1		
Dichloroethylene (cis), 1,2-	156592		0.00E+00	25,550	9,490	1		
Dichloroethylene (trans), 1,2-	156605		0.00E+00	25,550	9,490	1		
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354		0.00E+00	25,550	9,490	1		
Dichlorophenol, 2,4-	120832		0.00E+00	25,550	9,490	1		
Dichloropropane, 1,2-	78875		0.00E+00	25,550	9,490	1		
Dichloropropene, 1,3-	542756		0.00E+00	25,550	9,490	1		

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Constituent Name	CAS Number	Soil Half-life $t_{1/2}$ (days)	Soil Elimination Constant K_s	Integral Function All X	Integral Function Nursing Mother X	Gastrointestinal Relative Absorption Factor GRAF	Dermal Absorption Factor ABS	Half-life in Mother $t_{1/2}$ (days)
Diesel PM	9901		0.00E+00	25,550	9,490	1		
Diethyl ether (Ethyl ether)	60297		0.00E+00	25,550	9,490	1		
Diethyl phthalate	84662		0.00E+00	25,550	9,490	1		
Dimethyl Phthalate	131113		0.00E+00	25,550	9,490	1		
Dimethylamine	124403		0.00E+00	25,550	9,490	1		
Dimethylbenz(a)anthracene, 7,12-	57976		0.00E+00	25,550	9,490	1		
Dimethylbenzidine, 3,3'-	119937		0.00E+00	25,550	9,490	1		
Dimethylcarbamoyl chloride	79447		0.00E+00	25,550	9,490	1		
Dimethylhydrazine, 1,2-	540738		0.00E+00	25,550	9,490	1		
Dimethylphenol, 2,4-	105679		0.00E+00	25,550	9,490	1		
Dinitrobenzene, 1,2-	528290		0.00E+00	25,550	9,490	1		
Dinitrobenzene, 1,3-	99650		0.00E+00	25,550	9,490	1		
Dinitrobenzene, 1,4-	100254		0.00E+00	25,550	9,490	1		
Dinitro-o-cresol, 4,6-	534521		0.00E+00	25,550	9,490	1		
Dinitrophenol, 2,4-	51285		0.00E+00	25,550	9,490	1		
Dinitropyrene, 1,6-	42397648	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Dinitrotoluene, 2,4-	121142		0.00E+00	25,550	9,490	1		
Dinitrotoluene, 2,6-	606202		0.00E+00	25,550	9,490	1		
Dinitrotoluene, 4-Amino-2,6-	19406510		0.00E+00	25,550	9,490	1		
Dinitrotoluene, 2-Amino-4,6-	35572782		0.00E+00	25,550	9,490	1		
Di-n-octyl phthalate	117840		0.00E+00	25,550	9,490	1		
Dioxane, 1,4-	123911		0.00E+00	25,550	9,490	1		
Diphenylamine	122394		0.00E+00	25,550	9,490	1		
Ethoxyethanol, 2-	110805		0.00E+00	25,550	9,490	1		
Ethylbenzene	100414		0.00E+00	25,550	9,490	1		
Ethylene	74851		0.00E+00	25,550	9,490	1		
Ethyleneimine (Aziridine)	151564		0.00E+00	25,550	9,490	1		
Fluoranthene	206440		0.00E+00	25,550	9,490	1		
Fluorene	86737		0.00E+00	25,550	9,490	1		
Fluorotrichloromethane (Trichlorofluoromethane)	75694		0.00E+00	25,550	9,490	1		
Formaldehyde	50000		0.00E+00	25,550	9,490	1		
Furan (Epoxy-1,3-butadiene, 4-)	110009		0.00E+00	25,550	9,490	1		
Glutaraldehyde	111308		0.00E+00	25,550	9,490	1		
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorobenzene	118741		0.00E+00	25,550	9,490	1		
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683		0.00E+00	25,550	9,490	1		
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Hexachloroethane	67721		0.00E+00	25,550	9,490	1		

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Constituent Name	CAS Number	Soil Half-life $t_{1/2}$ (days)	Soil Elimination Constant K_s	Integral Function All X	Integral Function Nursing Mother X	Gastrointestinal Relative Absorption Factor GRAF	Dermal Absorption Factor ABS	Half-life in Mother $t_{1/2}$ (days)
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824		0.00E+00	25,550	9,490	1		
Hexane, n-	110543		0.00E+00	25,550	9,490	1		
Hexanone, 2-	591786		0.00E+00	25,550	9,490			
Hydrogen chloride	7647010		0.00E+00	25,550	9,490	1	0.01	
Hydrogen Cyanide	74908		0.00E+00	25,550	9,490	1		
Indeno[1,2,3-cd]pyrene	193395	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Iron	7439896		0.00E+00	25,550	9,490	1		
Isophorone	78591		0.00E+00	25,550	9,490	1		
Isoprene	9003310		0.00E+00	25,550	9,490	1		
Lead	7439921	1.00E+08	6.93E-09	2.262	0.312	1	0.01	
Malononitrile	109773		0.00E+00	25,550	9,490	1		
Manganese	7439965		0.00E+00	25,550	9,490	1		
Mercury	7439976	1.00E+08	6.93E-09	2.262	0.312	1	0.1	
Methacrylonitrile	126987		0.00E+00	25,550	9,490	1		
Methanol	67561		0.00E+00	25,550	9,490	1		
Methylcholanthrene, 3-	56495	5.70E+02	1.22E-03	24,727	8,667	1		
Methylcyclohexane	108872		0.00E+00	25,550	9,490	1		
Methylene chloride	75092		0.00E+00	25,550	9,490	1		
Methylethyl ketone	78933		0.00E+00	25,550	9,490	1		
Methylnaphthalene, 2-	91576		0.00E+00	25,550	9,490	1		
Methylphenol, 2-	95487		0.00E+00	25,550	9,490	1		
Methylphenol, 3-	108394		0.00E+00	25,550	9,490	1		
Methylphenol, 4-	106445		0.00E+00	25,550	9,490	1		
Methyltertbutyl ether (MTBE)	1634044		0.00E+00	25,550	9,490	1		
Molybdenum	7439987		0.00E+00	25,550	9,490	1		
Naphthalene	91203	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Nickel and compounds	7440020	1.00E+08	6.93E-09	2.262	0.312	1	0.04	
Nitric Oxide	10102439		0.00E+00	25,550	9,490	1		
Nitroacenaphthene, 5-	602879	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Nitroaniline, 2-	88744		0.00E+00	25,550	9,490	1		
Nitrobenzene	98953		0.00E+00	25,550	9,490	1		
Nitrochrysene, 6-	7496028	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Nitrogen Dioxide	10102440		0.00E+00	25,550	9,490	1		
Nitroglycerin	55630		0.00E+00	25,550	9,490	1		
Nitroguanidine	556887		0.00E+00	25,550	9,490	1		
Nitrophenol, 4-	100027		0.00E+00	25,550	9,490	1		
Nitropropane, 2-	79469		0.00E+00	25,550	9,490	1		
Nitropyrene, 1-	5522430	5.70E+02	1.22E-03	24,727	8,667	1	0.13	
Nitrosodiethylamine, N-	55185		0.00E+00	25,550	9,490	1		
Nitrosodimethylamine, N-	62759		0.00E+00	25,550	9,490	1		
Nitrosodi-n-butylamine, N-	924163		0.00E+00	25,550	9,490	1		
Nitrosodi-n-propylamine, N-	621647		0.00E+00	25,550	9,490	1		
Nitrosodiphenylamine, N-	86306		0.00E+00	25,550	9,490	1		
Nitroso-N-methylethylamine, N- (Nitrosomethylethylamine, N-)	10595956		0.00E+00	25,550	9,490	1		
Nitrosopiperidine, N-	100754		0.00E+00	25,550	9,490	1		

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Constituent Name	CAS Number	Soil Half-life $t_{1/2}$ (days)	Soil Elimination Constant K_s	Integral Function All X	Integral Function Nursing Mother X	Gastrointestinal Relative Absorption Factor GRAF	Dermal Absorption Factor ABS	Half-life in Mother $t_{1/2}$ (days)
Nitrosopyrrolidine, N-	930552		0.00E+00	25,550	9,490	1		
Nitrotoluene, m-	99081		0.00E+00	25,550	9,490	1		
Nitrotoluene, o-	88722		0.00E+00	25,550	9,490	1		
Nitrotoluene, p-	99990		0.00E+00	25,550	9,490	1		
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Pentachlorobenzene	608935		0.00E+00	25,550	9,490	1		
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Pentachloronitrobenzene	82688		0.00E+00	25,550	9,490	1		
Pentachlorophenol	87865		0.00E+00	25,550	9,490	1		
Perchlorate	7601903		0.00E+00	25,550	9,490	1		
Phenanthrene	85018		0.00E+00	25,550	9,490	1		
Phenol	108952		0.00E+00	25,550	9,490	1		
Phosgene	75445		0.00E+00	25,550	9,490	1		
Phosphorus (white)	7723140		0.00E+00	25,550	9,490	1		
Propanol, 2-	67630		0.00E+00	25,550	9,490	1		
Propylbenzene, n-	103651		0.00E+00	25,550	9,490	1		
Propylene (Propene)	115071		0.00E+00	25,550	9,490	1		
Pyrene	129000		0.00E+00	25,550	9,490	1		
Pyridine	110861		0.00E+00	25,550	9,490	1		
Selenium	7782492		0.00E+00	25,550	9,490	1		
Silica, Crystalline	1175		0.00E+00	25,550	9,490	1		
Strontium	7440246		0.00E+00	25,550	9,490	1		
Styrene	100425		0.00E+00	25,550	9,490	1		
Sulfur Dioxide	7446095		0.00E+00	25,550	9,490	1		
Sulfuric acid	7664939		0.00E+00	25,550	9,490	1		
Tetrachlorobenzene, 1,2,4,5-	95943		0.00E+00	25,550	9,490	1		
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Tetrachloroethane, 1,1,2,2-	79345		0.00E+00	25,550	9,490	1		
Tetrachloroethylene (PCE)	127184		0.00E+00	25,550	9,490	1		
Tetrachlorophenol, 2,3,4,6-	58902		0.00E+00	25,550	9,490	1		
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitramine)	479458		0.00E+00	25,550	9,490	1		
Thallium and compounds	7446186		0.00E+00	25,550	9,490	1		

NAWS China Lake OBOD HRA Update

Concentration and Exposure by Media Equation Constants

Constituent Name	CAS Number	Soil Half-life $t_{1/2}$ (days)	Soil Elimination Constant K_s	Integral Function All X	Integral Function Nursing Mother X	Gastrointestinal Relative Absorption Factor GRAF	Dermal Absorption Factor ABS	Half-life in Mother $t_{1/2}$ (days)
Toluene	108883		0.00E+00	25,550	9,490	1		
Toluidine, o- (Methylaniline, 2-)	95534		0.00E+00	25,550	9,490	1		
Total HpCDD	35822469	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total HpCDF	67562394	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total HxCDD	19408743	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total HxCDF	57117449	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total PeCDD	40321764	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total PeCDF	57117314	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total TCDD	1746016	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Total TCDF	51207319	4.72E+03	1.47E-04	18,899	4,370	0.43	0.02	2117
Trichlorobenzene, 1,2,4-	120821		0.00E+00	25,550	9,490	1		
Trichloroethane, 1,1,1- (Methyl chloroform)	71556		0.00E+00	25,550	9,490	1		
Trichloroethane, 1,1,2-	79005		0.00E+00	25,550	9,490	1		
Trichloroethylene (TCE)	79016		0.00E+00	25,550	9,490	1		
Trichlorophenol, 2,4,5-	95954		0.00E+00	25,550	9,490	1		
Trichlorophenol,2,4,6-	88062		0.00E+00	25,550	9,490	1		
Trimethylbenzene, 1,2,4-	95636		0.00E+00	25,550	9,490	1		
Trimethylbenzene, 1,3,5-	108678		0.00E+00	25,550	9,490	1		
Trimethylpentane, 2,2,4-	540841		0.00E+00	25,550	9,490	1		
Trinitrobenzene, 1,3,5-	99354		0.00E+00	25,550	9,490	1		
Trinitrotoluene, 2,4,6- (TNT)	118967		0.00E+00	25,550	9,490	1		
Urethane (Ethyl carbamate)	51796		0.00E+00	25,550	9,490	1		
Vanadium & Compounds	7440622		0.00E+00	25,550	9,490	1		
Vinyl acetate	108054		0.00E+00	25,550	9,490	1		
Vinyl Chloride	75014		0.00E+00	25,550	9,490	1		
Xylenes	1330207		0.00E+00	25,550	9,490	1		
Zinc	7440666		0.00E+00	25,550	9,490	1		

Source: Soil Half-life, GRAF, ABS and Half-life in mother data promulgate from the OEHHA Risk Assessment Guidelines (August 2003)

NOTES:

1. $K_s = 0.693/t_{1/2}$
2. $X = [\{e^{-Ks*Tf} - e^{-Ks*To}\}/K_s] + T_t$

NAWS China Lake OBOD HRA Update

Applicable Pathways

Constituent Name	CAS Number	Pathway Inhalation	Pathway Dermal Absorption	Pathway Soil Ingestion	Pathway Mother's Milk Ingestion
Acenaphthene	83329	1	1	1	
Acenaphthylene	208968	1	1	1	
Acetaldehyde	75070	1			
Acetone	67641	1	1	1	
Acetonitrile	75058	1	1	1	
Acetophenone	98862	1	1	1	
Acetylaminofluorene, 2-	53963	1	1	1	
Acrolein	107028	1	1	1	
Acrylonitrile	107131	1	1	1	
Allyl chloride	107051	1	1	1	
Aluminum	7429905	1	1	1	
Aminobiphenyl, 4-	92671	1	1	1	
Aminopyridine, 4-	504245	1	1	1	
Ammonia	7664417	1			
Aniline	62533	1	1	1	
Anthracene	120127	1	1	1	
Antimony and compounds	7440360	1	1	1	
Arsenic	7440382	1	1	1	
Azobenzene	103333	1	1	1	
Barium	7440393	1	1	1	
Benzaldehyde	100527	1	1	1	
Benzene	71432	1	1	1	
Benzidine	92875	1	1	1	
Benzo(A)Anthracene	56553	1	1	1	
Benzo(A)pyrene	50328	1	1	1	
Benzo(b)fluoranthene	205992	1	1	1	
Benzo(k)fluoranthene	207089	1	1	1	
Benzo[g,h,i]perylene	191242	1	1	1	
Benzofuran, 2,3-	271896	1	1	1	
Benzoic acid	65850	1	1	1	
Benzyl alcohol	100516	1	1	1	
Benzyl chloride	100447	1	1	1	
Beryllium	7440417	1	1	1	
Biphenyl, 1,1-	92524	1	1	1	
Bis(2-chloro-1-methylethyl)ether	108601	1	1	1	
Bis(2-chloroethyl)ether	111444	1	1	1	
Bis(2-chloroisopropyl)ether	39638329	1	1	1	
Bis(2-ethylhexyl)phthalate (DEHP)	117817	1	1	1	
Bis(chloromethyl)ether	542881	1	1	1	
Bromodichloromethane	75274	1	1	1	
Bromoform (tribromomethane)	75252	1	1	1	
Bromomethane	74839	1	1	1	
Butadiene-1,3	106990	1	1	1	
Butanol, 1-	71363	1	1	1	
Butyl benzyl phthalate	85687	1	1	1	
Butylacrylate	141322	1	1	1	
Butylbenzene, n-	104518	1	1	1	
Butylbenzene, T-	98066	1	1	1	
Cadmium	7440439	1	1	1	
Carbazole	86748	1	1	1	
Carbon Disulfide	75150	1	1	1	
Carbon Monoxide	630080	1			
Carbon tetrachloride	56235	1	1	1	
Chlorine	7782505	1	1	1	
Chloroacetophenone, 2-	532274	1	1	1	
Chloroaniline, 4-	106478	1	1	1	
Chlorobenzene	108907	1	1	1	
Chloroethane (Ethyl chloride)	75003	1	1	1	
Chloroform	67663	1	1	1	
Chloromethane (Methyl chloride)	74873	1	1	1	
Chloronaphthalene	91587	1	1	1	
Chloronitrobenzene, o-	88733	1	1	1	
Chlorophenol, 2-	95578	1	1	1	
Chloropicrin (trichloronitromethane)	76062	1			
Chlorotoluene, o-	95498	1	1	1	
Chromium (hex.)	18540299	1	1	1	
Chromium III	16065831	1	1	1	
Chrysene	218019	1	1	1	
Cobalt	7440484	1	1	1	
Copper	7440508	1	1	1	
Cumene (Isopropylbenzene)	98828	1	1	1	
Cyclohexane	110827	1	1	1	
Cyclotetramethylene Tetranitamine (HMX)	2691410	1	1	1	
Diaminotoluene, 2,4-	95807	1	1	1	
Diazomethane	334883	1	1	1	
Dibenz[a,h]anthracene	53703	1	1	1	
Dibenzofuran	132649	1	1	1	
Dibromochloromethane	124481	1	1	1	
Dibutyl phthalate	84742	1	1	1	
Dichlorobenzene, 1,2-	95501	1	1	1	

NAWS China Lake OBOD HRA Update
Applicable Pathways

Constituent Name	CAS Number	Pathway Inhalation	Pathway Dermal Absorption	Pathway Soil Ingestion	Pathway Mother's Milk Ingestion
Dichlorobenzene, 1,3-	541731	1	1	1	
Dichlorobenzene, 1,4-	106467	1	1	1	
Dichlorobenzidine, 3,3-	91941	1	1	1	
Dichlorodifluoromethane	75718	1	1	1	
Dichloroethane, 1,1-	75343	1	1	1	
Dichloroethane, 1,2-	107062	1	1	1	
Dichloroethylene (cis), 1,2-	156592	1	1	1	
Dichloroethylene (trans), 1,2-	156605	1	1	1	
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354	1	1	1	
Dichlorophenol, 2,4-	120832	1	1	1	
Dichloropropane, 1,2-	78875	1	1	1	
Dichloropropene, 1,3-	542756	1	1	1	
Diesel PM	9901	1			
Diethyl ether (Ethyl ether)	60297	1	1	1	
Diethyl phthalate	84662	1	1	1	
Dimethyl Phthalate	131113	1	1	1	
Dimethylamine	124403	1	1	1	
Dimethylbenz(a)anthracene, 7,12-	57976	1	1	1	
Dimethylbenzidine, 3,3'-	119937	1	1	1	
Dimethylcarbamoyl chloride	79447	1	1	1	
Dimethylhydrazine, 1,2-	540738	1	1	1	
Dimethylphenol, 2,4-	105679	1	1	1	
Dinitrobenzene, 1,2-	528290	1	1	1	
Dinitrobenzene, 1,3-	99650	1	1	1	
Dinitrobenzene, 1,4-	100254	1	1	1	
Dinitro-o-cresol, 4,6-	534521	1	1	1	
Dinitrophenol, 2,4-	51285	1	1	1	
Dinitropyrene, 1,6-	42397648	1	1	1	
Dinitrotoluene, 2,4-	121142	1	1	1	
Dinitrotoluene, 2,6-	606202	1	1	1	
Dinitrotoluene, 4-Amino-2,6-	19406510	1	1	1	
Dinitrotoluene, 2-Amino-4,6-	35572782	1	1	1	
Di-n-octyl phthalate	117840	1	1	1	
Dioxane, 1,4-	123911	1	1	1	
Diphenylamine	122394	1	1	1	
Ethoxyethanol, 2-	110805	1	1	1	
Ethylbenzene	100414	1	1	1	
Ethylene	74851	1			
Ethyleneimine (Aziridine)	151564	1	1	1	
Fluoranthene	206440	1	1	1	
Fluorene	86737	1	1	1	
Fluorotrichloromethane	75694	1	1	1	
Formaldehyde	50000	1	1	1	
Furan (Epoxy-1,3-butadiene, 4-)	110009	1	1	1	
Glutaraldehyde	111308	1			
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	1	1	1	1
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	1	1	1	1
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	1	1	1	1
Hexachlorobenzene	118741	1	1	1	
Hexachlorobutadiene (Hexachloro-1,3-	87683	1	1	1	
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1	1	1	1
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	1	1	1	1
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	1	1	1	1
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	1	1	1	1
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	1	1	1	1
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	1	1	1	1
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	1	1	1	1
Hexachloroethane	67721	1	1	1	
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	1	1	1	
Hexane, n-	110543	1	1	1	
Hexanone, 2-	591786	1	1	1	
Hydrogen chloride	7647010	1			
Hydrogen Cyanide	74908	1	1	1	
Indeno[1,2,3-cd]pyrene	193395	1	1	1	
Iron	7439896	1			
Isophorone	78591	1	1	1	
Isoprene	9003310	1			
Lead	7439921	1	1	1	
Malononitrile	109773	1	1	1	
Manganese	7439965	1	1	1	
Mercury	7439976	1	1	1	
Methacrylonitrile	126987	1	1	1	
Methanol	67561	1	1	1	
Methylcholanthrene, 3-	56495	1	1	1	
Methylcyclohexane	108872	1	1	1	
Methylene chloride	75092	1	1	1	
Methylethyl ketone	78933	1	1	1	
Methylnaphthalene, 2-	91576	1	1	1	
Methylphenol, 2-	95487	1	1	1	

NAWS China Lake OBOD HRA Update
Applicable Pathways

Constituent Name	CAS Number	Pathway Inhalation	Pathway Dermal Absorption	Pathway Soil Ingestion	Pathway Mother's Milk Ingestion
Methylphenol, 3-	108394	1	1	1	
Methylphenol, 4-	106445	1	1	1	
Methyltertbutyl ether (MTBE)	1634044	1	1	1	
Molybdenum	7439987	1			
Naphthalene	91203	1	1	1	
Nickel and compounds	7440020	1	1	1	
Nitric Oxide	10102439	1	1	1	
Nitroacenaphthene, 5-	602879	1	1	1	
Nitroaniline, 2-	88744	1	1	1	
Nitrobenzene	98953	1	1	1	
Nitrochrysene, 6-	7496028	1	1	1	
Nitrogen Dioxide	10102440	1	1	1	
Nitroglycerin	55630	1	1	1	
Nitroguanidine	556887	1	1	1	
Nitrophenol, 4-	100027	1	1	1	
Nitropropane, 2-	79469	1	1	1	
Nitropyrene, 1-	5522430	1	1	1	
Nitrosodiethylamine, N-	55185	1	1	1	
Nitrosodimethylamine, N-	62759	1	1	1	
Nitrosodi-n-butylamine, N-	924163	1	1	1	
Nitrosodi-n-propylamine, N-	621647	1	1	1	
Nitrosodiphenylamine, N-	86306	1	1	1	
Nitroso-N-methylethylamine, N-	10595956	1	1	1	
Nitrosopiperidine, N-	100754	1	1	1	
Nitrosopyrrolidine, N-	930552	1	1	1	
Nitrotoluene, m-	99081	1	1	1	
Nitrotoluene, o-	88722	1	1	1	
Nitrotoluene, p-	99990	1	1	1	
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	1	1	1	1
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	1	1	1	1
Pentachlorobenzene	608935	1	1	1	
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	1	1	1	1
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	1	1	1	1
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	1	1	1	1
Pentachloronitrobenzene	82688	1	1	1	
Pentachlorophenol	87865	1	1	1	
Perchlorate	7601903	1	1	1	
Phenanthrene	85018	1	1	1	
Phenol	108952	1	1	1	
Phosgene	75445	1			
Phosphorus (white)	7723140	1	1	1	
Propanol, 2-	67630	1			
Propylbenzene, n-	103651	1	1	1	
Propylene (Propene)	115071	1			
Pyrene	129000	1	1	1	
Pyridine	110861	1	1	1	
Selenium	7782492	1	1	1	
Silica, Crystalline	1175	1			
Strontium	7440246	1	1	1	
Styrene	100425	1	1	1	
Sulfur Dioxide	7446095	1			
Sulfuric acid	7664939	1			
Tetrachlorobenzene, 1,2,4,5-	95943	1	1	1	
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	1	1	1	1
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	1	1	1	1
Tetrachloroethane, 1,1,2,2-	79345	1	1	1	
Tetrachloroethylene (PCE)	127184	1	1	1	
Tetrachlorophenol, 2,3,4,6-	58902	1	1	1	
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl,	479458	1	1	1	
Thallium and compounds	7446186	1	1	1	
Toluene	108883	1	1	1	
Toluidine, o- (Methylaniline, 2-)	95534	1	1	1	
Total HpCDD	35822469	1	1	1	1
Total HpCDF	67562394	1	1	1	1
Total HxCDD	19408743	1	1	1	1
Total HxCDF	57117449	1	1	1	1
Total PeCDD	40321764	1	1	1	1
Total PeCDF	57117314	1	1	1	1
Total TCDD	1746016	1	1	1	1
Total TCDF	51207319	1	1	1	1
Trichlorobenzene, 1,2,4-	120821	1	1	1	
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	1	1	1	
Trichloroethane, 1,1,2-	79005	1	1	1	
Trichloroethylene (TCE)	79016	1	1	1	
Trichlorophenol, 2,4,5-	95954	1	1	1	
Trichlorophenol,2,4,6-	88062	1	1	1	
Trimethylbenzene, 1,2,4-	95636	1	1	1	
Trimethylbenzene, 1,3,5-	108678	1	1	1	
Trimethylpentane, 2,2,4-	540841	1	1	1	

NAWS China Lake OBOD HRA Update

Applicable Pathways

Constituent Name	CAS Number	Pathway Inhalation	Pathway Dermal Absorption	Pathway Soil Ingestion	Pathway Mother's Milk Ingestion
Trinitrobenzene, 1,3,5-	99354	1	1	1	
Trinitrotoluene, 2,4,6- (TNT)	118967	1	1	1	
Urethane (Ethyl carbamate)	51796	1	1	1	
Vanadium & Compounds	7440622	1	1	1	
Vinyl acetate	108054	1	1	1	
Vinyl Chloride	75014	1	1	1	
Xylenes	1330207	1	1	1	
Zinc	7440666	1	1	1	

Source: OEHHA Risk Assessment Guidelines (August 2003)

Appendix F

Toxicity Factors

F-1 Cancer Toxicity Factors
F-2 Chronic Noncancer Toxicity Factors
F-3 Acute Noncancer Toxicity Factors
F-4 Toxicity Factor References

NAWS China Lake OBOD HRA Update
Cancer Toxicity Factors

Constituent Name	CAS Number	Cancer Inhalation Unit Risk ($\mu g/m^3)^{-1}$	Cancer Inhalation Potency Factor (mg/kg-d)$^{-1}$	Cancer Oral Potency Factor (mg/kg-d)$^{-1}$
Acenaphthene	83329	-	-	-
Acenaphthylene	208968	3.40E-05	1.20E-01	-
Acetaldehyde	75070	2.70E-06	1.00E-02	-
Acetone	67641	-	-	-
Acetonitrile	75058	-	-	-
Acetophenone	98862	-	-	-
Acetylaminofluorene, 2-	53963	1.10E-05	3.90E-02	1.20E-01
Acrolein	107028	-	-	-
Acrylonitrile	107131	2.90E-04	1.00E+00	1.00E+00
Allyl chloride	107051	6.00E-06	2.10E-02	2.10E-02
Aluminum	7429905	-	-	-
Aminobiphenyl, 4-	92671	6.00E-03	2.10E+01	2.10E+01
Aminopyridine, 4-	504245	-	-	-
Ammonia	7664417	-	-	-
Aniline	62533	1.60E-06	5.70E-03	5.70E-03
Anthracene	120127	-	-	-
Antimony	7440360	-	-	-
Antimony and compounds	7440360	-	-	-
Arsenic	7440382	3.30E-03	1.20E+01	9.45E+00
Azobenzene	103333	3.10E-05	1.10E-01	1.10E-01
Barium	7440393	-	-	-
Benzaldehyde	100527	-	-	-
Benzene	71432	2.90E-05	1.00E-01	1.00E-01
Benzidine	92875	1.40E-01	5.00E+02	5.00E+02
Benzo(A)Anthracene	56553	1.10E-04	3.90E-01	1.20E+00
Benzo(A)pyrene	50328	1.10E-03	3.90E+00	1.20E+01
Benzo(b)fluoranthene	205992	1.10E-04	3.90E-01	1.20E+00
Benzo(k)fluoranthene	207089	1.10E-04	3.90E-01	1.20E+00
Benzo[g,h,i]perylene	191242	1.10E-05	3.90E-02	1.20E-01
Benzofuran, 2,3-	271896	-	-	-
Benzoic acid	65850	-	-	-
Benzyl alcohol	100516	-	-	-
Benzyl chloride	100447	4.90E-05	1.70E-01	1.70E-01
Beryllium	7440417	2.40E-03	8.40E+00	4.30E+00
Biphenyl, 1,1-	92524	-	-	-
Bis(2-chloro-1-methylethyl)ether	108601	1.00E-05	3.50E-02	7.00E-02
Bis(2-chloroethyl)ether	111444	7.10E-04	2.50E+00	2.50E+00
Bis(2-chloroisopropyl)ether	39638329	1.00E-05	3.50E-02	7.00E-02
Bis(2-ethylhexyl)phthalate (DEHP)	117817	2.40E-06	8.40E-03	8.40E-03
Bis(chloromethyl)ether	542881	1.30E-02	4.60E+01	4.60E+01
Bromodichloromethane	75274	3.70E-05	1.30E-01	1.30E-01
Bromoform (tribromomethane)	75252	1.10E-06	3.85E-03	7.90E-03
Bromomethane	74839	-	-	-
Butadiene-1,3	106990	1.70E-04	6.00E-01	3.40E+00
Butanol, 1-	71363	-	-	-
Butyl benzyl phthalate	85687	-	-	-
Butylacrylate	141322	1.37E-05	4.80E-02	4.80E-02
Butylbenzene, n-	104518	-	-	-
Butylbenzene, T-	98066	-	-	-
Cadmium	7440439	4.20E-03	1.50E+01	3.80E-01
Carbazole	86748	5.71E-06	2.00E-02	2.00E-02
Carbon Disulfide	75150	-	-	-
Carbon Monoxide	630080	-	-	-
Carbon Monoxide	56235	4.20E-05	1.50E-01	1.50E-01
Chlorine	7782505	-	-	-
Chloroacetophenone, 2-	532274	-	-	-
Chloroaniline, 4-	106478	-	-	-
Chlorobenzene	108907	-	-	-
Chloroethane (Ethyl chloride)	75003	8.29E-07	2.90E-03	2.90E-03
Chloroform	67663	5.30E-06	1.90E-02	3.10E-02
Chloromethane (Methyl chloride)	74873	1.80E-06	6.30E-03	1.30E-02
Chloronaphthalene	91587	-	-	-
Chloronitrobenzene, o-	88733	2.77E-06	9.70E-03	9.70E-03
Chlorophenol, 2-	95578	-	-	-
Chloropicrin (trichloronitromethane)	76062	-	-	-
Chlorotoluene, o-	95498	-	-	-
Chromium (hex.)	18540299	1.50E-01	5.10E+02	-
Chromium III	16065831	-	-	-
Chrysene	218019	1.10E-05	3.90E-02	1.20E-01
Cobalt	7440484	2.80E-03	9.80E+00	-

NAWS China Lake OBOD HRA Update
Cancer Toxicity Factors

Constituent Name	CAS Number	Cancer Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Cancer Inhalation Potency Factor $(mg/kg\text{-}d)^{-1}$	Cancer Oral Potency Factor $(mg/kg\text{-}d)^{-1}$
Copper	7440508	-	-	-
Cumene (Isopropylbenzene)	98828	-	-	-
Cyclohexane	110827	-	-	-
Cyclotetramethylene Tetranitramine (HMX)	2691410	-	-	-
Diaminotoluene, 2,4-	95807	1.10E-03	4.00E+00	3.80E+00
Diazomethane	334883	-	-	-
Dibenz[a,h]anthracene	53703	1.20E-03	4.10E+00	4.10E+00
Dibenzofuran	132649	-	-	-
Dibromochloromethane	124481	2.70E-05	9.40E-02	9.40E-02
Dibutyl phthalate	84742	-	-	-
Dichlorobenzene, 1,2-	95501	-	-	-
Dichlorobenzene, 1,3-	541731	-	-	-
Dichlorobenzene, 1,4-	106467	1.10E-05	4.00E-02	5.40E-03
Dichlorobenzidine, 3,3-	91941	3.40E-04	1.20E+00	1.20E+00
Dichlorodifluoromethane	75718	-	-	-
Dichloroethane, 1,1-	75343	1.60E-06	5.70E-03	5.70E-03
Dichloroethane, 1,2-	107062	2.20E-05	7.20E-02	4.70E-02
Dichloroethylene (cis), 1,2-	156592	-	-	-
Dichloroethylene (trans), 1,2-	156605	-	-	-
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354	5.00E-05	1.75E-01	6.00E-01
Dichlorophenol, 2,4-	120832	-	-	-
Dichloropropane, 1,2-	78875	1.00E-05	3.60E-02	3.60E-02
Dichloropropene, 1,3-	542756	1.60E-05	5.50E-02	9.10E-02
Diesel PM	9901	3.00E-04	1.10E+00	-
Diethyl ether (Ethyl ether)	60297	-	-	-
Diethyl phthalate	84662	-	-	-
Dimethyl Phthalate	131113	-	-	-
Dimethylamine	124403	-	-	-
Dimethylbenz(a)anthracene, 7,12-	57976	7.10E-02	2.50E+02	2.50E+02
Dimethylbenzidine, 3,3'-	119937	2.63E-03	9.20E+00	2.30E+00
Dimethylcarbamoyl chloride	79447	3.70E-03	1.30E+01	1.30E+01
Dimethylhydrazine, 1,2-	540738	1.60E-01	5.50E+02	5.50E+02
Dimethylphenol, 2,4-	105679	-	-	-
Dinitrobenzene, 1,2-	528290	-	-	-
Dinitrobenzene, 1,3-	99650	-	-	-
Dinitrobenzene, 1,4-	100254	-	-	-
Dinitro-o-cresol, 4,6-	534521	-	-	-
Dinitrophenol, 2,4-	51285	-	-	-
Dinitropyrene, 1,6-	42397648	1.10E-02	3.90E+01	1.20E+02
Dinitrotoluene, 2,4-	121142	8.90E-05	3.10E-01	3.10E-01
Dinitrotoluene, 2,6-	606202	-	-	6.80E-01
Dinitrotoluene, 4-Amino-2,6-	19406510	-	-	-
Dinitrotoluene, 4-Amino-4,6-	35572782	-	-	-
Di-n-octyl phthalate	117840	-	-	-
Dioxane, 1,4-	123911	7.70E-06	2.70E-02	2.70E-02
Diphenylamine	122394	-	-	-
Ethoxyethanol, 2-	110805	-	-	-
Ethylbenzene	100414	1.10E-06	3.85E-03	3.85E-03
Ethylene	74851	-	-	-
Ethyleneimine (Aziridine)	151564	1.90E-02	6.50E+01	6.50E+01
Fluoranthene	206440	-	-	-
Fluorene	86737	-	-	-
Fluorotrichloromethane (Trichlorofluorometha	75694	-	-	-
Formaldehyde	50000	6.00E-06	2.10E-02	-
Furan (Epoxy-1,3-butadiene, 4-)	110009	-	-	-
Glutaraldehyde	111308	-	-	-
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	3.80E-01	1.30E+03	1.30E+01
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	3.80E-01	1.30E+03	1.30E+01
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	3.80E-01	1.30E+03	1.30E+01
Hexachlorobenzene	118741	5.10E-04	1.80E+00	1.80E+00
Hexachlorobutadiene (Hexachloro-1,3-butadi	87683	2.20E-05	7.70E-02	7.80E-02
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	3.80E+00	1.30E+04	1.30E+01
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	3.80E+00	1.30E+04	1.30E+04
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	3.80E+00	1.30E+04	1.30E+01
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	3.80E+00	1.30E+04	1.30E+04
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	3.80E+00	1.30E+04	1.30E+01
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	3.80E+00	1.30E+04	1.30E+01
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	3.80E+00	1.30E+04	1.30E+04
Hexachloroethane	67721	1.10E-05	3.90E-02	3.90E-02
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	3.14E-05	1.10E-01	1.10E-01

NAWS China Lake OBOD HRA Update
Cancer Toxicity Factors

Constituent Name	CAS Number	Cancer Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Cancer Inhalation Potency Factor $(mg/kg\text{-}d)^{-1}$	Cancer Oral Potency Factor $(mg/kg\text{-}d)^{-1}$
Hexane, n-	110543	-	-	-
Hexanone, 2-	591786	-	-	-
Hydrogen chloride	7647010	-	-	-
Hydrogen Cyanide	74908	-	-	-
Indeno[1,2,3-cd]pyrene	193395	1.10E-04	3.90E-01	1.20E+00
Iron	7439896	-	-	-
Isophorone	78591	2.71E-07	9.50E-04	9.50E-04
Isoprene	9003310	-	-	-
Lead	7439921	1.20E-05	4.20E-02	8.50E-03
Malononitrile	109773	-	-	-
Manganese	7439965	-	-	-
Mercury	7439976	-	-	-
Methacrylonitrile	126987	-	-	-
Methanol	67561	-	-	-
Methylcholanthrene, 3-	56495	6.30E-03	2.20E+01	2.20E+01
Methylcyclohexane	108872	-	-	-
Methylene chloride	75092	1.00E-06	3.50E-03	1.40E-02
Methylethyl ketone	78933	-	-	-
Methylnaphthalene, 2-	91576	3.40E-05	1.20E-01	-
Methylphenol, 2-	95487	-	-	-
Methylphenol, 3-	108394	-	-	-
Methylphenol, 4-	106445	-	-	-
Methyltertbutyl ether (MTBE)	1634044	2.60E-07	9.10E-04	1.80E-03
Molybdenum	7439987	-	-	-
Naphthalene	91203	3.40E-05	1.20E-01	-
Nickel and compounds	7440020	2.60E-04	9.10E-01	-
Nitric Oxide	10102439	-	-	-
Nitroacenaphthene, 5-	602879	3.70E-05	1.30E-01	1.30E-01
Nitroaniline, 2-	88744	-	-	-
Nitrobenzene	98953	-	-	-
Nitrochrysene, 6-	7496028	1.10E-02	3.90E+01	1.20E+02
Nitrogen Dioxide	10102440	-	-	-
Nitroglycerin	55630	4.00E-06	1.40E-02	1.40E-02
Nitroguanidine	556887	-	-	-
Nitrophenol, 4-	100027	-	-	-
Nitropropane, 2-	79469	2.70E-03	9.45E+00	9.50E+00
Nitropyrene, 1-	5522430	1.10E-04	3.90E-01	1.20E+00
Nitrosodiethylamine, N-	55185	1.00E-02	3.60E+01	3.60E+01
Nitrosodimethylamine, N-	62759	4.60E-03	1.60E+01	1.60E+01
Nitrosodi-n-butylamine, N-	924163	3.10E-03	1.10E+01	1.10E+01
Nitrosodi-n-propylamine, N-	621647	2.00E-03	7.00E+00	7.00E+00
Nitrosodiphenylamine, N-	86306	2.60E-06	9.00E-03	9.00E-03
Nitroso-N-methylethylamine, N- (Nitrosometh	10595956	6.30E-03	2.20E+01	2.20E+01
Nitrosopiperidine, N-	100754	2.70E-03	9.40E+00	9.40E+00
Nitrosopyrrolidine, N-	930552	6.00E-04	2.10E+00	2.10E+00
Nitrotoluene, m-	99081	-	-	-
Nitrotoluene, o-	88722	-	-	2.30E-01
Nitrotoluene, p-	99990	-	-	1.70E-02
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	3.80E-03	1.30E+01	1.30E+01
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	3.80E-03	1.30E+01	1.30E+01
Pentachlorobenzene	608935	-	-	-
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	1.90E+00	6.50E+03	6.50E+02
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	1.90E+01	6.50E+04	6.50E+04
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	3.80E+01	1.30E+05	1.30E+05
Pentachloronitrobenzene	82688	7.43E-05	2.60E-01	2.60E-01
Pentachlorophenol	87865	4.60E-06	1.80E-02	8.10E-02
Perchlorate	7601903	-	-	-
Phenanthrene	85018	-	-	-
Phenol	108952	-	-	-
Phosgene	75445	-	-	-
Phosphorus (white)	7723140	-	-	-
Propanol, 2-	67630	-	-	-
Propylbenzene, n-	103651	-	-	-
Propylene (Propene)	115071	-	-	-
Pyrene	129000	-	-	-
Pyridine	110861	-	-	-
Selenium	7782492	-	-	-
Silica, Crystalline	1175	-	-	-
Strontium	7440246	0.00E+00	0.00E+00	-
Styrene	100425	-	-	-

NAWS China Lake OBOD HRA Update
Cancer Toxicity Factors

Constituent Name	CAS Number	Cancer Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Cancer Inhalation Potency Factor $(mg/kg\text{-}d)^{-1}$	Cancer Oral Potency Factor $(mg/kg\text{-}d)^{-1}$
Sulfur Dioxide	7446095	-	-	-
Sulfuric acid	7664939	-	-	-
Tetrachlorobenzene, 1,2,4,5-	95943	-	-	-
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	3.80E+00	1.30E+04	1.30E+04
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	3.80E+01	1.30E+05	1.30E+05
Tetrachloroethane, 1,1,2,2-	79345	5.80E-05	2.00E-01	2.70E-01
Tetrachloroethylene (PCE)	127184	5.90E-06	2.10E-02	5.40E-01
Tetrachlorophenol, 2,3,4,6-	58902	-	-	-
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitropher	479458	-	-	-
Thallium and compounds	7446186	-	-	-
Toluene	108883	-	-	-
Toluidine, o- (Methylaniline, 2-)	95534	6.86E-05	2.40E-01	2.40E-01
Total HpCDD	35822469	3.80E-01	1.30E+03	1.30E+04
Total HpCDF	67562394	3.80E-01	1.30E+03	1.30E+03
Total HxCDD	19408743	3.80E+00	1.30E+04	1.30E+04
Total HxCDF	57117449	3.80E+00	1.30E+04	1.30E+04
Total PeCDD	40321764	1.90E+01	1.30E+05	6.50E+04
Total PeCDF	57117314	1.90E+01	6.50E+04	6.50E+04
Total TCDD	1746016	3.80E+01	1.30E+05	1.30E+05
Total TCDF	51207319	3.80E+00	1.30E+04	1.30E+04
Trichlorobenzene, 1,2,4-	120821	-	-	3.60E-03
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	-	-	-
Trichloroethane, 1,1,2-	79005	1.60E-05	5.70E-02	7.20E-02
Trichloroethylene (TCE)	79016	2.00E-06	7.00E-03	1.30E-02
Trichlorophenol, 2,4,5-	95954	-	-	-
Trichlorophenol,2,4,6-	88062	2.00E-05	7.00E-02	7.00E-02
Trimethylbenzene, 1,2,4-	95636	-	-	-
Trimethylbenzene, 1,3,5-	108678	-	-	-
Trimethylpentane, 2,2,4-	540841	-	-	-
Trinitrobenzene, 1,3,5-	99354	-	-	-
Trinitrotoluene, 2,4,6- (TNT)	118967	8.57E-06	3.00E-02	3.00E-02
Urethane (Ethyl carbamate)	51796	2.90E-04	1.00E+00	1.00E+00
Vanadium & Compounds	7440622	-	-	-
Vinyl acetate	108054	-	-	-
Vinyl Chloride	75014	7.80E-05	2.70E-01	2.70E-01
Xylenes	1330207	-	-	-
Zinc	7440666	-	-	-

NAWS China Lake OBOD HRA Update
Chronic Noncancer Toxicity Factors

Constituent Name	CAS Number	Chronic Inhalation REL ($\mu g/m^3$)	Chronic Inhalation RfD (mg/kg/d)	Chronic Oral RfD (mg/kg/d)
Acenaphthene	83329	2.10E+02		6.00E-02
Acenaphthylene	208968	9.00E+00		2.00E-02
Acetaldehyde	75070	9.00E+00		-
Acetone	67641	3.50E+02		9.00E-01
Acetonitrile	75058	6.00E+01		6.00E-03
Acetophenone	98862	2.00E-02		1.00E-01
Acetylaminofluorene, 2-	53963	-		-
Acrolein	107028	6.00E-02		5.00E-04
Acrylonitrile	107131	5.00E+00		1.00E-03
Allyl chloride	107051	1.00E+00		5.00E-02
Aluminum	7429905	5.00E+00		1.00E+00
Aminobiphenyl, 4-	92671	-		-
Aminopyridine, 4-	504245	7.00E-02		2.00E-05
Ammonia	7664417	2.00E+02		-
Aniline	62533	1.00E+00		7.00E-03
Anthracene	120127	1.05E+03		3.00E-01
Antimony	7440360	2.00E-01		4.00E-04
Antimony and compounds	7440360	2.00E-01		4.00E-04
Arsenic	7440382	3.00E-02		3.00E-04
Azobenzene	103333	-		-
Barium	7440393	5.00E-01		7.00E-02
Benzaldehyde	100527	3.50E+02		1.00E-01
Benzene	71432	6.00E+01		4.00E-03
Benzidine	92875	1.00E+01		3.00E-03
Benzo(A)Anthracene	56553	-		-
Benzo(A)pyrene	50328	-		-
Benzo(b)fluoranthene	205992	-		-
Benzo(k)fluoranthene	207089	-		-
Benzo[g,h,i]perylene	191242	-		-
Benzofuran, 2,3-	271896	1.40E+01		4.00E-03
Benzoic acid	65850	1.40E+04		4.00E+00
Benzyl alcohol	100516	1.05E+03		3.00E-01
Benzyl chloride	100447	1.20E+01		2.90E-03
Beryllium	7440417	7.00E-03		2.00E-03
Biphenyl, 1,1-	92524	1.75E+02		5.00E-02
Bis(2-chloro-1-methylethyl)ether	108601	1.30E-01		4.00E-02
Bis(2-chloroethyl)ether	111444	-		-
Bis(2-chloroisopropyl)ether	39638329	1.90E-01		4.00E-02
Bis(2-ethylhexyl)phthalate (DEHP)	117817	7.00E+01		2.00E-02
Bis(chloromethyl)ether	542881	-		-
Bromodichloromethane	75274	1.10E-01		2.00E-02
Bromoform (tribromomethane)	75252	1.10E-01		2.00E-02
Bromomethane	74839	5.00E+00		1.40E-03
Butadiene-1,3	106990	2.00E+01		-
Butanol, 1-	71363	9.10E+00		1.00E-01
Butyl benzyl phthalate	85687	7.00E+02		2.00E-01
Butylacrylate	141322	4.80E+01		-
Butylbenzene, n-	104518	1.40E+02		4.00E-02
Butylbenzene, T-	98066	1.40E+02		4.00E-02
Cadmium	7440439	2.00E-02		5.00E-04
Carbazole	86748	-		-
Carbon Disulfide	75150	8.00E+02		1.10E+01
Carbon Monoxide	630080	-		-
Carbon tetrachloride	56235	4.00E+01		7.00E-04
Chlorine	7782505	2.00E-01		1.00E-01
Chloroacetophenone, 2-	532274	3.00E-02		8.60E-06
Chloroaniline, 4-	106478	1.40E+01		4.00E-03
Chlorobenzene	108907	1.00E+03		2.00E-02
Chloroethane (Ethyl chloride)	75003	3.00E+04		4.00E-01
Chloroform	67663	3.00E+02		1.00E-02
Chloromethane (Methyl chloride)	74873	9.00E+01		-
Chloronaphthalene	91587	2.80E+02		8.00E-02
Chloronitrobenzene, o-	88733	7.00E-02		1.00E-03
Chlorophenol, 2-	95578	1.80E+01		5.00E-03
Chloropicrin (trichloronitromethane)	76062	4.00E-01		-
Chlorotoluene, o-	95498	7.00E+01		2.00E-02
Chromium (hex.)	18540299	2.00E-01		2.00E-02
Chromium III	16065831	-		1.50E+00
Chrysene	218019	-		-
Cobalt	7440484	2.00E-02		2.00E-02
Copper	7440508	2.40E+00		4.00E-02
Cumene (Isopropylbenzene)	98828	4.00E+02		1.00E-01

NAWS China Lake OBOD HRA Update
Chronic Noncancer Toxicity Factors

Constituent Name	CAS Number	Chronic Inhalation REL ($\mu g/m^3$)	Chronic Inhalation RfD (mg/kg/d)	Chronic Oral RfD (mg/kg/d)
Cyclohexane	110827	6.00E+03		5.70E+00
Cyclotetramethylene Tetranitramine (HMX)	2691410	1.75E+02		5.00E-02
Diaminotoluene, 2,4-	95807	-		-
Diazomethane	334883	5.00E+00		1.40E-03
Dibenz[a,h]anthracene	53703	-		-
Dibenzofuran	132649	1.40E+01		4.00E-03
Dibromochloromethane	124481	7.00E+01		2.00E-02
Dibutyl phthalate	84742	3.50E+02		1.00E-01
Dichlorobenzene, 1,2-	95501	2.00E+02		9.00E-02
Dichlorobenzene, 1,3-	541731	3.15E+00		9.00E-04
Dichlorobenzene, 1,4-	106467	8.00E+02		3.00E-02
Dichlorobenzidine, 3,3-	91941	-		-
Dichlorodifluoromethane	75718	2.00E+02		2.00E-01
Dichloroethane, 1,1-	75343	5.00E+02		1.00E-01
Dichloroethane, 1,2-	107062	4.00E+02		3.00E-02
Dichloroethylene (cis), 1,2-	156592	3.50E+01		1.00E-02
Dichloroethylene (trans), 1,2-	156605	7.00E+01		2.00E-02
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354	7.00E+01		5.00E-02
Dichlorophenol, 2,4-	120832	1.05E+01		3.00E-03
Dichloropropane, 1,2-	78875	4.00E+00		1.10E-03
Dichloropropene, 1,3-	542756	2.00E+01		3.00E-02
Diesel PM	9901	5.00E+00		-
Diethyl ether (Ethyl ether)	60297	7.00E+02		2.00E-01
Diethyl phthalate	84662	2.80E+03		8.00E-01
Dimethyl Phthalate	131113	3.50E+04		1.00E+01
Dimethylamine	124403	2.10E-02		5.70E-06
Dimethylbenz(a)anthracene, 7,12-	57976	-		-
Dimethylbenzidine, 3,3'-	119937	-		-
Dimethylcarbamoyl chloride	79447	-		-
Dimethylhydrazine, 1,2-	540738	-		-
Dimethylphenol, 2,4-	105679	7.00E+01		2.00E-02
Dinitrobenzene, 1,2-	528290	3.50E-01		1.00E-04
Dinitrobenzene, 1,3-	99650	3.50E-01		1.00E-04
Dinitrobenzene, 1,4-	100254	3.50E-01		1.00E-04
Dinitro-o-cresol, 4,6-	534521	7.00E+00		1.00E-04
Dinitrophenol, 2,4-	51285	7.00E+00		2.00E-03
Dinitropyrene, 1,6-	42397648	-		-
Dinitrotoluene, 2,4-	121142	7.00E+00		2.00E-03
Dinitrotoluene, 2,6-	606202	3.50E+00		1.00E-03
Dinitrotoluene, 4-Amino-2,6-	19406510	-	-	2.00E-04
Dinitrotoluene, 4-Amino-4,6-	35572782	-	-	2.00E-04
Di-n-octyl phthalate	117840	1.40E+02		4.00E-02
Dioxane, 1,4-	123911	3.00E+03		-
Diphenylamine	122394	8.75E+01		2.50E-02
Ethoxyethanol, 2-	110805	7.00E+01		4.00E-01
Ethylbenzene	100414	2.00E+03		1.00E-01
Ethylene	74851	3.00E+03		-
Ethyleneimine (Aziridine)	151564	-		-
Fluoranthene	206440	1.40E+02		4.00E-02
Fluorene	86737	1.40E+02		4.00E-02
Fluorotrichloromethane (Trichlorofluoromethane)	75694	7.00E+02		3.00E-01
Formaldehyde	50000	3.00E+00		2.00E-01
Furan (Epoxy-1,3-butadiene, 4-)	110009	3.50E+00		1.00E-03
Glutaraldehyde	111308	8.00E-02		-
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	4.00E-03		1.00E-06
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	4.00E-03		1.00E-06
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	4.00E-03		1.00E-06
Hexachlorobenzene	118741	2.80E+00		8.00E-04
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683	8.60E-02		3.00E-01
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	4.00E-04		1.00E-07
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	4.00E-04		1.00E-07
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	4.00E-04		1.00E-07
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	4.00E-04		1.00E-07
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	4.00E-04		1.00E-07
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	4.00E-04		1.00E-07
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	4.00E-04		1.00E-07
Hexachloroethane	67721	3.50E+00		1.00E-03
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	1.05E+01		3.00E-03
Hexane, n-	110543	7.00E+03		6.00E-02
Hexanone, 2-	591786	2.00E+04		-
Hydrogen chloride	7647010	9.00E+00		-
Hydrogen Cyanide	74908	9.00E+00		2.00E-02

NAWS China Lake OBOD HRA Update
Chronic Noncancer Toxicity Factors

Constituent Name	CAS Number	Chronic Inhalation REL ($\mu g/m^3$)	Chronic Inhalation RfD (mg/kg/d)	Chronic Oral RfD (mg/kg/d)
Indeno[1,2,3-cd]pyrene	193395	-		-
Iron	7439896	5.00E+03		-
Isophorone	78591	2.00E+03		2.00E-01
Isoprene	9003310	3.00E+03		-
Lead	7439921	-		-
Malononitrile	109773	7.00E-02		1.00E-04
Manganese	7439965	2.00E-01		1.40E-01
Mercury	7439976	9.00E-02		5.00E-03
Methacrylonitrile	126987	7.00E-04		1.00E-04
Methanol	67561	4.00E+03		5.00E-01
Methylcholanthrene, 3-	56495	-		-
Methylcyclohexane	108872	3.00E+03		8.60E-01
Methylene chloride	75092	4.00E+02		6.00E-02
Methylethyl ketone	78933	1.00E+03		6.00E-01
Methylnaphthalene, 2-	91576	9.00E+00		2.00E-02
Methylphenol, 2-	95487	6.00E+02		5.00E-02
Methylphenol, 3-	108394	6.00E+02		5.00E-02
Methylphenol, 4-	106445	6.00E+02		5.00E-03
Methyltertbutyl ether (MTBE)	1634044	8.00E+03		8.57E-01
Molybdenum	7439987	1.50E+04		-
Naphthalene	91203	9.00E+00		2.00E-02
Nickel and compounds	7440020	5.00E-02		5.00E-02
Nitric Oxide	10102439	-		1.00E-01
Nitroacenaphthene, 5-	602879	-		-
Nitroaniline, 2-	88744	1.00E-01		3.00E-03
Nitrobenzene	98953	1.70E+00		5.00E-04
Nitrochrysene, 6-	7496028	-		-
Nitrogen Dioxide	10102440	4.70E+02		1.00E+00
Nitroglycerin	55630	-		-
Nitroguanidine	556887	3.50E+02		1.00E-01
Nitrophenol, 4-	100027	7.00E+00		2.00E-03
Nitropropane, 2-	79469	2.00E+01		5.71E-03
Nitropyrene, 1-	5522430	-		-
Nitrosodiethylamine, N-	55185	-		-
Nitrosodimethylamine, N-	62759	-		8.00E-06
Nitrosodi-n-butylamine, N-	924163	-		-
Nitrosodi-n-propylamine, N-	621647	-		-
Nitrosodiphenylamine, N-	86306	-		2.00E-02
Nitroso-N-methylethylamine, N- (Nitrosomethylethylar	10595956	-		-
Nitrosopiperidine, N-	100754	-		-
Nitrosopyrrolidine, N-	930552	-		-
Nitrotoluene, m-	99081	3.50E+01		2.00E-02
Nitrotoluene, o-	88722	3.50E+01		1.00E-02
Nitrotoluene, p-	99990	3.50E+01		1.00E-02
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	4.00E-02		1.00E-05
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	4.00E-02		1.00E-05
Pentachlorobenzene	608935	2.80E+00		8.00E-04
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	8.00E-04		2.00E-07
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	8.00E-05		2.00E-08
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	8.00E-05		2.00E-08
Pentachloronitrobenzene	82688	1.05E+01		3.00E-03
Pentachlorophenol	87865	2.00E-01		3.00E-02
Perchlorate	7601903	-		1.00E-04
Phenanthrene	85018	1.05E+03		3.00E-01
Phenol	108952	2.00E+02		3.00E-01
Phosgene	75445	-		-
Phosphorus (white)	7723140	7.00E-02		2.00E-05
Propanol, 2-	67630	7.00E+03		-
Propylbenzene, n-	103651	1.40E+02		4.00E-02
Propylene (Propene)	115071	3.00E+03		-
Pyrene	129000	1.05E+02		3.00E-02
Pyridine	110861	3.50E+00		1.00E-03
Selenium	7782492	2.00E+01		5.00E-03
Silica, Crystalline	1175	3.00E+00		-
Strontium	7440246	-		6.00E-01
Styrene	100425	9.00E+02		2.00E-01
Sulfur Dioxide	7446095	6.60E+02		-
Sulfuric acid	7664939	1.00E+00		-
Tetrachlorobenzene, 1,2,4,5-	95943	1.05E+00		3.00E-04
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	4.00E-04		1.00E-07
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	4.00E-05		1.00E-08
Tetrachloroethane, 1,1,2,2-	79345	2.10E+02		6.00E-02

NAWS China Lake OBOD HRA Update
Chronic Noncancer Toxicity Factors

Constituent Name	CAS Number	Chronic Inhalation REL ($\mu g/m^3$)	Chronic Inhalation RfD (mg/kg/d)	Chronic Oral RfD (mg/kg/d)
Tetrachloroethylene (PCE)	127184	3.50E+01		1.00E-02
Tetrachlorophenol, 2,3,4,6-	58902	8.80E+01		3.00E-02
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnit	479458	3.50E+01		1.00E-02
Thallium and compounds	7446186	-		8.00E-05
Toluene	108883	3.00E+02		2.00E-01
Toluidine, o- (Methylaniline, 2-)	95534	-		-
Total HpCDD	35822469	4.00E-03		1.00E-06
Total HpCDF	67562394	4.00E-03		1.00E-06
Total HxCDD	19408743	4.00E-04		1.00E-07
Total HxCDF	57117449	4.00E-04		1.00E-07
Total PeCDD	40321764	8.00E-05		2.00E-08
Total PeCDF	57117314	8.00E-05		2.00E-08
Total TCDD	1746016	4.00E-05		1.00E-08
Total TCDF	51207319	4.00E-04		1.00E-07
Trichlorobenzene, 1,2,4-	120821	4.00E+00		1.00E-02
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	1.00E+03		2.80E-01
Trichloroethane, 1,1,2-	79005	1.40E+01		4.00E-03
Trichloroethylene (TCE)	79016	6.00E+02		3.00E-04
Trichlorophenol, 2,4,5-	95954	3.50E+02		1.00E-01
Trichlorophenol,2,4,6-	88062	3.50E-01		1.00E-04
Trimethylbenzene, 1,2,4-	95636	6.00E+00		5.00E-02
Trimethylbenzene, 1,3,5-	108678	6.00E+00		5.00E-02
Trimethylpentane, 2,2,4-	540841	3.00E+03		8.60E-01
Trinitrobenzene, 1,3,5-	99354	1.05E+02		3.00E-02
Trinitrotoluene, 2,4,6- (TNT)	118967	2.20E-01		5.00E-04
Urethane (Ethyl carbamate)	51796	-		-
Vanadium & Compounds	7440622	-		7.00E-03
Vinyl acetate	108054	2.00E+02		1.00E+00
Vinyl Chloride	75014	2.60E+01		3.00E-03
Xylenes	1330207	7.00E+02		2.00E+00
Zinc	7440666	3.50E+01		3.00E-01

NAWS China Lake OBOD HRA Update
Acute Noncancer Toxicity Factors

Constituent Name	CAS Number	Acute Inhalation REL (µg/m^3)
Acenaphthene	83329	-
Acenaphthylene	208968	7.86E+04
Acetaldehyde	75070	-
Acetone	67641	-
Acetonitrile	75058	-
Acetophenone	98862	3.01E+04
Acetylaminofluorene, 2-	53963	-
Acrolein	107028	1.90E-01
Acrylonitrile	107131	2.17E+04
Allyl chloride	107051	-
Aluminum	7429905	-
Aminobiphenyl, 4-	92671	-
Aminopyridine, 4-	504245	-
Ammonia	7664417	3.20E+03
Aniline	62533	3.05E+04
Anthracene	120127	-
Antimony	7440360	1.49E+03
Antimony and compounds	7440360	1.49E+03
Arsenic	7440382	1.90E-01
Azobenzene	103333	-
Barium	7440393	1.52E+03
Benzaldehyde	100527	-
Benzene	71432	1.30E+03
Benzidine	92875	-
Benzo(A)Anthracene	56553	-
Benzo(A)pyrene	50328	1.00E+03
Benzo(b)fluoranthene	205992	-
Benzo(k)fluoranthene	207089	-
Benzo[g,h,i]perylene	191242	2.99E+02
Benzofuran, 2,3-	271896	-
Benzoic acid	65850	-
Benzyl alcohol	100516	-
Benzyl chloride	100447	2.40E+02
Beryllium	7440417	9.95E+00
Biphenyl, 1,1-	92524	-
Bis(2-chloro-1-methylethyl)ether	108601	-
Bis(2-chloroethyl)ether	111444	5.85E+04
Bis(2-chloroisopropyl)ether	39638329	-
Bis(2-ethylhexyl)phthalate (DEHP)	117817	-
Bis(chloromethyl)ether	542881	-
Bromodichloromethane	75274	-
Bromoform (tribromomethane)	75252	1.55E+04
Bromomethane	74839	3.90E+03
Butadiene-1,3	106990	-
Butanol, 1-	71363	-
Butyl benzyl phthalate	85687	-
Butylacrylate	141322	-
Butylbenzene, n-	104518	-
Butylbenzene, T-	98066	-
Cadmium	7440439	2.99E+01
Carbazole	86748	-
Carbon Disulfide	75150	6.20E+03
Carbon Monoxide	630080	2.30E+04
Carbon tetrachloride	56235	1.90E+03
Chlorine	7782505	2.10E+02

NAWS China Lake OBOD HRA Update
Acute Noncancer Toxicity Factors

Constituent Name	CAS Number	Acute Inhalation REL (µg/m^3)
Chloroacetophenone, 2-	532274	-
Chloroaniline, 4-	106478	3.00E+04
Chlorobenzene	108907	3.45E+05
Chloroethane (Ethyl chloride)	75003	-
Chloroform	67663	1.50E+02
Chloromethane (Methyl chloride)	74873	2.07E+05
Chloronaphthalene	91587	5.99E+02
Chloronitrobenzene, o-	88733	-
Chlorophenol, 2-	95578	6.31E+03
Chloropicrin (trichloronitromethane)	76062	2.90E+01
Chlorotoluene, o-	95498	-
Chromium (hex.)	18540299	1.50E+02
Chromium III	16065831	1.49E+03
Chrysene	218019	2.99E+02
Cobalt	7440484	-
Copper	7440508	1.00E+02
Cumene (Isopropylbenzene)	98828	-
Cyclohexane	110827	-
Cyclotetramethylene Tetranitramine (HMX)	2691410	-
Diaminotoluene, 2,4-	95807	-
Diazomethane	334883	3.90E+03
Dibenz[a,h]anthracene	53703	3.01E+04
Dibenzofuran	132649	-
Dibromochloromethane	124481	-
Dibutyl phthalate	84742	1.50E+04
Dichlorobenzene, 1,2-	95501	3.01E+05
Dichlorobenzene, 1,3-	541731	-
Dichlorobenzene, 1,4-	106467	6.61E+05
Dichlorobenzidine, 3,3-	91941	6.21E+03
Dichlorodifluoromethane	75718	1.48E+07
Dichloroethane, 1,1-	75343	1.21E+06
Dichloroethane, 1,2-	107062	8.09E+03
Dichloroethylene (cis), 1,2-	156592	-
Dichloroethylene (trans), 1,2-	156605	-
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354	7.93E+04
Dichlorophenol, 2,4-	120832	3.00E+04
Dichloropropane, 1,2-	78875	5.08E+05
Dichloropropene, 1,3-	542756	1.36E+04
Diethyl ether (Ethyl ether)	60297	-
Diethyl phthalate	84662	1.50E+04
Dimethyl Phthalate	131113	-
Dimethylamine	124403	-
Dimethylbenz(a)anthracene, 7,12-	57976	-
Dimethylbenzidine, 3,3'-	119937	-
Dimethylcarbamoyl chloride	79447	-
Dimethylhydrazine, 1,2-	540738	-
Dimethylphenol, 2,4-	105679	-
Dinitrobenzene, 1,2-	528290	-
Dinitrobenzene, 1,3-	99650	-
Dinitrobenzene, 1,4-	100254	-
Dinitro-o-cresol, 4,6-	534521	9.79E+02
Dinitrophenol, 2,4-	51285	9.79E+02
Dinitropyrene, 1,6-	42397648	-
Dinitrotoluene, 2,4-	121142	4.47E+02
Dinitrotoluene, 2,6-	606202	4.47E+02

NAWS China Lake OBOD HRA Update
Acute Noncancer Toxicity Factors

Constituent Name	CAS Number	Acute Inhalation REL (µg/m^3)
Dinitrotoluene, 4-Amino-2,6-	19406510	-
Dinitrotoluene, 4-Amino-4,6-	35572782	-
Di-n-octyl phthalate	117840	-
Dioxane, 1,4-	123911	3.00E+03
Diphenylamine	122394	-
Ethoxyethanol, 2-	110805	3.70E+02
Ethylbenzene	100414	5.43E+05
Ethylene	74851	-
Ethyleneimine (Aziridine)	151564	-
Fluoranthene	206440	-
Fluorene	86737	-
Fluorotrichloromethane (Trichlorofluoromethane)	75694	2.81E+06
Formaldehyde	50000	9.40E+01
Furan (Epoxy-1,3-butadiene, 4-)	110009	-
Glutaraldehyde	111308	-
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	-
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	-
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	-
Hexachlorobenzene	118741	7.45E+01
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683	3.20E+04
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	-
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	-

NAWS China Lake OBOD HRA Update
Acute Noncancer Toxicity Factors

Constituent Name	CAS Number	Acute Inhalation REL (µg/m^3)
Hexachlorodibenzofuran, 1,2,3,7,8,9·	72918219	-
Hexachlorodibenzofuran, 2,3,4,6,7,8·	60851345	-
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8·	39227286	-
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8·	57653857	-
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9·	19408743	-
Hexachloroethane	67721	2.90E+04
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	-
Hexane, n-	110543	-
Hexanone, 2-	591786	-
Hydrogen chloride	7647010	2.10E+03
Hydrogen Cyanide	74908	3.40E+02
Indeno[1,2,3-cd]pyrene	193395	-
Iron	7439896	2.50E+06
Isophorone	78591	-
Isoprene	9003310	-
Lead	7439921	3.81E+01
Malononitrile	109773	-
Manganese	7439965	-
Mercury	7439976	1.80E+00
Methacrylonitrile	126987	-
Methanol	67561	2.80E+04
Methylcholanthrene, 3-	56495	-
Methylcyclohexane	108872	-
Methylene chloride	75092	1.40E+04
Methylethyl ketone	78933	1.30E+04
Methylnaphthalene, 2-	91576	7.86E+04
Methylphenol, 2-	95487	6.63E+04
Methylphenol, 3-	108394	6.63E+04
Methylphenol, 4-	106445	6.63E+04
Methyltertbutyl ether (MTBE)	1634044	-
Molybdenum	7439987	5.00E+06
Naphthalene	91203	7.86E+04
Nickel and compounds	7440020	6.00E+00
Nitric Oxide	10102439	-
Nitroacenaphthene, 5-	602879	-
Nitroaniline, 2-	88744	-
Nitrobenzene	98953	1.51E+04
Nitrochrysene, 6-	7496028	-
Nitrogen Dioxide	10102440	4.70E+02
Nitroglycerin	55630	-
Nitroguanidine	556887	-
Nitrophenol, 4-	100027	9.79E+02
Nitropropane, 2-	79469	-
Nitropyrene, 1-	5522430	-
Nitrosodiethylamine, N-	55185	-
Nitrosodimethylamine, N-	62759	-
Nitrosodi-n-butylamine, N-	924163	-
Nitrosodi-n-propylamine, N-	621647	-
Nitrosodiphenylamine, N-	86306	-
Nitroso-N-methylethylamine, N- (Nitrosomethylethylar	10595956	-
Nitrosopiperidine, N-	100754	-
Nitrosopyrrolidine, N-	930552	-
Nitrotoluene, m-	99081	-
Nitrotoluene, o-	88722	-
Nitrotoluene, p-	99990	-

NAWS China Lake OBOD HRA Update
Acute Noncancer Toxicity Factors

Constituent Name	CAS Number	Acute Inhalation REL (µg/m^3)
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	-
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	-
Pentachlorobenzene	608935	1.00E+03
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	-
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	-
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	-
Pentachloronitrobenzene	82688	1.45E+03
Pentachlorophenol	87865	1.53E+03
Perchlorate	7601903	-
Phenanthrene	85018	-
Phenol	108952	5.80E+03
Phosgene	75445	4.00E+00
Phosphorus (white)	7723140	-
Propanol, 2-	67630	3.20E+03
Propylbenzene, n-	103651	-
Propylene (Propene)	115071	-
Pyrene	129000	-
Pyridine	110861	4.85E+04
Selenium	7782492	2.94E+00
Silica, Crystalline	1175	-
Strontium	7440246	-
Styrene	100425	2.10E+04
Sulfur Dioxide	7446095	6.60E+02
Sulfuric acid	7664939	1.20E+02
Tetrachlorobenzene, 1,2,4,5-	95943	3.00E+04
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	-
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	-
Tetrachloroethane, 1,1,2,2-	79345	2.06E+04
Tetrachloroethylene (PCE)	127184	2.00E+04
Tetrachlorophenol, 2,3,4,6-	58902	-
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnit	479458	-
Thallium and compounds	7446186	1.34E+02
Toluene	108883	3.70E+04
Toluidine, o- (Methylaniline, 2-)	95534	2.63E+04
Total HpCDD	35822469	-
Total HpCDF	67562394	-
Total HxCDD	19408743	-
Total HxCDF	57117449	-
Total PeCDD	40321764	-
Total PeCDF	57117314	-
Total TCDD	1746016	-
Total TCDF	51207319	-
Trichlorobenzene, 1,2,4-	120821	2.23E+04
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	6.80E+04
Trichloroethane, 1,1,2-	79005	1.64E+05
Trichloroethylene (TCE)	79016	5.37E+05
Trichlorophenol, 2,4,5-	95954	2.99E+04
Trichlorophenol,2,4,6-	88062	-
Trimethylbenzene, 1,2,4-	95636	-
Trimethylbenzene, 1,3,5-	108678	-
Trimethylpentane, 2,2,4-	540841	-
Trinitrobenzene, 1,3,5-	99354	3.00E+04
Trinitrotoluene, 2,4,6- (TNT)	118967	-
Urethane (Ethyl carbamate)	51796	-
Vanadium & Compounds	7440622	3.00E+01

NAWS China Lake OBOD HRA Update
Acute Noncancer Toxicity Factors

Constituent Name	CAS Number	Acute Inhalation REL (µg/m^3)
Vinyl acetate	108054	1.76E+04
Vinyl Chloride	75014	1.80E+05
Xylenes	1330207	2.20E+04
Zinc	7440666	-

Notes:
Some constituents have exposure averaging times over a period of greater than one hour. A one-hour assumption has been carried through this risl assessment. Therefore the one-hour assumption is conservative since the REL could be adjusted for the one-hour expiosure rather than the longe averaging time for which the compound was developed. The constuituents affected by this conservative assumptions are listed below with the actua averaging time, in hours, for which the REL was developed in parentheses

Arsenic (4)
Benzene (6)
Carbon disulfide (6)
Carbon tetrachloride (7)
Chloroform (7)

NAWS China Lake OB/OD HRA
Reference List

	CAS	Quadrant	Surrogate	Cancer URF (Inhalation)	Cancer Potency Factor (Inhalation)	Cancer Oral Slope Factor	Chronic REL (Inhalation)	Chronic REL (Oral)	Acute REL
				Ref	Ref	Ref	Ref	Ref	Ref
Acenaphthene	83329	1		-	-	-	EPA 9 PRGs	IRIS	-
Acenaphthylene	208968	1	Naphthalene	OEHHA	OEHHA	-	OEHHA	IRIS	HHRAP
Acetaldehyde	75070	1		OEHHA	OEHHA	-	OEHHA	-	-
Acetone	67641	1		-	-	-	EPA 9 PRGs	IRIS	-
Acetonitrile	75058	1		-	-	-	IRIS	PRTV	-
Acetophenone	98862	1		-	-	-	PRTV	IRIS	HHRAP
Acetylaminofluorene, 2-	53963	1	2-Nitrofluorene	OEHHA	OEHHA	OEHHA			-
Acrolein	107028	1		-	-	-	OEHHA	IRIS	OEHHA
Acrylonitrile	107131	1		OEHHA	OEHHA	OEHHA	OEHHA	HEAST	HHRAP
Allyl chloride	107051	1		OEHHA	OEHHA	OEHHA	IRIS	PRTV	-
Aluminum	7429905	1		-	-	-	PRTV	PRTV	-
Aminobiphenyl, 4-	92671	1		OEHHA	OEHHA	OEHHA	-	-	-
Aminopyridine, 4-	504245	2		-	-	-	EPA 9 PRGs	HEAST	-
Ammonia	7664417	1		-	-	-	OEHHA	-	OEHHA
Aniline	62533	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	HHRAP
Anthracene	120127	1		-	-	-	EPA 9 PRGs	IRIS	-
Antimony	7440360	1		-	-	-	OEHHA	IRIS	HHRAP
Antimony and compounds	7440360	1		-	-	-	OEHHA	IRIS	HHRAP
Arsenic	7440382	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	OEHHA
Azobenzene	103333	1		OEHHA	OEHHA	OEHHA	-	-	-
Barium	7440393	1		-	-	-	HEAST	IRIS	HHRAP
Benzaldehyde	100527	1		-	-	-	EPA 9 PRGs	IRIS	-
Benzene	71432	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	OEHHA
Benzidine	92875	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	-
Benzo(A)Anthracene	56553	1		OEHHA	OEHHA	OEHHA	-	-	-
Benzo(A)pyrene	50328	1		OEHHA	OEHHA	OEHHA	-	-	HHRAP
Benzo(b)fluoranthene	205992	1		OEHHA	OEHHA	OEHHA	-	-	-
Benzo(k)fluoranthene	207089	1		OEHHA	OEHHA	OEHHA	-	-	-
Benzo[g,h,i]perylene	191242	1	Chrysene	OEHHA	OEHHA	OEHHA		-	HHRAP
Benzofuran, 2,3-	271896	1	Dibenzofuran	-	-	-	EPA 9 PRGs	PRTV	-
Benzoic acid	65850	1		-	-	-	EPA 9 PRGs	IRIS	-
Benzyl alcohol	100516	1		-	-	-	EPA 9 PRGs	HEAST	-
Benzyl chloride	100447	1		OEHHA	OEHHA	OEHHA	OEHHA	EPA 9 PRGs	OEHHA
Beryllium	7440417	1		OEHHA	OEHHA	IRIS	OEHHA	OEHHA	HHRAP
Biphenyl, 1,1-	92524	1		-	-	-	EPA 9 PRGs	IRIS	-
Bis(2-chloro-1-methylethyl)ether	108601	2		HEAST	HEAST	HEAST	EPA 9 PRGs	EPA 9 PRGs	-
Bis(2-chloroethyl)ether	111444	1		OEHHA	OEHHA	OEHHA	-	-	HHRAP
Bis(2-chloroisopropyl)ether	39638329	1		EPA 9 PRGs	EPA 9 PRGs	EPA 9 PRGs	EPA 9 PRGs	IRIS	-
Bis(2-ethylhexyl)phthalate (DEHP)	117817	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	-
Bis(chloromethyl)ether	542881	2		OEHHA	OEHHA	OEHHA	-	-	-
Bromodichloromethane	75274	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	IRIS	-
Bromoform (tribromomethane)	75252	1		IRIS	IRIS	IRIS	EPA 9 PRGs	IRIS	HHRAP
Bromomethane	74839	1		-	-	-	OEHHA	IRIS	OEHHA
Butadiene-1,3	106990	1		OEHHA	OEHHA	OEHHA	OEHHA	-	-
Butanol, 1-	71363	1		-	-	-	EPA 9 PRGs	IRIS	-
Butyl benzyl phthalate	85687	1		-	-	-	EPA 9 PRGs	IRIS	-

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Butylacrylate	141322	1	Ethylacrylate	EPA 9 PRGs	EPA 9 PRGs	HEAST	OEHHA		-
Butylbenzene, n-	104518	1		-	-	-	EPA 9 PRGs	EPA 9 PRGs	-
Butylbenzene, T-	98066	1		-	-	-	EPA 9 PRGs	EPA 9 PRGs	-
Cadmium	7440439	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	HHRAP
Carbazole	86748	1		EPA 9 PRGs	EPA 9 PRGs	HEAST	-	-	-
Carbon Disulfide	75150	1		-	-	-	OEHHA	IRIS	OEHHA
Carbon Monoxide	630080	1		-	-	-	-	-	OEHHA
Carbon tetrachloride	56235	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	OEHHA
Chlorine	7782505	1		-	-	-	OEHHA	IRIS	OEHHA
Chloroacetophenone, 2-	532274	1		-	-	-	OEHHA	EPA 9 PRGs	-
Chloroaniline, 4-	106478	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Chlorobenzene	108907	1		-	-	-	OEHHA	IRIS	HHRAP
Chloroethane (Ethyl chloride)	75003	1		EPA 9 PRGs	EPA 9 PRGs	EPA 9 PRGs	OEHHA	EPA 9 PRGs	-
Chloroform	67663	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	OEHHA
Chloromethane (Methyl chloride)	74873	1		HEAST	HEAST	HEAST	IRIS	-	HHRAP
Chloronaphthalene	91587	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Chloronitrobenzene, o-	88733	2		EPA 9 PRGs	EPA 9 PRGs	HEAST	PRTV	PRTV	-
Chlorophenol, 2-	95578	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Chloropicrin (trichloronitromethane)	76062	2		-	-	-	OEHHA	-	OEHHA
Chlorotoluene, o-	95498	1		-	-	-	EPA 9 PRGs	IRIS	-
Chromium (hex.)	18540299	1		OEHHA	OEHHA	-	OEHHA	OEHHA	HHRAP
Chromium III	16065831	1		-	-	-		IRIS	HHRAP
Chrysene	218019	1		OEHHA	OEHHA	OEHHA		-	HHRAP
Cobalt	7440484	1		PRTV	PRTV	-	PRTV	PRTV	-
Copper	7440508	1		-	-	-	OEHHA	HEAST	OEHHA
Cumene (Isopropylbenzene)	98828	1		-	-	-	IRIS	IRIS	-
Cyclohexane	110827	1		-	-	-	IRIS	EPA 9 PRGs	-
Diaminotoluene, 2,4-	95807	2		OEHHA	OEHHA	OEHHA	-	-	-
Diazomethane	334883	2	Bromomethane	-	-	-	OEHHA	IRIS	OEHHA
Dibenz[a,h]anthracene	53703	1		OEHHA	OEHHA	OEHHA	-	-	HHRAP
Dibenzofuran	132649	1		-	-	-	EPA 9 PRGs	PRTV	-
Dibromochloromethane	124481	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	IRIS	-
Dibutyl phthalate	84742	2		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Dichlorobenzene, 1,2-	95501	1		-	-	-	HEAST	IRIS	HHRAP
Dichlorobenzene, 1,3-	541731	1		-	-	-	EPA 9 PRGs	EPA 9 PRGs	-
Dichlorobenzene, 1,4-	106467	1		OEHHA	OEHHA	OEHHA	OEHHA	EPA 9 PRGs	HHRAP
Dichlorobenzidine, 3,3-	91941	1		OEHHA	OEHHA	OEHHA	-	-	HHRAP
Dichlorodifluoromethane	75718	1		-	-	-	HEAST	HEAST	HHRAP
Dichloroethane, 1,1-	75343	1		OEHHA	OEHHA	OEHHA	HEAST	HEAST	HHRAP
Dichloroethane, 1,2-	107062	1		OEHHA	OEHHA	OEHHA	OEHHA	EPA 9 PRGs	HHRAP
Dichloroethylene (cis), 1,2-	156592	1		-	-	-	EPA 9 PRGs	PRTV	-
Dichloroethylene (trans), 1,2-	156605	1		-	-	-	EPA 9 PRGs	IRIS	-
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354	1		PRTV	PRTV	PRTV	OEHHA	IRIS	HHRAP
Dichlorophenol, 2,4-	120832	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Dichloropropane, 1,2-	78875	1		OEHHA	OEHHA	OEHHA	IRIS	EPA 9 PRGs	HHRAP
Dichloropropene, 1,3-	542756	1		OEHHA	OEHHA	OEHHA	IRIS	IRIS	HHRAP
Diethyl ether (Ethyl ether)	60297	1		-	-	-	EPA 9 PRGs	IRIS	-

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Diethyl phthalate	84662	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Dimethyl Phthalate	131113	1		-	-	-	EPA 9 PRGs	PRTV	-
Dimethylamine	124403	2		-	-	-	OEHHA	EPA 9 PRGs	-
Dimethylbenz(a)anthracene, 7,12-	57976	1		OEHHA	OEHHA	OEHHA	-	-	-
Dimethylbenzidine, 3,3'-	119937	1		EPA 9 PRGs	EPA 9 PRGs	HEAST	-	-	-
Dimethylcarbamoyl chloride	79447	2		OEHHA	OEHHA	OEHHA	-	-	-
Dimethylhydrazine, 1,2-	540738	2		OEHHA	OEHHA	OEHHA	-	-	-
Dimethylphenol, 2,4-	105679	1		-	-	-	EPA 9 PRGs	IRIS	-
Dinitrobenzene, 1,2-	528290	2		-	-	-	EPA 9 PRGs	HEAST	-
Dinitrobenzene, 1,3-	99650	1		-	-	-	EPA 9 PRGs	IRIS	-
Dinitrobenzene, 1,4-	100254	2		-	-	-	EPA 9 PRGs	HEAST	-
Dinitro-o-cresol, 4,6-	534521	2	2,4-Dinitrophenol	-	-	-	EPA 9 PRGs	PRTV	HHRAP
Dinitrophenol, 2,4-	51285	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Dinitropyrene, 1,6-	42397648	1		OEHHA	OEHHA	OEHHA	-	-	-
Dinitrotoluene, 2,4-	121142	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	IRIS	HHRAP
Dinitrotoluene, 2,6-	606202	1		-	-	IRIS	EPA 9 PRGs	HEAST	HHRAP
Di-n-octyl phthalate	117840	1		-	-	-	EPA 9 PRGs	PRTV	-
Dioxane, 1,4-	123911	1		OEHHA	OEHHA	OEHHA	OEHHA		OEHHA
Diphenylamine	122394	1		-	-	-	EPA 9 PRGs	IRIS	-
Ethoxyethanol, 2-	110805	2		-	-	-	OEHHA	HEAST	OEHHA
Ethylbenzene	100414	1		PRTV	PRTV	EPA 9 PRGs	OEHHA	IRIS	HHRAP
Ethylene	74851	1	Propylene	-	-	-	OEHHA	-	-
Ethyleneimine (Aziridine)	151564	2		OEHHA	OEHHA	OEHHA	-	-	-
Fluoranthene	206440	1		-	-	-	EPA 9 PRGs	IRIS	-
Fluorene	86737	1		-	-	-	EPA 9 PRGs	IRIS	-
Fluorotrichloromethane (Trichlorofluoromethane)	75694	1		-	-	-	OEHHA	IRIS	HHRAP
Formaldehyde	50000	1		OEHHA	OEHHA	-	OEHHA	IRIS	OEHHA
Furan (Epoxy-1,3-butadiene, 4-)	110009	1		-	-	-	EPA 9 PRGs	IRIS	-
Glutaraldehyde	111308	2		-	-	-	OEHHA	-	-
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorobenzene	118741	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	HHRAP
Hexachlorobutadiene (Hexachloro-1,3-butadiene)	87683	1		IRIS	IRIS	IRIS	EPA 9 PRGs	HEAST	HHRAP
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Hexachloroethane	67721	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	IRIS	HHRAP
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	1		EPA 9 PRGs	EPA 9 PRGs	IRIS	EPA 9 PRGs	IRIS	-
Hexane, n-	110543	1		-	-	-	OEHHA	HEAST	-
Hydrogen chloride	7647010	1		-	-	-	OEHHA	-	OEHHA
Hydrogen Cyanide	74908	1		-	-	-	OEHHA	IRIS	OEHHA
Indeno[1,2,3-cd]pyrene	193395	1		OEHHA	OEHHA	OEHHA	-	-	-

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Iron	7439896	1		-	-	-	NIOSH	-	NIOSH
Isophorone	78591	1		EPA 9 PRGs	EPA 9 PRGs	IRIS	OEHHA	IRIS	-
Isoprene	9003310	1	Propylene	-	-	-	OEHHA	-	-
Lead	7439921	1		OEHHA	OEHHA	OEHHA	-	-	HHRAP
Malononitrile	109773	2		-	-	-	EPA 9 PRGs	PRTV	-
Manganese	7439965	2		-	-	-	OEHHA	IRIS	-
Mercury	7782492			-	-	-	OEHHA	OEHHA	OEHHA
Methacrylonitrile	126987	2		-	-	-	HEAST	IRIS	-
Methanol	67561	2		-	-	-	OEHHA	IRIS	OEHHA
Methylcholanthrene, 3-	56495	1		OEHHA	OEHHA	OEHHA	-	-	-
Methylcyclohexane	108872	1		-	-	-	HEAST	EPA 9 PRGs	-
Methylene chloride	75092	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	OEHHA
Methylethyl ketone	78933	1		-	-	-	OEHHA	IRIS	OEHHA
Methylnaphthalene, 2-	91576	1	Naphthalene	OEHHA	OEHHA	-	OEHHA	IRIS	HHRAP
Methylphenol, 2-	95487	1		-	-	-	OEHHA	IRIS	HHRAP
Methylphenol, 3-	108394	1		-	-	-	OEHHA	IRIS	HHRAP
Methylphenol, 4-	106445	1		-	-	-	OEHHA	HEAST	HHRAP
Methyltertbutyl ether (MTBE)	1634044	1		OEHHA	OEHHA	OEHHA	OEHHA	EPA 9 PRGs	-
Molybdenum	7439987	1		-	-	-	OSHA	-	NIOSH
Naphthalene	91203	1		OEHHA	OEHHA	-	OEHHA	IRIS	HHRAP
Nickel and compounds	7440020	1		OEHHA	OEHHA	-	OEHHA	OEHHA	OEHHA
Nitric Oxide	10102439	1		-	-	-	-	IRIS	-
Nitroacenaphthene, 5-	602879	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitroaniline, 2-	88744	1		-	-	-	PRTV	PRTV	-
Nitrobenzene	98953	1		-	-	-	OEHHA	IRIS	HHRAP
Nitrochrysene, 6-	7496028	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrogen Dioxide	10102440	1		-	-	-	OEHHA	IRIS	OEHHA
Nitroglycerin	55630	1		EPA 9 PRGs	EPA 9 PRGs	EPA 9 PRGs	-	-	-
Nitroguanidine	556887	1		-	-	-	EPA 9 PRGs	IRIS	-
Nitrophenol, 4-	100027	1	2,4-Dinitrophenol	-	-	-	EPA 9 PRGs	IRIS	HHRAP
Nitropropane, 2-	79469	1		HEAST	HEAST	PRTV	OEHHA	EPA 9 PRGs	-
Nitropyrene, 1-	5522430	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrosodiethylamine, N-	55185	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrosodimethylamine, N-	62759	1		OEHHA	OEHHA	OEHHA	-	PRTV	-
Nitrosodi-n-butylamine, N-	924163	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrosodi-n-propylamine, N-	621647	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrosodiphenylamine, N-	86306	1		OEHHA	OEHHA	OEHHA	-	PRTV	-
Nitroso-N-methylethylamine, N- (Nitrosomethylethylami	10595956	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrosopiperidine, N-	100754	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrosopyrrolidine, N-	930552	1		OEHHA	OEHHA	OEHHA	-	-	-
Nitrotoluene, o-	88722	1	p-nitrotoluene	-	-	PRTV	EPA 9 PRGs	HEAST	-
Nitrotoluene, p-	99990	1		-	-	PRTV	EPA 9 PRGs	RAIS	-
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Pentachlorobenzene	608935	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-

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Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Pentachloronitrobenzene	82688	1		EPA 9 PRGs	EPA 9 PRGs	HEAST	EPA 9 PRGs	IRIS	HHRAP
Pentachlorophenol	87865	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	HHRAP
Perchlorate	7601903	2		-	-	-	-	EPA 9 PRGs	-
Phenanthrene	85018	1	Anthracene	-	-	-	EPA 9 PRGs	IRIS	-
Phenol	108952	1		-	-	-	OEHHA	IRIS	OEHHA
Phosgene	75445	2		-	-	-	0.00E+00	-	OEHHA
Phosphorus (white)	7723140	2		-	-	-	OEHHA	IRIS	-
Propanol, 2-	67630	1		-	-	-	OEHHA	-	OEHHA
Propylbenzene, n-	103651	1		-	-	-	EPA 9 PRGs	EPA 9 PRGs	-
Propylene (Propene)	115071	1		-	-	-	OEHHA	-	-
Pyrene	129000	1		-	-	-	EPA 9 PRGs	IRIS	-
Pyridine	110861	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Selenium	7782492	2		-	-	-	OEHHA	IRIS	HHRAP
Silica, Crystalline	1175	2		-	-	-	OEHHA	-	-
Strontium	7440246	2		0.00E+00	0.00E+00	0.00E+00	0.00E+00	IRIS	0.00E+00
Styrene	100425	1		-	-	-	OEHHA	IRIS	OEHHA
Sulfur Dioxide	7446095	1		-	-	-	OEHHA	-	OEHHA
Sulfuric acid	7664939	2		-	-	-	OEHHA	-	OEHHA
Tetrachlorobenzene, 1,2,4,5-	95943	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Tetrachloroethane, 1,1,2,2-	79345	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	PRTV	HHRAP
Tetrachloroethylene (PCE)	127184	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	OEHHA
Tetrachlorophenol, 2,3,4,6-	58902	1		-	-	-	OEHHA	IRIS	-
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl, Trinitrophenylmethylnitram	479458	1		-	-	-	EPA 9 PRGs	HEAST	-
Thallium and compounds	7446186	1		-	-	-	-	IRIS	HHRAP
Toluene	108883	1		-	-	-	OEHHA	IRIS	OEHHA
Toluidine, o- (Methylaniline, 2-)	95534	1		EPA 9 PRGs	EPA 9 PRGs	HEAST	-	-	HHRAP
Total HpCDD	35822469	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total HpCDF	67562394	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total HxCDD	19408743	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total HxCDF	57117449	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total PeCDD	40321764	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total PeCDF	57117314	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total TCDD	1746016	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Total TCDF	51207319	1		OEHHA	OEHHA	OEHHA	OEHHA	OEHHA	-
Trichlorobenzene, 1,2,4-	120821	1		-	-	OEHHA	IRIS	IRIS	HHRAP
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	1		-	-	-	OEHHA	PRTV	OEHHA
Trichloroethane, 1,1,2-	79005	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	IRIS	HHRAP
Trichloroethylene (TCE) (Freon 11)	79016	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	HHRAP
Trichlorophenol, 2,4,5-	95954	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP
Trichlorophenol,2,4,6-	88062	1		OEHHA	OEHHA	OEHHA	EPA 9 PRGs	EPA 9 PRGs	-
Trimethylbenzene, 1,2,4-	95636	1		-	-	-	PRTV	PRTV	-
Trimethylbenzene, 1,3,5-	108678	1		-	-	-	PRTV	PRTV	-
Trimethylpentane, 2,2,4-	540841	1	Methylcyclohexane	-	-	-	HEAST	EPA 9 PRGs	-
Trinitrobenzene, 1,3,5-	99354	1		-	-	-	EPA 9 PRGs	IRIS	HHRAP

	CAS	Quadrant	Surrogate	Cancer URF (Inhalation)	Cancer Potency Factor (Inhalation)	Cancer Oral Slope Factor	Chronic REL (Inhalation)	Chronic REL (Oral)	Acute REL
Trinitrotoluene, 2,4,6- (TNT)	118967	1		EPA 9 PRGs	EPA 9 PRGs	IRIS	EPA 9 PRGs	IRIS	-
Urethane (Ethyl carbamate)	51796	2		OEHHA	OEHHA	OEHHA	-	0.00E+00	-
Vanadium & Compounds	7440622	1		-	-	-	-	HEAST	OEHHA
Vinyl acetate	108054	1		-	-	-	OEHHA	HEAST	HHRAP
Vinyl Chloride	75014	1		OEHHA	OEHHA	OEHHA	OEHHA	IRIS	OEHHA
Xylenes	1330207	1		-	-	-	OEHHA	HEAST	OEHHA
Zinc	7440666	1		-	-	-	OEHHA	IRIS	-

References (in order of priority):
1) OEHHA - Air Toxics Hot Spots Program Risk Assessment Guidelines, Appendix L - Table 1, OEHHA/ARB Approved Health Values for Use in Hot Spot Facility Risk Assessments, August 2003

2) IRIS/PRTV/HEAST (RAIS) - Oak Ridge National Laboratory Risk Assessment Information System (RAIS), September 2003 with order: Tier 1 (IRIS), Tier 2 (PRTV), and Tier 3 (HEAST, and other sources).

3) HHRAP - US EPA Region 6, Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Table A-4, July 1998.

4) RAGS - Risk Assessment Guidance for Superfund (RAGS) (Interim Guidance) (November 1995).

5) EPA 9 PRGs - US EPA Region 9, Preliminary Remediation Goals, October 2002.

Footnotes:

a. According to RAIS, this value is from the Integrated Risk Information System (IRIS).

b. According to RAIS, this value is from the Health Effects and Environmental Affects Summary Table (HEAST).

c. According to RAIS, this value is from the Peer Reviewed Toxicity Values (PRTV).

f. HEAST concluded that toxicity data were inadequate for calculation of oral RfDs for copper and substituted the current drinking water standard (MCLG) of 1.3 mg/L. The RAIS converts this MCLG to an RfD for chronic and subchronic oral exposure.

g. Listed as "Dinitrotoluene mixture, 2,4-/2,6-" in IRIS. The value is based on a study using technical grade DNT.

m. IRIS no longer separates manganese values for chronic oral RfDs into water and diet RfDs. The chronic oral RfD for the total oral intake of manganese is 1.40E-01. However, when assessing exposure to manganese from drinking water or soil, IRIS recommends a modifying factor of 3, thereby lowering the RfD to 4.67E-02, which has been rounded to 4.6e-02. Rounding to 4.7E-02 is more accurate, but makes the value less conservative. HEAST values remain separated into water and diet subchronic RfDs.

n. The cancer potency of PCB mixtures is determined using a three tiered approach that depends on the information available. Criteria for use of the Risk and Persistence Tier include: food chain exposure; sediment or soil ingestion; dust or aerosol inhalation; dermal exposure if an absorption factor has been applied; any early-life exposure; and the presence of dioxin-like, tumor-promoting, or persistent congeners. This value, 200e+00 per (mg/kg)/day, is the upper-bound slope factor for the High Risks and Persistence Tier. The central-estimate slope factor for this tier is 1.00+e00 per (mg/kg)/day.

n. Region 4 has adopted a Potency Equivalency Factor (PEF) methodology for carcinogenic polycyclic aromatic hydrocarbons (PAHs) and dioxins and furans on the Target Compound List as described in Supplemental Guidance from RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance) (November 1995). These TEFs are based on potency of each compounds relative to that of benzo(a)pyrene (BaP) and 2,3,7,8-TCDD. The following TEFs were used to convert each PAH concentration to an equivalent concentration of BaP: 1)benzo(a)pyrene, TEF=1.0; 2) benz(a)anthracene, TEF=0.1; (3)benzo(b)fluoranthene, TEF=0.1; (4)benzo(k)fluoranthene, TEF=0.01; (5) chrysene, TEF=0.001; (6) dibenz(a,h)anthracene, TEF=1.0; (7) indeno(1,2,3-cd)pyrene, TEF=0.1. The following TEFs were used to convert each dioxin and furan concentration to an equivalent concentration of TCDD: (1) 2,3,7,8-TCDD, TEF=1.0; (2) 2,3,7,8-PeCDD, TEF=0.5; (3) 2,3,7,8-HxCDD, TEF=0.1; (4)2,3,7,8-HpCDD, TEF=0.01; (5) OCDD, TEF=0.001; (6) 2,3,7,8 - TCDF, TEF=0.1; (7) 1,2,3,7,8-PeCDF, TEF=0.5;

u. The inhalation Slope Factor was calculated from inhalation unit risk as described in Supplemental Guidance from RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance) (November 1995)

v. The Risk Assessment Program has contacted Superfund and been given provisional values which should be used for DOE-ORR projects. This value should be clearly documented as provisional. For other projects, Superfund Health Risk Technical Support Center should be contacted directly (513) 569-7300.

w. This value was withdrawn by NCEA. "The cancer slope factor was withdrawn because of the re-evaluation of the rodent data which does not support genotoxic mode of action based on our proposed cancer guidelines. This chemical is now being reassessed for IRIS which automatically flags further use of any provisional cancer or non-cancer assessments." If this chemical is identified as a risk driver, the risk assessor should consult the EPA Superfund Technical Support Center. All withdrawn values should be clearly documented when used in any risk assessment activity.

ad. The inhalation Unit Risk was calculated from inhalation slope factor as described in Supplemental Guidance from RAGS: Region 4 Bulletins, Human Health Risk Assessment (Interim Guidance (November 1995).

	CAS	Quadrant	Surrogate	Cancer URF (Inhalation)	Cancer Potency Factor (Inhalation)	Cancer Oral Slope Factor	Chronic REL (Inhalation)	Chronic REL (Oral)	Acute REL

ah. These toxicity values present EPA's most current evaluation of the potential health risks from exposure to trichloroethylene (TCE). The citation presented is as follows: 20001. Trichloroethylene Health Risks Assessment: Synthesis and Characterization (External Review Draft). USEPA EPA/600/P-01/002A. 01 August 2001. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment, Washington Office, Washington, DD,. This NCEA report can be viewed http://oaspub.epa.gov/eims/eimsapi.dispdetail?deid=23249. EPA Region IX and Region III have adopted these toxicity values as well.

x. According to HHRAP, the TEEL-1 value is based on ERPG-1 value.

y. According to HHRAP, this value equals TEEL-1 value from sum of all three cresol isomers.

Appendix G

Applicable Target Organ Systems

G-1 Chronic Noncancer
G-2 Acute Noncancer

China Lake OBOD - HRA

Applicable Target Organs for Chronic Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Chronic Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Acenaphthene	83329	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Acenaphthylene	208968	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Acetaldehyde	75070	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Acetone	67641	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Acetonitrile	75058	3	0	0	0	0	0	0	0	3	3	0	0	0	0
Acetophenone	98862	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Acetylaminofluorene, 2-	53963	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acrolein	107028	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Acrylonitrile	107131	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Allyl chloride	107051	3	0	0	0	0	0	0	0	3	0	0	3	0	0
Aluminum	7429905	0	0	0	0	0	3	0	0	0	0	0	3	3	0
Aminobiphenyl, 4-	92671	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aminopyridine, 4-	504245	0	0	0	0	0	0	0	0	0	0	0	0	3	0
Ammonia	7664417	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Aniline	62533	3	0	3	0	0	3	3	0	3	0	0	3	0	0
Anthracene	120127	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Antimony	7440360	0	0	3	0	0	3	0	0	0	0	0	3	3	0
Antimony and compounds	7440360	0	0	3	0	0	3	0	0	0	0	0	3	3	0
Arsenic	7440382	0	0	3	1	0	0	0	0	0	1	0	0	2	0
Azobenzene	103333	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barium	7440393	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Benzaldehyde	100527	3	0	0	0	0	0	0	0	3	0	0	0	0	0
Benzene	71432	0	0	0	1	0	0	1	0	0	1	0	0	0	0
Benzidine	92875	3	0	0	0	0	0	3	0	3	0	0	0	3	0
Benzo(A)Anthracene	56553	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzo(A)pyrene	50328	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzo(b)fluoranthene	205992	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzo(k)fluoranthene	207089	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzo[g,h,i]perylene	191242	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzofuran, 2,3-	271896	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzoic acid	65850	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzyl alcohol	100516	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Benzyl chloride	100447	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Beryllium	7440417	2	0	0	0	0	0	0	1	0	0	0	1	0	0
Biphenyl, 1,1-	92524	3	0	0	0	0	3	0	0	3	3	0	3	0	0
Bis(2-chloro-1-methylethyl)ether	108601	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Bis(2-chloroethyl)ether	111444	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bis(2-chloroisopropyl)ether	39638329	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Bis(2-ethylhexyl)phthalate (DEHP)	117817	3	0	0	0	0	3	0	0	0	3	3	3	0	0
Bis(chloromethyl)ether	542881	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromodichloromethane	75274	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Bromoform (tribromomethane)	75252	3	0	0	0	0	3	0	0	3	3	0	3	3	0
Bromomethane	74839	0	0	0	1	0	0	0	0	0	1	0	1	0	0
Butadiene-1,3	106990	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Butanol, 1-	71363	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Butyl benzyl phthalate	85687	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Butylacrylate	141322	0	0	0	0	0	1	0	0	0	0	0	1	1	0
Butylbenzene, n-	104518	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Butylbenzene, T-	98066	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Cadmium	7440439	0	0	0	0	0	0	0	0	3	0	0	1	0	0

China Lake OBOD - HRA

Applicable Target Organs for Chronic Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Chronic Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Carbazole	86748	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Disulfide	75150	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Carbon Monoxide	630080	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon tetrachloride	56235	1	0	0	1	0	0	0	0	0	1	0	0	0	0
Chlorine	7782505	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Chloroacetophenone, 2-	532274	0	0	0	0	0	3	0	0	0	0	0	3	3	0
Chloroaniline, 4-	106478	0	0	0	0	0	0	0	3	0	0	0	0	0	3
Chlorobenzene	108907	1	0	0	0	0	0	0	0	1	0	1	0	0	0
Chloroethane (Ethyl chloride)	75003	1	0	0	1	0	0	0	0	0	0	0	0	0	0
Chloroform	67663	1	0	0	1	0	0	0	0	1	0	0	0	0	0
Chloromethane (Methyl chloride)	74873	3	0	0	0	0	0	0	0	3	3	3	0	0	0
Chloronaphthalene	91587	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Chloronitrobenzene, o-	88733	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Chlorophenol, 2-	95578	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Chloropicrin (trichloronitromethane)	76062	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Chlorotoluene, o-	95498	3	0	0	0	0	3	0	0	3	3	0	3	3	0
Chromium (hex.)	18540299	0	0	0	0	0	0	2	0	0	0	0	1	0	0
Chromium III	16065831	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Chrysene	218019	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Cobalt	7440484	0	0	0	0	0	0	0	0	0	0	0	3	3	0
Copper	7440508	3	0	0	0	0	3	0	0	3	0	0	3	3	0
Cumene (Isopropylbenzene)	98828	0	0	0	3	0	3	0	0	3	3	0	3	3	0
Cyclohexane	110827	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Cyclotetramethylene Tetranitramine (HMX)	2691410	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Diaminotoluene, 2,4-	95807	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diazomethane	334883	0	0	0	0	0	3	0	0	0	0	0	3	0	0
Dibenz[a,h]anthracene	53703	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Dibenzofuran	132649	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Dibromochloromethane	124481	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Dibutyl phthalate	84742	3	0	0	0	0	3	0	0	0	0	0	3	0	0
Dichlorobenzene, 1,2-	95501	3	0	0	0	0	3	0	0	3	0	0	3	3	0
Dichlorobenzene, 1,3-	541731	0	0	0	0	0	0	0	0	0	0	0	3	0	0
Dichlorobenzene, 1,4-	106467	1	0	0	0	0	0	0	0	1	1	0	1	0	0
Dichlorobenzidine, 3,3-	91941	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichlorodifluoromethane	75718	0	0	3	0	0	0	0	0	0	3	0	0	0	0
Dichloroethane, 1,1-	75343	3	0	0	0	0	0	0	0	3	3	0	3	3	0
Dichloroethane, 1,2-	107062	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichloroethylene (cis), 1,2-	156592	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Dichloroethylene (trans), 1,2-	156605	0	0	0	0	0	0	0	3	0	0	0	0	0	3
Dichloroethylene, 1,1- (Dichloroethene, 1,1	75354	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichlorophenol, 2,4-	120832	0	0	0	0	0	0	0	0	0	3	0	0	0	3
Dichloropropane, 1,2-	78875	3	0	0	0	0	3	0	0	3	3	0	3	3	0
Dichloropropene, 1,3-	542756	3	0	0	0	0	3	0	0	3	3	0	3	3	0
Diesel PM	9901	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Diethyl ether (Ethyl ether)	60297	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Diethyl phthalate	84662	0	0	0	0	0	3	0	0	0	3	3	3	3	0
Dimethyl Phthalate	131113	3	0	0	0	0	3	0	0	0	0	0	3	0	0
Dimethylamine	124403	0	0	0	0	0	3	0	0	0	0	0	3	3	0
Dimethylbenz(a)anthracene, 7,12-	57976	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Dimethylbenzidine, 3,3'-	119937	0	0	0	0	0	0	0	0	0	0	0	0	0	0

China Lake OBOD - HRA

Applicable Target Organs for Chronic Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Chronic Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Dimethylcarbamoyl chloride	79447	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylhydrazine, 1,2-	540738	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylphenol, 2,4-	105679	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Dinitrobenzene, 1,2-	528290	3	0	3	0	0	3	3	0	0	3	0	0	3	0
Dinitrobenzene, 1,3-	99650	3	0	3	0	0	3	3	0	0	3	0	0	3	0
Dinitrobenzene, 1,4-	100254	3	0	3	0	0	3	3	0	0	3	0	0	3	0
Dinitro-o-cresol, 4,6-	534521	0	0	3	0	3	0	0	0	0	0	0	0	0	0
Dinitrophenol, 2,4-	51285	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Dinitropyrene, 1,6-	42397648	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitrotoluene, 2,4-	121142	3	0	0	0	0	0	3	0	0	3	0	0	0	0
Dinitrotoluene, 2,6-	606202	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Dinitrotoluene, 4-Amino-2,6-	19406510	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dinitrotoluene, 4-Amino-4,6-	35572782	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Di-n-octyl phthalate	117840	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Dioxane, 1,4-	123911	1	0	1	0	0	0	0	0	1	0	0	0	0	0
Diphenylamine	122394	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethoxyethanol, 2-	110805	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Ethylbenzene	100414	1	0	0	1	1	0	0	0	1	0	0	0	0	0
Ethylene	74851	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethyleneimine (Aziridine)	151564	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluoranthene	206440	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluorene	86737	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluorotrichloromethane (Trichlorofluoromet	75694	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Formaldehyde	50000	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Furan (Epoxy-1,3-butadiene, 4-)	110009	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutaraldehyde	111308	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8	35822469	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorobenzene	118741	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorobutadiene (Hexachloro-1,3-buta	87683	0	0	0	0	0	3	0	0	3	0	0	3	3	0
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexachloroethane	67721	0	0	0	0	0	3	0	0	3	0	0	3	3	0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX	121824	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexane, n-	110543	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Hexanone, 2-	591786	0	0	0	0	0	1	0	0	0	1	0	1	1	0
Hydrogen chloride	7647010	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Hydrogen Cyanide	74908	0	0	1	0	1	0	0	0	0	1	0	0	0	0
Indeno[1,2,3-cd]pyrene	193395	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron	7439896	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Isophorone	78591	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Isoprene	9003310	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lead	7439921	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malononitrile	109773	0	0	0	0	0	0	0	0	0	0	0	0	0	3

China Lake OBOD - HRA

Applicable Target Organs for Chronic Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Chronic Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Manganese	7439965	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Mercury	7439976	0	0	0	0	0	0	0	2	2	1	0	0	0	0
Methacrylonitrile	126987	0	0	0	0	0	3	0	0	0	3	0	0	3	0
Methanol	67561	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Methylcholanthrene, 3-	56495	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Methylcyclohexane	108872	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Methylene chloride	75092	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Methylethyl ketone	78933	0	0	0	0	0	3	0	0	0	3	0	3	3	0
Methylnaphthalene, 2-	91576	0	0	3	0	3	0	0	0	0	0	0	0	0	3
Methylphenol, 2-	95487	3	0	3	0	0	3	0	0	3	3	0	3	3	0
Methylphenol, 3-	108394	3	0	3	0	0	3	0	0	3	3	0	3	3	0
Methylphenol, 4-	106445	3	0	3	0	0	3	0	0	3	3	0	3	3	0
Methyltertbutyl ether (MTBE)	1634044	1	0	0	0	0	1	0	0	1	0	0	0	0	0
Molybdenum	7439987	3	0	0	0	0	3	0	0	3	0	0	3	0	0
Naphthalene	91203	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Nickel and compounds	7440020	2	0	0	0	0	0	1	0	0	0	0	1	0	0
Nitric Oxide	10102439	0	0	0	0	0	2	2	0	0	2	0	2	2	0
Nitroacenaphthene, 5-	602879	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroaniline, 2-	88744	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Nitrobenzene	98953	3	0	3	0	0	3	3	0	3	0	3	0	3	0
Nitrochrysene, 6-	7496028	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrogen Dioxide	10102440	0	0	3	0	0	3	0	0	0	0	0	3	0	0
Nitroglycerin	55630	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroguanidine	556887	0	0	0	3	0	0	0	0	0	0	3	0	0	3
Nitrophenol, 4-	100027	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Nitropropane, 2-	79469	3	0	0	0	0	3	0	0	3	3	0	3	3	0
Nitropyrene, 1-	5522430	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodiethylamine, N-	55185	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodimethylamine, N-	62759	2	0	0	0	0	0	0	0	2	0	0	2	0	0
Nitrosodi-n-butylamine, N-	924163	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodi-n-propylamine, N-	621647	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodiphenylamine, N-	86306	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroso-N-methylethylamine, N- (Nitrosome	10595956	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosopiperidine, N-	100754	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosopyrrolidine, N-	930552	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrotoluene, m-	99081	3	0	3	0	0	0	3	0	0	3	0	0	3	0
Nitrotoluene, o-	88722	3	0	3	0	0	0	3	0	0	3	0	0	3	0
Nitrotoluene, p-	99990	3	0	3	0	0	0	3	0	0	3	0	0	3	0
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9	3268879	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pentachlorobenzene	608935	3	0	0	0	0	0	0	0	3	0	0	0	0	3
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pentachloronitrobenzene	82688	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Pentachlorophenol	87865	3	0	3	0	0	3	0	0	3	3	0	3	3	0
Perchlorate	7601903	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Phenanthrene	85018	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Phenol	108952	1	0	1	0	0	0	0	0	1	1	0	0	0	0
Phosgene	75445	0	0	0	0	0	0	0	0	0	0	0	0	0	0

China Lake OBOD - HRA

Applicable Target Organs for Chronic Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Chronic Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Phosphorus (white)	7723140	3	0	0	0	0	3	0	0	0	0	0	0	3	0
Propanol, 2-	67630	0	0	0	1	0	0	0	0	1	0	0	0	0	0
Propylbenzene, n-	103651	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Propylene (Propene)	115071	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Pyrene	129000	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Pyridine	110861	3	0	0	0	3	0	0	0	3	3	0	0	3	0
Selenium	7782492	1	0	1	0	0	0	0	0	0	1	0	0	0	0
Silica, Crystalline	1175	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Strontium	7440246	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Styrene	100425	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sulfur Dioxide	7446095	0	0	0	0	0	1	0	0	0	0	0	1	1	0
Sulfuric acid	7664939	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tetrachlorobenzene, 1,2,4,5-	95943	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	3	0	0	3	3	0	3	0	0	0	3	3	0	0
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	3	0	0	3	3	0	3	0	0	0	3	3	0	0
Tetrachloroethane, 1,1,2,2-	79345	3	0	0	0	0	0	0	0	3	3	0	0	3	0
Tetrachloroethylene (PCE)	127184	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Tetrachlorophenol, 2,3,4,6-	58902	3	0	0	0	0	0	0	0	0	0	0	0	0	3
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl,	479458	3	0	0	0	0	3	0	0	3	3	0	3	3	0
Thallium and compounds	7446186	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Toluene	108883	0	0	0	1	0	0	0	0	0	1	0	1	0	0
Toluidine, o- (Methylaniline, 2-)	95534	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total HpCDD	35822469	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total HpCDF	67562394	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total HxCDD	19408743	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total HxCDF	57117449	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total PeCDD	40321764	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total PeCDF	57117314	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Total TCDD	1746016	3	0	0	3	3	0	3	0	0	0	3	3	0	0
Total TCDF	51207319	3	0	0	3	3	0	3	0	0	0	3	3	0	0
Trichlorobenzene, 1,2,4-	120821	3	0	0	0	0	3	0	0	0	0	3	3	3	0
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Trichloroethane, 1,1,2-	79005	3	0	0	0	0	3	0	0	3	3	0	3	0	0
Trichloroethylene (TCE)	79016	0	0	0	0	0	1	0	0	0	1	0	0	0	0
Trichlorophenol, 2,4,5-	95954	3	0	0	0	0	0	0	0	3	0	0	0	0	0
Trichlorophenol,2,4,6-	88062	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Trimethylbenzene, 1,2,4-	95636	0	0	0	0	0	3	3	0	0	3	0	3	3	0
Trimethylbenzene, 1,3,5-	108678	0	0	0	0	0	3	3	0	0	3	0	3	3	0
Trimethylpentane, 2,2,4-	540841	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Trinitrobenzene, 1,3,5-	99354	0	0	0	0	0	0	3	0	0	0	0	0	0	3
Trinitrotoluene, 2,4,6- (TNT)	118967	3	0	3	0	0	3	3	0	3	3	0	3	3	0
Urethane (Ethyl carbamate)	51796	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium & Compounds	7440622	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Vinyl acetate	108054	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Vinyl Chloride	75014	3	0	0	0	0	0	3	3	0	3	0	3	0	0
Xylenes	1330207	0	0	0	0	0	0	0	0	0	1	0	1	0	0
Zinc	7440666	0	0	0	3	0	0	0	0	0	0	0	0	0	3

China Lake - OBOD HRA

Applicable Target Organs for Acute Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Acute Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Acenaphthene	83329	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Acenaphthylene	208968	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetaldehyde	75070	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetone	67641	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetonitrile	75058	1	0	1	0	0	0	0	0	1	1	0	1	0	0
Acetophenone	98862	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Acetylaminofluorene, 2-	53963	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acrolein	107028	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Acrylonitrile	107131	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Allyl chloride	107051	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aluminum	7429905	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aminobiphenyl, 4-	92671	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aminopyridine, 4-	504245	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ammonia	7664417	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Aniline	62533	1	0	0	0	0	1	1	0	1	0	0	1	1	0
Anthracene	120127	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antimony	7440360	0	0	1	0	0	1	0	0	0	0	0	1	1	0
Antimony and compounds	7440360	0	0	1	0	0	1	0	0	0	0	0	1	1	0
Arsenic	7440382	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Azobenzene	103333	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Barium	7440393	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Benzaldehyde	100527	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzene	71432	0	0	0	1	0	0	1	1	0	0	1	0	0	0
Benzidine	92875	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzo(A)Anthracene	56553	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzo(A)pyrene	50328	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Benzo(b)fluoranthene	205992	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzo(k)fluoranthene	207089	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzo[g,h,i]perylene	191242	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzofuran, 2,3-	271896	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzoic acid	65850	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzyl alcohol	100516	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Benzyl chloride	100447	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Beryllium	7440417	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Biphenyl, 1,1-	92524	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bis(2-chloro-1-methylethyl)ether	108601	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bis(2-chloroethyl)ether	111444	1	0	0	0	0	1	0	0	0	0	0	1	0	0
Bis(2-chloroisopropyl)ether	39638329	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bis(2-ethylhexyl)phthalate (DEHP)	117817	1	0	0	0	0	1	0	0	0	1	1	1	0	0
Bis(chloromethyl)ether	542881	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromodichloromethane	75274	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bromoform (tribromomethane)	75252	1	0	0	0	0	1	0	0	1	1	0	1	1	0
Bromomethane	74839	0	0	0	1	0	0	0	0	0	1	1	1	0	0
Butadiene-1,3	106990	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Butanol, 1-	71363	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Butyl benzyl phthalate	85687	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Butylacrylate	141322	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Butylbenzene, n-	104518	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Butylbenzene, T-	98066	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	7440439	0	0	0	0	0	0	0	0	0	0	0	0	0	0

China Lake - OBOD HRA

Applicable Target Organs for Acute Exposure to Noncancer Substances

Substance	CAS Number	Target Organs for Acute Noncancer Health Effects													
		Alimentary Tract	Bone	Cardiovascular	Developmental	Endocrine	Eye	Hematologic	Immune	Kidney	Nervous	Reproductive	Respiratory	Skin	Other
Carbazole	86748	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carbon Disulfide	75150	0	0	0	1	0	0	0	0	0	1	1	0	0	0
Carbon Monoxide	630080	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Carbon tetrachloride	56235	1	0	0	1	0	0	0	0	0	1	1	0	0	0
Chlorine	7782505	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Chloroacetophenone, 2-	532274	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloroaniline, 4-	106478	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chlorobenzene	108907	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloroethane (Ethyl chloride)	75003	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloroform	67663	0	0	0	1	0	0	0	0	0	1	1	0	0	0
Chloromethane (Methyl chloride)	74873	1	0	0	0	0	0	0	0	1	1	1	0	0	0
Chloronaphthalene	91587	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chloronitrobenzene, o-	88733	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chlorophenol, 2-	95578	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chloropicrin (trichloronitromethane)	76062	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Chlorotoluene, o-	95498	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium (hex.)	18540299	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chromium III	16065831	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Chrysene	218019	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Cobalt	7440484	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Copper	7440508	1	0	0	0	0	1	0	0	1	0	0	1	1	0
Cumene (Isopropylbenzene)	98828	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclohexane	110827	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclotetramethylene Tetranitramine (HMX)	2691410	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diaminotoluene, 2,4-	95807	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diazomethane	334883	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Dibenz[a,h]anthracene	53703	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dibenzofuran	132649	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dibromochloromethane	124481	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dibutyl phthalate	84742	1	0	0	0	0	1	0	0	0	0	0	1	0	0
Dichlorobenzene, 1,2-	95501	1	0	0	0	0	1	0	0	0	0	0	0	1	0
Dichlorobenzene, 1,3-	541731	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichlorobenzene, 1,4-	106467	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichlorobenzidine, 3,3-	91941	1	0	0	0	0	0	0	0	0	0	0	1	1	0
Dichlorodifluoromethane	75718	0	0	1	0	0	0	0	0	0	1	0	0	0	0
Dichloroethane, 1,1-	75343	1	0	0	0	0	0	0	0	1	1	0	1	1	0
Dichloroethane, 1,2-	107062	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichloroethylene (cis), 1,2-	156592	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichloroethylene (trans), 1,2-	156605	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichloroethylene, 1,1- (Dichloroethene, 1,1-)	75354	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dichlorophenol, 2,4-	120832	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dichloropropane, 1,2-	78875	1	0	0	0	0	1	0	0	1	1	0	1	1	0
Dichloropropene, 1,3-	542756	1	0	0	0	0	1	0	0	1	1	0	1	1	0
Diesel PM	9901	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diethyl ether (Ethyl ether)	60297	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diethyl phthalate	84662	0	0	0	0	0	1	0	0	0	1	1	1	1	0
Dimethyl Phthalate	131113	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylamine	124403	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylbenz(a)anthracene, 7,12-	57976	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylbenzidine, 3,3'-	119937	0	0	0	0	0	0	0	0	0	0	0	0	0	0

China Lake - OBOD HRA

Applicable Target Organs for Acute Exposure to Noncancer Substances

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Dimethylcarbamoyl chloride	79447	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylhydrazine, 1,2-	540738	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dimethylphenol, 2,4-	105679	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitrobenzene, 1,2-	528290	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitrobenzene, 1,3-	99650	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitrobenzene, 1,4-	100254	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitro-o-cresol, 4,6-	534521	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Dinitrophenol, 2,4-	51285	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dinitropyrene, 1,6-	42397648	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitrotoluene, 2,4-	121142	1	0	0	0	0	0	1	0	0	1	0	0	0	0
Dinitrotoluene, 2,6-	606202	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Dinitrotoluene, 4-Amino-2,6-	19406510	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dinitrotoluene, 4-Amino-4,6-	35572782	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Di-n-octyl phthalate	117840	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dioxane, 1,4-	123911	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Diphenylamine	122394	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethoxyethanol, 2-	110805	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Ethylbenzene	100414	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethylene	74851	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethyleneimine (Aziridine)	151564	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluoranthene	206440	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluorene	86737	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fluorotrichloromethane (Trichlorofluorometh	75694	0	0	1	0	0	0	0	1	0	0	0	1	1	0
Formaldehyde	50000	0	0	0	0	0	1	0	1	0	0	0	1	0	0
Furan (Epoxy-1,3-butadiene, 4-)	110009	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glutaraldehyde	111308	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptachlorodibenzofuran, 1,2,3,4,6,7,8-	67562394	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptachlorodibenzofuran, 1,2,3,4,7,8,9-	55673897	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Heptachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8-	35822469	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorobenzene	118741	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorobutadiene (Hexachloro-1,3-butad	87683	0	0	0	0	0	1	0	0	1	0	0	1	1	0
Hexachlorodibenzofuran, 1,2,3,4,7,8-	70648269	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorodibenzofuran, 1,2,3,6,7,8-	57117449	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorodibenzofuran, 1,2,3,7,8,9-	72918219	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorodibenzofuran, 2,3,4,6,7,8-	60851345	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorodibenzo-p-Dioxin, 1,2,3,4,7,8-	39227286	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorodibenzo-p-Dioxin, 1,2,3,6,7,8-	57653857	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachlorodibenzo-p-Dioxin, 1,2,3,7,8,9-	19408743	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexachloroethane	67721	0	0	0	0	0	1	0	0	1	0	0	1	1	0
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121824	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexane, n-	110543	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hexanone, 2-	591786	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrogen chloride	7647010	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Hydrogen Cyanide	74908	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Indeno[1,2,3-cd]pyrene	193395	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Iron	7439896	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Isophorone	78591	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Isoprene	9003310	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lead	7439921	1	0	0	0	0	1	1	0	1	1	0	0	0	0
Malononitrile	109773	0	0	0	0	0	0	0	0	0	0	0	0	0	0

China Lake - OBOD HRA

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Manganese	7439965	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mercury	7439976	0	0	0	1	0	0	0	0	0	0	1	0	0	0
Methacrylonitrile	126987	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methanol	67561	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Methylcholanthrene, 3-	56495	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methylcyclohexane	108872	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methylene chloride	75092	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Methylethyl ketone	78933	0	0	0	0	0	1	0	0	0	1	0	1	1	0
Methylnaphthalene, 2-	91576	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Methylphenol, 2-	95487	1	0	1	0	0	1	0	0	1	1	0	1	1	0
Methylphenol, 3-	108394	1	0	1	0	0	1	0	0	1	1	0	1	1	0
Methylphenol, 4-	106445	1	0	1	0	0	1	0	0	1	1	0	1	1	0
Methyltertbutyl ether (MTBE)	1634044	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Molybdenum	7439987	1	0	0	0	0	1	0	0	1	0	0	1	0	0
Naphthalene	91203	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nickel and compounds	7440020	0	0	0	0	0	0	0	1	0	0	0	1	0	0
Nitric Oxide	10102439	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroacenaphthene, 5-	602879	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroaniline, 2-	88744	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrobenzene	98953	1	0	1	0	0	1	1	0	1	0	1	0	1	0
Nitrochrysene, 6-	7496028	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrogen Dioxide	10102440	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Nitroglycerin	55630	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroguanidine	556887	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrophenol, 4-	100027	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Nitropropane, 2-	79469	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitropyrene, 1-	5522430	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodiethylamine, N-	55185	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodimethylamine, N-	62759	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodi-n-butylamine, N-	924163	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodi-n-propylamine, N-	621647	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosodiphenylamine, N-	86306	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitroso-N-methylethylamine, N- (Nitrosomet	10595956	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosopiperidine, N-	100754	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrosopyrrolidine, N-	930552	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrotoluene, m-	99081	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrotoluene, o-	88722	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrotoluene, p-	99990	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octachlorodibenzofuran, 1,2,3,4,6,7,8,9-	39001020	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octachlorodibenzo-p-Dioxin, 1,2,3,4,6,7,8,9-	3268879	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentachlorobenzene	608935	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Pentachlorodibenzofuran, 1,2,3,7,8-	57117416	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentachlorodibenzofuran, 2,3,4,7,8-	57117314	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentachlorodibenzo-p-Dioxin, 1,2,3,7,8-	40321764	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pentachloronitrobenzene	82688	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Pentachlorophenol	87865	1	0	1	0	0	1	0	0	1	1	0	1	1	0
Perchlorate	7601903	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	85018	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	108952	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Phosgene	75445	0	0	0	0	0	0	0	0	0	0	0	1	0	0

China Lake - OBOD HRA

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Phosphorus (white)	7723140	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Propanol, 2-	67630	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Propylbenzene, n-	103651	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Propylene (Propene)	115071	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyrene	129000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pyridine	110861	1	0	0	0	0	1	0	0	1	1	0	0	1	0
Selenium	7782492	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silica, Crystalline	1175	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Strontium	7440246	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Styrene	100425	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Sulfur Dioxide	7446095	0	0	0	0	0	1	0	0	0	0	0	1	1	0
Sulfuric acid	7664939	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tetrachlorobenzene, 1,2,4,5-	95943	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tetrachlorodibenzofuran, 2,3,7,8-	51207319	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetrachlorodibenzo-p-Dioxin, 2,3,7,8-	1746016	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetrachloroethane, 1,1,2,2-	79345	1	0	0	0	0	0	0	0	1	1	0	0	1	0
Tetrachloroethylene (PCE)	127184	0	0	0	0	0	1	0	0	0	1	0	1	0	0
Tetrachlorophenol, 2,3,4,6-	58902	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tetranitro-N-methylaniline, N,2,4,6- (Tetryl,	479458	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thallium and compounds	7446186	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Toluene	108883	0	0	0	1	0	1	0	0	0	1	1	1	0	0
Toluidine, o- (Methylaniline, 2-)	95534	1	0	0	0	0	1	1	0	1	0	0	0	1	0
Total HpCDD	35822469	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total HpCDF	67562394	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total HxCDD	19408743	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total HxCDF	57117449	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total PeCDD	40321764	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total PeCDF	57117314	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total TCDD	1746016	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total TCDF	51207319	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichlorobenzene, 1,2,4-	120821	1	0	0	0	0	1	0	0	0	0	0	1	1	0
Trichloroethane, 1,1,1- (Methyl chloroform)	71556	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Trichloroethane, 1,1,2-	79005	1	0	0	0	0	1	0	0	1	1	0	1	0	0
Trichloroethylene (TCE)	79016	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trichlorophenol, 2,4,5-	95954	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Trichlorophenol,2,4,6-	88062	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trimethylbenzene, 1,2,4-	95636	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trimethylbenzene, 1,3,5-	108678	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trimethylpentane, 2,2,4-	540841	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trinitrobenzene, 1,3,5-	99354	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Trinitrotoluene, 2,4,6- (TNT)	118967	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Urethane (Ethyl carbamate)	51796	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vanadium & Compounds	7440622	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Vinyl acetate	108054	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vinyl Chloride	75014	0	0	0	0	0	1	0	0	0	1	0	1	0	0
Xylenes	1330207	0	0	0	0	0	1	0	0	0	0	0	1	0	0
Zinc	7440666	0	0	0	0	0	0	0	0	0	0	0	0	0	0