

Date: 5/15/07

To: Don Bryan, Tradewinds  
John Lague, URS

From: April Matsumura, Clean Air Branch

**Subj: Boiler Emission Calculations**

Thank you for correcting my error showing the methanol emission figure in the boiler column. It should have been in the dryer column.

I have reviewed the boiler calculations in your application and have attached some comments.

Also attached are potential boiler emission calculations that will be included in my report. These calculations are based on EPA emission factors which provide the most conservative analysis. The emission figures, however, will be adjusted based on the following information you provide:

1. Boiler fuel usage or hourly limit for fuel oil no. 2.
2. Max boiler heat capacity.

Thank you for your assistance.

# SECTION THREE

# Project Emissions Estimates

**Table 3-10**  
**Estimated Hazardous Air Pollutant (HAP) Emissions from O'okala Mill Cogeneration Boiler**  
**[Results Presented with both AP-42 and NCASI Emission Factors for Wood Firing]**

HAP	Emission Factor (lb/MMBtu)			Total Boiler Emissions (tons/year)	
	Wood Firing AP-42	Wood Firing NCASI	Distillate Firing AP-42	Based on AP-42 Factors	Based on NCASI Factors
Acetaldehyde	8.30E-04	1.9E-04	-	4.15E-01	9.51E-02
Acetophenone	3.20E-09	2.6E-07	-	1.60E-06	1.30E-04
Acrolein	4.00E-03	7.8E-05	--	2.00E+00	3.90E-02
Benzene	4.20E-03	3.3E-03	--	2.10E+00	1.65E+00
Bis(2-Ethylhexyl)phthalate	4.70E-08	4.7E-08	2.14E-04	3.15E-03	3.15E-03
Carbon Tetrachloride	4.50E-05	8.9E-07	-	2.25E-02	4.46E-04
Chlorine	7.90E-04		-	3.95E-01	0.00E+00
Chlorobenzene	3.30E-05	1.7E-05	-	1.65E-02	8.51E-03
Chloroform	2.80E-05	3.1E-05	-	1.40E-02	1.55E-02
2,4-Dinitrophenol	1.80E-07	4.8E-07	-	9.01E-05	2.40E-04
Ethylbenzene	3.10E-05	6.8E-06	-	1.55E-02	3.40E-03
Formaldehyde	4.40E-03	1.3E-03	4.36E-04	2.21E+00	6.57E-01
Hydrogen Chloride	1.90E-02	6.7E-04	-	9.51E+00	3.35E-01
Naphthalene	9.70E-05	1.6E-04	1.13E-03	6.51E-02	9.66E-02
4-Nitrophenol	1.10E-07	3.3E-07	-	5.51E-05	1.65E-04
Pentachlorophenol	5.10E-08	4.6E-08	-	2.55E-05	2.30E-05
Phenol	5.10E-05	1.4E-05	-	2.55E-02	7.01E-03
Polycyclic Organic Matter	-		2.36E-05	3.45E-04	3.45E-04
Propionaldehyde	6.10E-05	6.1E-05	-	3.05E-02	3.05E-02
Styrene	1.90E-03	6.4E-04	-	9.51E-01	3.20E-01
2,3,7,8 Tetrachlorodibenzo-p-Dioxins	8.60E-12		-	4.30E-09	0.00E+00
Toluene	9.20E-04	2.9E-05	6.20E-03	5.51E-01	1.05E-01
2,4,6 Trichlorophenol	2.20E-08	2.2E-07	-	1.10E-05	1.10E-04
Vinyl Chloride	1.80E-05	1.8E-05	-	9.01E-03	9.01E-03
o-Xylene	2.50E-05	1.7E-05	1.09E-04	1.41E-02	1.01E-02
Antimony <sup>4</sup>	7.90E-06	4.2E-07	-	3.95E-03	2.10E-04
Arsenic <sup>4</sup>	2.20E-05	1.0E-06	4.00E-06	1.11E-02	5.59E-04
Beryllium <sup>4</sup>	1.10E-06	1.9E-06	3.00E-06	5.95E-04	9.95E-04

*Benzene*

*Circled figures in lb/1000 gal. Need to convert to lb/MMBtu*  
*Missing phosphorus.*

# SECTION THREE

# Project Emissions Estimates

Table 3-12

Estimated Maximum Annual Emissions of Hazardous Air Pollutants from All Sources of the Operational O'okala Veneer Mill and Cogeneration Plant (tons per year)<sup>1</sup>

HAP	Boiler Annual Emissions (tons/year) <sup>1</sup>	Dryer Annual Emissions (tons/year) <sup>2</sup>	Total Project Emissions (tons/year)
Acetaldehyde	9.51E-02	1.50645	1.60E+00
Acetone	-	2.1165	2.12E+00
Acetophenone	1.30E-04	-	1.30E-04
Acrolein	3.90E-02	-	3.90E-02
Benzene	1.65E+00	-	1.65E+00
Carbon Tetrachloride	4.46E-04	-	4.46E-04
Chloroform	1.55E-02	-	1.55E-02
Ethylbenzene	3.40E-03	-	3.40E-03
Formaldehyde	6.57E-01	0.3154	9.73E-01
Hydrogen Chloride	3.35E-01	-	3.35E-01
Methanol	-	2.573	2.57E+00
Methyl Isobutyl Ketone	-	1.2948	1.29E+00
Naphthalene	9.66E-02	-	9.66E-02
Phenol	7.01E-03	0.1245	1.32E-01
Styrene	3.20E-01	-	3.20E-01
1,1,1-Trichloroethane	-	-	0.00E+00
Toluene	1.05E-01	-	1.05E-01
o-Xylene	1.01E-02	-	1.01E-02
Arsenic	5.59E-04	-	5.59E-04
Beryllium	9.95E-04	-	9.95E-04
Cadmium	9.95E-04	-	9.95E-04
Chromium, total	3.44E-04	-	3.44E-04
Cobalt	9.51E-05	-	9.51E-05
Lead	3.03E-03	-	3.03E-03
Manganese	7.52E-02	-	7.52E-02
Mercury	5.39E-04	-	5.39E-04
Nickel	1.50E-03	-	1.50E-03
Selenium	1.72E-03	-	1.72E-03
ALL HAPS (tons per year)	3.42 19.26	7.93	11.35 27.19

<sup>1</sup> Boiler annual emissions in this table are based on NCASI emission factors and assumed average boiler load factor of 89%, excluding 264 hours on fuel oil.

<sup>2</sup> Dryer annual emissions are based on 7,200 hours of operation per year.

*No HAP totals based on EPA factors shown.*

**Table 7: Boiler Emissions - Wood Fuel**

Pollutant	Emission Factor (lb/MMBTU)	Reference	at 8,760 hr/yr		
			(lb/hr)	(g/sec)	(tpy)
CO	0.305	manufacturer	41.18	5.188	180.35
NOx	0.230	manufacturer	31.05	3.912	35.71
PM	0.029	AP-42, App B	3.88	0.489	4.46
PM-10	0.025	manufacturer	3.38	0.425	3.88
PM-2.5	0.020	AP-42, App B	2.72	0.342	3.12
SO2	0.025	manufacturer	3.38	0.425	3.88
VOC	0.017	manufacturer	2.30	0.289	2.64

## Notes:

1. Manufacturer guaranteed emission factors per 11/10/06 application, App. B, §E9(b).
2. PM = 1.15 \* PM-10, based on AP-42 Appendix B, Table B.2.2, Category 2, 1/95.
3. PM-2.5 = 0.7 \* PM, based on AP-42 Appendix B, Table B.2.2, Category 2, 1/95.

**Table 8: Boiler Emissions - Fuel Oil No. 2**

Pollutant	Emission Factor (lb/MMBTU)	Reference	at 8,760 hr/yr		
			(lb/hr)	(g/sec)	(tpy)
CO	0.0400	manufacturer	5.40	0.680	23.65
NOx	0.1700	manufacturer	22.95	2.892	26.39
PM	0.0161	AP-42, App B	2.17	0.274	2.50
PM-10	0.0140	manufacturer	1.89	0.238	2.17
PM-2.5	0.0113	AP-42, App B	1.52	0.192	1.75
SO2	0.4500	manufacturer	60.75	7.654	69.86
VOC	0.0014	manufacturer	0.19	0.024	0.22

## Notes:

1. Manufacturer guaranteed emission factors per 11/10/06 application, App. B, §E9(b).
2. PM = 1.15 \* PM-10, based on AP-42 Appendix B, Table B.2.2, Category 2, 1/95.
3. PM-2.5 = 0.7 \* PM, based on AP-42 Appendix B, Table B.2.2, Category 2, 1/95.

**Table 9: Worst-case Boiler Emissions (tpy)**

Pollutant	Wood Fuel at 8,760 hr/yr	Fuel Oil No. 2 at 8,760 hr/yr	Maximum at 8,760 hr/yr
CO	180.3	23.7	180.3
NOx	35.7	26.4	35.7
PM	4.5	2.5	4.5
PM-10	3.9	2.2	3.9
PM-2.5	3.1	1.7	3.1
SO2	3.9	69.9	69.9
VOC	2.6	0.2	2.6

**Table : HAP Emissions from Boiler fired on Wood Fuel  
(without and with a proposed limit)**

Hazardous Air Pollutant (Italics indicate metals.)	AP-42 EF (lb/MMBTU)	Emissions (without HCL limit)		Proposed Limit (lb/MMBTU)	Emissions (with HCL limit)	
		(lb/hr)	(tpy)		(lb/hr)	(tpy)
Acetaldehyde	8.30E-04	1.12E-01	0.49078		0.49078	0.49078
Acetophenone	3.20E-09	4.32E-07	0.00000		0.00000	0.00000
Acrolein	4.00E-03	5.40E-01	2.36520		2.36520	2.36520
<i>Antimony Compounds</i>	7.90E-06	1.07E-03	0.00467		0.00467	0.00467
<i>Arsenic Compounds</i>	2.20E-05	2.97E-03	0.01301		0.01301	0.01301
Benzene	4.20E-03	5.67E-01	2.48346		2.48346	2.48346
<i>Beryllium Compounds</i>	1.10E-06	1.49E-04	0.00065		0.00065	0.00065
Bis(2-ethylhexyl)phthalate (DEHP)	4.70E-08	6.35E-06	0.00003		0.00003	0.00003
<i>Cadmium Compounds</i>	4.10E-06	5.54E-04	0.00242		0.00242	0.00242
Carbon tetrachloride	4.50E-05	6.08E-03	0.02661		0.02661	0.02661
Chlorine	7.90E-04	1.07E-01	0.46713		0.46713	0.46713
Chlorobenzene	3.30E-05	4.46E-03	0.01951		0.01951	0.01951
Chloroform	2.80E-05	3.78E-03	0.01656		0.01656	0.01656
<i>Chromium Compounds</i>	2.10E-05	2.84E-03	0.01242		0.01242	0.01242
<i>Cobalt Compounds</i>	6.50E-06	8.78E-04	0.00384		0.00384	0.00384
2,4-Dinitrophenol	1.80E-07	2.43E-05	0.00011		0.00011	0.00011
Ethyl benzene	3.10E-05	4.19E-03	0.01833		0.01833	0.01833
Formaldehyde	4.40E-03	5.94E-01	2.60172		2.60172	2.60172
Hydrochloric acid	1.90E-02	2.57E+00	<b>11.23470</b>	<b>0.00800</b>	1.08E+00	<b>4.73040</b>
<i>Lead Compounds</i>	4.80E-05	6.48E-03	0.02838		0.02838	0.02838
<i>Manganese Compounds</i>	1.60E-03	2.16E-01	0.94608		0.94608	0.94608
<i>Mercury Compounds</i>	3.50E-06	4.73E-04	0.00207		0.00207	0.00207
Naphthalene	9.70E-05	1.31E-02	0.05736		0.05736	0.05736
<i>Nickel Compounds</i>	3.30E-05	4.46E-03	0.01951		0.01951	0.01951
4-Nitrophenol	1.10E-07	1.49E-05	0.00007		0.00007	0.00007
Pentachlorophenol	5.10E-08	6.89E-06	0.00003		0.00003	0.00003
Phenol	5.10E-05	6.89E-03	0.03016		0.03016	0.03016
<i>Phosphorus</i>	2.70E-05	3.65E-03	0.01597		0.01597	0.01597
Propionaldehyde	6.10E-05	8.24E-03	0.03607		0.03607	0.03607
<i>Selenium Compounds</i>	2.80E-06	3.78E-04	0.00166		0.00166	0.00166
Styrene	1.90E-03	2.57E-01	1.12347		1.12347	1.12347
2,3,7,8-Tetrachlorodibenzo-p-dioxin	8.60E-12	1.16E-09	0.00000		0.00000	0.00000
Toluene	9.20E-04	1.24E-01	0.54400		0.54400	0.54400
2,4,6-Trichlorophenol	2.20E-08	2.97E-06	0.00001		0.00001	0.00001
Vinyl chloride	1.80E-05	2.43E-03	0.01064		0.01064	0.01064
o-Xylene	2.20E-05	2.97E-03	0.01301		0.01301	0.01301
<b>Total (tpy)</b>			<b>22.6</b>		<b>Total (tpy)</b>	<b>16.1</b>

**Input:**  
 Heat value = **0.14 MMBTU/gal**  
 Boiler Max Heat Capacity for FO2 = **135 MMBTU/hr**  
 Operating limit for FO2 = **264 hr/yr**

**Table: HAP Emissions from Boiler fired on Diesel Oil**

Hazardous Air Pollutant	AP-42 Table Reference	Emis. Factor (lb/1000 gal)	Emis. Factor (lb/MMBTU)	Emissions (lb/hr)	Emissions (tpy)	
					8,760 hr/yr	264 hr/yr
Formaldehyde	1.3-8	6.10E-02	4.36E-04	5.88E-02	<b>2.58E-01</b>	<b>7.76E-03</b>
POM	1.3-8	3.30E-03	2.36E-05	3.18E-03	<b>1.39E-02</b>	<b>4.20E-04</b>
Benzene	1.3-9	2.14E-04	1.53E-06	2.06E-04	<b>9.04E-04</b>	<b>2.72E-05</b>
Ethylbenzene	1.3-9	6.36E-05	4.54E-07	6.13E-05	<b>2.69E-04</b>	<b>8.10E-06</b>
Naphthalene	1.3-9	1.13E-03	8.07E-06	1.09E-03	<b>4.77E-03</b>	<b>1.44E-04</b>
1,1,1-Trichloroethane	1.3-9	2.36E-04	1.69E-06	2.28E-04	<b>9.97E-04</b>	<b>3.00E-05</b>
Toluene	1.3-9	6.20E-03	4.43E-05	5.98E-03	<b>2.62E-02</b>	<b>7.89E-04</b>
o-Xylene	1.3-9	1.09E-04	7.79E-07	1.05E-04	<b>4.60E-04</b>	<b>1.39E-05</b>
Arsenic	1.3-10	n/a	4.00E-06	5.40E-04	<b>2.37E-03</b>	<b>7.13E-05</b>
Beryllium	1.3-10	n/a	3.00E-06	4.05E-04	<b>1.77E-03</b>	<b>5.35E-05</b>
Cadmium	1.3-10	n/a	3.00E-06	4.05E-04	<b>1.77E-03</b>	<b>5.35E-05</b>
Chromium	1.3-10	n/a	3.00E-06	4.05E-04	<b>1.77E-03</b>	<b>5.35E-05</b>
Lead	1.3-10	n/a	9.00E-06	1.22E-03	<b>5.32E-03</b>	<b>1.60E-04</b>
Manganese	1.3-10	n/a	6.00E-06	8.10E-04	<b>3.55E-03</b>	<b>1.07E-04</b>
Mercury	1.3-10	n/a	3.00E-06	4.05E-04	<b>1.77E-03</b>	<b>5.35E-05</b>
Nickel	1.3-10	n/a	3.00E-06	4.05E-04	<b>1.77E-03</b>	<b>5.35E-05</b>
Selenium	1.3-10	n/a	1.50E-05	2.03E-03	<b>8.87E-03</b>	<b>2.67E-04</b>
<b>Total</b>					<b>3.34E-01</b>	<b>1.01E-02</b>

Notes:

- Factors from Tables 1.3-8 and 1.3-9 in units of lb/1,000 gallons were converted to lb/MMBTU/hr based on 0.14 MMBTU/gal fuel oil no. 2 heating value.
- Compounds listed in Table 1.3-9, such as acecanphthene are classified a POM, and accounted for by the Table 1.3-8 POM emission factor.
- Emissions based on boiler maximum heat capacity of 135 MMBTU/hr.

Alphabetize HAPs

<b>Table: HAP Emissions from Boiler fired on Diesel Oil</b>		
<b>Hazardous Air Pollutant</b>	<b>Emissions (tpy)</b>	
	<b>8,760 hr/yr</b>	<b>264 hr/yr</b>
<i>Arsenic</i>	2.37E-03	7.13E-05
<i>Benzene</i>	9.04E-04	2.72E-05
<i>Beryllium</i>	1.77E-03	5.35E-05
<i>Cadmium</i>	1.77E-03	5.35E-05
<i>Chromium</i>	1.77E-03	5.35E-05
<i>Ethylbenzene</i>	2.69E-04	8.10E-06
<i>Formaldehyde</i>	2.58E-01	7.76E-03
<i>Lead</i>	5.32E-03	1.60E-04
<i>Manganese</i>	3.55E-03	1.07E-04
<i>Mercury</i>	1.77E-03	5.35E-05
<i>Naphthalene</i>	4.77E-03	1.44E-04
<i>Nickel</i>	1.77E-03	5.35E-05
<i>Selenium</i>	8.87E-03	2.67E-04
<i>Toluene</i>	2.62E-02	7.89E-04
<i>1,1,1-Trichloroethane</i>	9.97E-04	3.00E-05
<i>o-Xylene</i>	4.60E-04	1.39E-05
<i>POM</i>	1.39E-02	4.20E-04
<b>Total</b>	<b>3.34E-01</b>	<b>1.01E-02</b>

**Table 11: Total Facility HAP Emissions (with no HCl limit)**

<b>Hazardous Air Pollutant</b> <i>(Italics indicate metals.)</i>	<b>Boiler on wood fuel, no HCl limit</b>	<b>Boiler on fuel oil no. 2 264 hr/yr</b>	<b>Dryer</b>	<b>Total Emissions</b>
Acetaldehyde	0.49078		1.51000	2.00078
Acetophenone	0.00000		2.12000	2.12000
Acrolein	2.36520			2.36520
<i>Antimony Compounds</i>	0.00467			0.00467
<i>Arsenic Compounds</i>	0.01301	7.13E-05		0.01308
Benzene (includes that from gasoline)	2.48346	2.72E-05		2.48349
<i>Beryllium Compounds</i>	0.00065	5.35E-05		0.00070
Bis(2-ethylhexyl)phthalate (DEHP)	0.00003			0.00003
<i>Cadmium Compounds</i>	0.00242	5.35E-05		0.00248
Carbon tetrachloride	0.02661			0.02661
Chlorine	0.46713			0.46713
Chlorobenzene	0.01951			0.01951
Chloroform	0.01656			0.01656
<i>Chromium Compounds</i>	0.01242	5.35E-05		0.01247
<i>Cobalt Compounds</i>	0.00384			0.00384
2,4-Dinitrophenol	0.00011			0.00011
Ethylbenzene	0.01833	8.10E-06		0.01834
Formaldehyde	2.60172	7.76E-03	0.32000	2.92948
Hydrochloric acid	<b>11.23470</b>			11.23470
<i>Lead Compounds</i>	0.02838	1.60E-04		0.02854
<i>Manganese Compounds</i>	0.94608	1.07E-04		0.94619
<i>Mercury Compounds</i>	0.00207	5.35E-05		0.00212
Methanol			2.57000	2.57000
Methyl isobutyl ketone (Hexone)			1.29000	1.29000
Naphthalene	0.05736	1.44E-04		0.05750
<i>Nickel Compounds</i>	0.01951	5.35E-05		0.01957
4-Nitrophenol	0.00007			0.00007
Pentachlorophenol	0.00003			0.00003
Phenol	0.03016		0.12000	0.15016
<i>Phosphorus</i>	0.01597			0.01597
Propionaldehyde	0.03607			0.03607
<i>Selenium Compounds</i>	0.00166	2.67E-04		0.00192
Styrene	1.12347			1.12347
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.00000			0.00000
Toluene	0.54400	7.89E-04		0.54479
1,1,1-Trichloroethane		3.00E-05		0.00003
2,4,6-Trichlorophenol	0.00001			0.00001
Vinyl chloride	0.01064			0.01064
o-Xylenes	0.01301	1.39E-05		0.01302
POM		4.20E-04		0.00042
<b>Total HAPs</b>	<b>22.6</b>	<b>1.0E-02</b>	<b>7.9</b>	<b>30.5</b>

**Table 12: Total Facility HAP Emissions (w/ HCl limit)**

<b>Hazardous Air Pollutant</b> <i>(Italics indicate metals.)</i>	<b>Boiler - wood</b> <b>w/ HCl limit</b>	<b>Boiler - diesel</b> <b>264 hr/yr</b>	<b>Dryer</b>	<b>Total</b> <b>Emissions</b>
Acetaldehyde	4.9E-01		1.51	2.0E+00
Acetophenone	1.9E-06		2.12	2.1E+00
Acrolein	2.37			2.4E+00
<i>Antimony Compounds</i>	4.7E-03			4.7E-03
<i>Arsenic Compounds</i>	1.3E-02	7.1E-05		1.3E-02
Benzene (includes that from gasoline)	2.48	2.7E-05		2.5E+00
<i>Beryllium Compounds</i>	6.5E-04	5.3E-05		7.0E-04
Bis(2-ethylhexyl)phthalate (DEHP)	2.8E-05			2.8E-05
<i>Cadmium Compounds</i>	2.4E-03	5.3E-05		2.5E-03
Carbon tetrachloride	2.7E-02			2.7E-02
Chlorine	4.7E-01			4.7E-01
Chlorobenzene	2.0E-02			2.0E-02
Chloroform	1.7E-02			1.7E-02
<i>Chromium Compounds</i>	1.2E-02	5.3E-05		1.2E-02
<i>Cobalt Compounds</i>	3.8E-03			3.8E-03
2,4-Dinitrophenol	1.1E-04			1.1E-04
Ethylbenzene	1.8E-02	8.1E-06		1.8E-02
Formaldehyde	2.60	7.8E-03	3.2E-01	2.9E+00
Hydrochloric acid	<b>4.73</b>			4.7E+00
<i>Lead Compounds</i>	2.8E-02	1.6E-04		2.9E-02
<i>Manganese Compounds</i>	9.5E-01	1.1E-04		9.5E-01
<i>Mercury Compounds</i>	2.1E-03	5.3E-05		2.1E-03
Methanol			2.57	2.6E+00
Methyl isobutyl ketone (Hexone)			1.29	1.3E+00
Naphthalene	5.7E-02	1.4E-04		5.7E-02
<i>Nickel Compounds</i>	2.0E-02	5.3E-05		2.0E-02
4-Nitrophenol	6.5E-05			6.5E-05
Pentachlorophenol	3.0E-05			3.0E-05
Phenol	3.0E-02		1.2E-01	1.5E-01
<i>Phosphorus</i>	1.6E-02			1.6E-02
Propionaldehyde	3.6E-02			3.6E-02
<i>Selenium Compounds</i>	1.7E-03	2.7E-04		1.9E-03
Styrene	1.12			1.1E+00
2,3,7,8-Tetrachlorodibenzo-p-dioxin	5.1E-09			5.1E-09
Toluene	5.4E-01	7.9E-04		5.4E-01
1,1,1-Trichloroethane		3.0E-05		3.0E-05
2,4,6-Trichlorophenol	1.3E-05			1.3E-05
Vinyl chloride	1.1E-02			1.1E-02
o-Xylenes	1.3E-02	1.4E-05		1.3E-02
POM		4.2E-04		4.2E-04
<b>Total HAPs</b>	<b>16.1</b>	<b>1.0E-02</b>	<b>7.9</b>	<b>24.0</b>