GEORGIA-PACIFIC CORPORATION

PALATKA OPERATIONS

PSD PERMIT APPLICATION

NO. 4 RECOVERY BOILER AND EVAPORATOR AREA PROJECTS

NOVEMBER 2005

Department of
Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Colleen M. Castille
Secretary

November 22, 2005

Mr. John Bunyak, Chief
Policy, Planning & Permit Review Branch
NPS – Air Quality Division
P. O. Box 25287
Denver, Colorado 80225

RE: Georgia-Pacific Corporation, Palatka Mill
No. 4 Recovery Boiler
1070005-035-AC, PSD-FL-367

Dear Mr. Bunyak:

Enclosed for your review and comment is a PSD application submitted by Georgia-Pacific Corporation to modify the No. 4 Recovery Boiler and associated evaporators at their facility is Palatka, Putnam County, Florida.

Your comments may be forwarded to my attention at the letterhead address or faxed to the Bureau of Air Regulation at 850/921-9533. If you have any questions, please contact Bruce Mitchell, review engineer, at 850/413-9198.

Sincerely,

Patty Adams

for Jeffrey F. Koerner, P.E., Administrator
North Permitting Section

JFK/pa

Enclosure

cc: B. Mitchell

"More Protection, Less Process"

Department of
Environmental Protection

Jeb Bush
Governor

Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Colleen M. Castille
Secretary

November 22, 2005

Mr. Gregg M. Worley, Chief
Air Permits Section
U.S. EPA, Region 4
61 Forsyth Street
Atlanta, Georgia 30303-8960

RE: Georgia-Pacific Corporation, Palatka Mill
No. 4 Recovery Boiler
1070005-035-AC, PSD-FL-367

Dear Mr. Worley:

Enclosed for your review and comment is a PSD application submitted by Georgia-Pacific Corporation to modify the No. 4 Recovery Boiler and associated evaporators at their facility is Palatka, Putnam County, Florida.

Your comments may be forwarded to my attention at the letterhead address or faxed to the Bureau of Air Regulation at 850/921-9533. If you have any questions, please contact Bruce Mitchell, review engineer, at 850/413-9198.

Sincerely,

Patty Adams

Jeffrey F. Koerner, P.E., Administrator
North Permitting Section

JFK/pa

Enclosure

cc: B. Mitchell

EXP

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ORIGIN: **TLH**

From: DEP AIR RESOURCE MGMT
P. Adams
DIRECTOR OFFICE STE 23
111 S MAGNOLIA DR
TALLAHASSEE, FL 32301
UNITED STATES Tel:850-921-9505

Sender's ref
37550201000 A7 AP255

To: DEP Northeast District Office
Mr. Chris Kirts
7825 Baymeadows Way
Air Section, Suite 200B
Jacksonville, FL 32256
UNITED STATES

POSTCODE:
32256

Tel: 904-807-3235

Description: PSD-FL-367

Weight: 7 lbs for 1 pcs
Date: 2005-11-22

DHL standard terms and conditions apply.

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Air Section, Suite 200B
7825 Baymeadows Way

Jacksonville, FL 32256
UNITED STATES

Attention To:	Mr. Chris Kirts
Phone#:	904-807-3235
Sent By:	P. Adams
Phone#:	850-921-9505

Rate Estimate:	6.18
Protection:	Not Required
Description:	PSD-FL-367
Weight (lbs.):	7
Dimensions:	0 x 0 x 0
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Special Svc:	
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P. Adams
DIRECTOR OFFICE STE 23
111 S MAGNOLIA DR
TALLAHASSEE, FL 32301
UNITED STATES Tel:850-921-9505

ORIGIN: TLH

Sender's ref.
37550201000

To: National Park Service
Mr. John Bunyak
12795 W. Alameda Parkway
Air Division
Lakewood, CO 80228
UNITED STATES

POSTCODE:
80228

Tel: 303-966-2818

Description: PSD-FL-367 application

Weight: 7 lbs for 1 pcs
Date: 2005-11-22

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To(Company):
National Park Service
Air Division
12795 W. Alameda Parkway

Lakewood, CO 80228
UNITED STATES

Attention To: Mr. John Bunyak
Phone#: 303-966-2818

Sent By: P. Adams
Phone#: 850-921-9505

Rate Estimate: 19.07
Protection: Not Required
Description: PSD-FL-367 application

Weight (lbs.): 7
Dimensions: 0 x 0 x 0

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From: DEP AIR RESOURCE MGMT
P. Adams
DIRECTOR OFFICE STE 23
111 S MAGNOLIA DR
TALLAHASSEE, FL 32301
UNITED STATES Tel:850-921-9505

ORIGIN: TLH

Sender's ref
375503201000 A7 AP255

To: U.S. EPA Region 4
Mr. Gregg M. Worley
61 Forsyth Street
Air Permits Section
Atlanta, GA 30303
UNITED STATES

POSTCODE:
30303

Tel: 404-562-9141

Description: PSD-FL-367 application

Weight: 7 lbs for 1 pcs
Date: 2005-11-22

DHL standard terms and conditions apply.

HARB 6V
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(2L)US30303

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SENDER'S RECEIPT
Waybill #: 28805355456

To(Company):
U.S. EPA Region 4
Air Permits Section
61 Forsyth Street

Atlanta, GA 30303
UNITED STATES

Attention To: Mr. Gregg M. Worley
Phone#: 404-562-9141

Sent By: P. Adams
Phone#: 850-921-9505

Rate Estimate: 6.37
Protection: Not Required
Description: PSD-FL-367 application

Weight (lbs.): 7
Dimensions: 0 x 0 x 0

Ship Ref: 375503201000 A7 AP255
Service Level: Next Day 12:00 (Next business day by 12 PM)

Special Svc:

Date Printed: 11/22/2005
Bill Shipment To: Sender
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Dear Bruce,

Thanks For your understanding.

The three enclosed PSD applications are okay but the Four you Received on Friday Need 13 pages Replaced. Please Remove old B-39-51 + Replace with new B 39-51. I highlighted the new cover page B-39.

Thanks

Ed James

From: Origin ID: (386)329-0918
Myra Carpenter
Georgia-Pacific Corporation
215 State Road 216

Palatka, FL 32177

FedEx
Express

E

CLS 102705/09/18

Ship Date: 15NOV05
ActWgt: 32 LB Dimmed: 18 X 13 X 12 IN
System#: 3377843/INET2300
Account#: S *********

REF:

Delivery Address Bar Code

SHIP TO: (850)413-9198 **BILL SENDER**

Bureau of Air Regulation XXXXXX
FDEP
2600 Blair Stone Road
MS #3500
Tallahassee, FL 32399

STANDARD OVERNIGHT **WED**

Deliver By:
16NOV05

TRK# **7907 1306 9320** FORM 0201

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Georgia-Pacific

Palatka Pulp and Paper Operations
Consumer Products Division

P.O. Box 919
Palatka, FL 32178-0919
(386) 325-2001

November 14, 2005

Florida Department of Environmental Protection
Bureau of Air Regulation
2600 Blair Stone Road, MS# 3500
Tallahassee, FL 32399

Attention: PSD Permit Application

RE: PSD APPLICATION FOR NO. 4 RECOVERY BOILER AND EVAPORATOR AREA PROJECTS

To whom it may concern:

Please find enclosed seven (7) copies of the PSD Application for modification to the No. 4 Recovery Boiler and also a check in the amount of $7,500.

Please contact me at 386-329-0918 if you have any questions.

Sincerely,

Myra J. Carpenter
Environmental Superintendent

cc: T. Wyles, w/o attachment
E. Jamro, w/o attachment
W. Jernigan, w/o attachment
S. Matchett – GP, w/o attachment
D. Buff – (1 copy of application)

Tube Replacement Project and Increase of Efficiency for No. 4 Recovery Boiler:

First, the Mill plans to replace a large percentage of the tubes in the No. 4 Recovery Boiler (Emission Unit ID No. 018). This includes tubes in the superheater, economizer, and generating banks of the Boiler. This major tube work is estimated to commence in April 2006 and conclude in 2008. The total cost of this work is estimated to be in the range of $24 million. Many of the tubes to be replaced are originals that have been in place since the Boiler was constructed in the mid-1970s. For these reasons, it is GP's opinion that this work does not constitute routine maintenance, repair, and replacement.

Although still in the preliminary engineering phase, the Mill is also considering replacement of, or changes to, the combustion air system for the Boiler. The objective of this part of the project is to lower peak furnace exit gas temperature and velocity into the superheater in an effort to reduce the potential for corrosion and pluggage of the superheater in the future. The new air system is also expected to reduce carry over and fouling in the Boiler convection banks. Through the staging of air, it is anticipated that emissions of some pollutants (*e.g.*, total reduced sulfur compounds and carbon monoxide) will be more consistently controlled. The Mill plans to install a fourth level of combustion air to the Recovery Boiler to help maintain NO_x emission rates at their current levels. The Mill is in the process of receiving vendor quotations for this work, including suggested scope. As such, the exact scope of this work is not available at this time. The estimated cost for this project is less than $2 million.

A third project involves a modification to the black liquor evaporation system (No. 4 Evaporator Set). This change would increase the solids concentration of the black liquor to the Recovery Boiler from 65 percent solids to approximately 75 percent solids. When the new system is operational, the liquor from the concentrator will pass through a Crystallizer vessel to raise the temperature of the liquor. The liquor will then enter a storage/flash tank at lower pressure where the moisture will "flash off". The "flash" vapors will then be routed to the existing evaporator system and collected as part of the existing non-condensible gas (NCG) collection system. The purpose of the project is to increase Boiler efficiency by reducing the amount of water entering the Boiler with the liquor solids. By reducing the amount of water vaporization being performed by the Boiler, less supplemental fuel will be required to process the same amount of black liquor solids (BLS). Furthermore, the increase in solids will improve the efficiency of the Boiler for steam production per pound of BLS, thus reducing the amount of steam produced from oil in the other boilers. The estimated cost for this project is between $5-6 million.

Finally, the Mill is considering the removal of some internal baffles and resizing some downcomer piping in the existing concentrators. The unit currently has scaling problems, leading to frequent "boil outs". The proposed changes will improve liquor circulation and increase velocity through the tubes, which should reduce scaling and fouling. This will increase the time between "boil outs". In addition, an external heat exchanger will be added to the existing concentrators to preheat the liquor with steam prior to entry into the concentrators. This will allow for increased evaporation surface, providing for a capability that more closely matches the capacity of the Recovery Boiler.

Scope of Application

Emissions Unit ID Number	Description of Emissions Unit	Air Permit Type	Air Permit Proc. Fee
018	No. 4 Recovery Boiler	AC1A	$7,500

Application Processing Fee

Check one: ☒ Attached - Amount: $7,500 ☐ Not Applicable

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1. EXECUTIVE SUMMARY

Georgia-Pacific Corporation (GP) operates an unbleached and bleached Kraft pulp and paper Mill in Palatka, Florida (Putnam County). Processes and systems at the Mill include a batch digester system, multiple effect evaporator (MEE) system, condensate stripper system, recovery boiler and smelt dissolving tanks, lime kiln, tall oil plant, utilities, bleach plant, chlorine dioxide plant, paper machines and converting operations used to produce finished paper products from virgin wood.

Putnam County has been designated by the U.S. Environmental Protection Agency (US EPA) as in attainment or unclassified for all criteria pollutants. The existing Mill is classified as a major stationary source under Prevention of Significant Deterioration (PSD) and Clean Air Act Title V definitions since it has the potential-to-emit more than 100 tons per year (tpy) of at least one regulated air pollutant.

This PSD application is being submitted to implement several projects for the No. 4 Recovery Boiler and associated evaporators. First, the Mill plans to replace a large percentage of the tubes in the No. 4 Recovery Boiler (Emission Unit ID No. 018). This includes tubes in the superheater, economizer, and generating banks of the Boiler. This major tube work is estimated to commence in May 2006 and conclude in 2008. The total cost of this work is estimated to be in the range of $24 million. Many of the tubes to be replaced are originals that have been in place since the Boiler was constructed in the mid-1970s. For these reasons, it is GP's opinion that this work does not constitute routine maintenance, repair, and replacement.

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A third project involves a modification to the black liquor evaporation system (No. 4 Evaporator Set). This change will increase the solids concentration of the black liquor to the Recovery Boiler from 65 percent solids to approximately 75 percent solids. When the new system is operational, the liquor from the concentrator will pass through a Crystallizer vessel to raise the temperature of the liquor. The liquor will then enter a storage/flash tank at lower pressure where the moisture will "flash off". The "flash" vapors will then be routed to the existing evaporator system and collected as part of the existing non-condensible gas (NCG) collection system. The purpose of the project is to increase Boiler efficiency by reducing the amount of water entering the Boiler with the liquor solids. By reducing the amount of water vaporization being performed by the Boiler, less supplemental fuel will be required to process the same amount of black liquor solids (BLS). Furthermore, the increase in solids will improve the efficiency of the Boiler for steam production per pound of BLS, thus reducing the amount of steam produced from oil firing in the other boilers. The estimated cost for this work is in the range of $5-6 million.

Finally, the Mill is considering the removal of some internal baffles and resizing some downcomer piping in the existing concentrators. The unit currently has scaling problems, leading to frequent "boil outs". The proposed changes will improve liquor circulation and increase velocity through the tubes, which should reduce scaling and fouling. This will increase the time between "boil outs". In addition, an external heat exchanger will be added to the existing concentrators to preheat the liquor with steam prior to entry into the concentrators. This will allow for increased evaporation surface, providing for a capability that more closely matches the capacity of the Recovery Boiler.

This project is being evaluated under the current Florida Department of Environmental Protection (FDEP) Prevention of Significant Deterioration (PSD) regulations. These regulations generally require a comparison of past actual emissions to the proposed permitted emission rates. While these projects may jointly allow for an increase in actual throughput for the Recovery Boiler, a change in the permitted capacity or emission rates is not being requested.

As directed by the FDEP, actual-to-potential emission increases for this project have been added to increases for other past and future projects, even though those projects are unrelated. GP continues to believe this process of aggregating unrelated projects is inconsistent with past guidance on this topic. At any rate, in the interest of time, the combined increases are presented in this application. Based on the comparison of past actual-to-future potential emissions, PSD review is triggered for particulate matter (both total suspended particulate matter and particulate matter less than 10 micrometers in aerodynamic diameter), nitrogen oxides, carbon monoxide, sulfuric acid mist, and ozone (based on a significant increase in volatile organic compound emissions).

Even though the evaluation for PSD applicability is based on the combined projects, this application only addresses the projects in the Chemical Recovery area. As discussed with the FDEP on October 20th, it is critical that this work be initiated during the spring 2006 outage.

The PSD permit application includes completed permit application forms, detailed emission calculations, Best Available Control Technology (BACT) review, and an air quality analysis.

2. PERMIT APPLICATION FORMS

The completed, long version of the Florida Department of Environmental Protection's (FDEP's) permit application is included in Attachment A.

3. INTRODUCTION

3.1 Facility Location and Description

Georgia-Pacific Corporation (GP) operates an unbleached and bleached Kraft pulp and paper Mill in Palatka, Florida (Putnam County). Processes and systems at the Mill include a batch digester system, multiple effect evaporator (MEE) system, condensate stripper system, recovery boiler and smelt dissolving tanks, lime kiln, tall oil plant, utilities, bleach plant, chlorine dioxide plant, paper machines and converting operations used to produce finished paper products from virgin wood.

The Mill site is located north of County Road 216 and west of U.S. Highway 17. The approximate Universal Trans Mercator (UTM) coordinates are 434.0 kilometers (km) east and 3283.4 km north in Zone 17. The Mill location is shown on a United States Geological Survey (USGS) topographic map in Figure 3-1. A plot plan of the facility is included as Figure 3-2. Figure 3-3 is a simplified process flow diagram for the entire facility.

While equipment capacities may vary throughout the Mill, the current permitted allowable production level is 118 tons per hour of air dried unbleached pulp (ADUP) and 1,850 ADUP per day as a maximum monthly average.

Putnam County has been designated by the U.S. Environmental Protection Agency (US EPA) as in attainment or unclassified for all criteria pollutants. The existing Mill is classified as a major stationary source under Prevention of Significant Deterioration (PSD) and Clean Air Act Title V definitions since it has the potential-to-emit more than 100 tons per year (tpy) of at least one regulated air pollutant. The initial Title V permit was issued to the Palatka Mill on October 30, 2000. The Mill is currently operating under Title V Permit 1070005-029-AV, issued in February 2005.

3.2 Project Description

The No. 4 Recovery Boiler (Emission Unit 018) was originally constructed in 1975 and started up in 1976. The current, permitted capacity of the Boiler is 210,000 pounds (lbs) per hour of black liquor solids (BLS) and 5.04 million pounds (MM lbs) of BLS per day. The Boiler is currently permitted to combust natural gas and No. 6 fuel oil with a sulfur content not to exceed 2.35% by weight and on-spec used oil as start-up fuels. The Recovery Boiler, which is equipped with an electrostatic precipitator (ESP) for particulate matter control, has been subjected to PSD review twice in the past – once in 1991 and a second time in 1995.

In 1991, the entire bottom of the Recovery Boiler was replaced and modifications were made to the combustion air system. These changes made to the combustion air system resulted in an increased throughput from 189,000 lbs BLS per hour to the current permitted capacity of 210,000 lbs BLS per hour.

The project in 1995 involved the addition of sixteen (16) screen tube banks in the Boiler. One of the benefits from the project was a decrease in the flue gas temperature in certain sections of the Boiler, which reduced tube abrasion, resulting in an improvement in performance and reduced maintenance downtime. The installation of the additional tubes also had the potential to increase BLS throughput and steam production by 4% and 30,000 pounds per hour, respectively. While an actual throughput increase was anticipated, the Mill did not expect, nor request, an increase in the permitted capacity of the unit (210,000 lbs/hour and 5.04 MM lbs BLS/day).

The Mill is now proposing to implement several projects for the No. 4 Recovery Boiler and associated evaporators. These projects, described in more detail below, include (1) extensive replacement of tubes, (2) replacement or changes to the air system, (3) addition of a crystallizer, and (4) miscellaneous changes (*i.e.,* baffles, heat exchanger, piping, etc.) to the concentrators. Figure 3-4 is a simplified flow diagram of the Recovery Boiler.

Tube Replacements

The Mill plans to replace a large percentage of the tubes in the No. 4 Recovery Boiler (Emission Unit ID No. 018). This includes tubes in the superheater, economizer, and generating banks of the Boiler. This major tube work is estimated to commence in May 2006 and conclude in 2008. The total cost of this work is estimated to be in the range of $24 million. Many of the tubes to be replaced are originals that have been in place since the Boiler was constructed in the mid-1970s. For these reasons, it is GP's opinion that this work does not constitute routine maintenance, repair, and replacement. The preliminary scope for the tube replacements, although subject to change, is presented in Table 3-1.

Table 3-1. Preliminary Scope for Tube Maintenance on No. 4 Recovery Boiler

Boiler Section	Approximate Number of Tubes Involved	Affected Area/ Total Tube Area in Boiler (Percent)	Comments
Superheater	3,500	37.1	Most tubes are original. Three tubes have failed under pressure in the past 18 months.
Economizer	1,700	23.6	Tubes are original. Five tubes have failed under pressure in the past 26 months. Numerous tubes are plugged at both ends from previous failures.
Generating Bank	2,100	16.9	Tubes are original to Boiler.
Floor	130	1.2	All but 14 tubes are original to Boiler.

Combustion Air System

Although still in the preliminary engineering phase, the Mill is also considering replacement of, or changes to, the combustion air system for the Boiler. The objective of this part of the project is to lower peak furnace exit gas temperature and velocity into the superheater in an effort to reduce the potential for corrosion and pluggage of the superheater in the future. The new air system is also expected to reduce carry over and fouling in the Boiler convection banks. Through the staging of air, it is anticipated that emissions of some pollutants (*e.g.,* total reduced sulfur (TRS) compounds and carbon monoxide (CO)) will be more consistently controlled and/or reduced. At the same time, by reducing CO and increasing boiler efficiency, nitrogen oxide (NO_x) emissions are expected to increase slightly. To avoid the slight increase in NO_x emissions, the Mill plans to install a fourth level of combustion air to the boiler. The Mill is in the process of receiving vendor quotations for this work, including suggested scope. As such, the exact scope of this work is not available at this time. The current cost estimate is less than $2 million.

Crystallizer

A third project involves a modification to the black liquor evaporation system (No. 4 Evaporator Set). This change will increase the solids concentration of the black liquor to the Recovery Boiler from 65 percent solids to approximately 75 percent solids. When the new system is operational, the liquor from the concentrator will pass through a Crystallizer vessel to raise the temperature of the liquor. The liquor will then enter a storage/flash tank at lower pressure where the moisture will "flash off". The "flash" vapors will then be routed to the existing evaporator system and collected as part of the existing non-condensible gas (NCG) collection system. The purpose of the project is to increase Boiler efficiency by reducing the amount of water entering the Boiler with the liquor solids. By reducing the amount of water vaporization being performed by the Boiler, less supplemental fuel will be required to process the same amount of black liquor solids (BLS). Furthermore, the increase in solids will improve the efficiency of the Boiler for steam production per pound of BLS, thus reducing the amount of steam produced from oil firing in the other boilers. The estimated cost of this work is in the range of $5 to $6 million.

Concentrators

Finally, the Mill is considering the removal of some internal baffles and resizing some downcomer piping in the existing concentrators. The unit currently has scaling problems, leading to frequent "boil outs". The proposed changes will improve liquor circulation and increase velocity through the tubes, which should reduce scaling and fouling. This will increase the time between "boil outs". In addition, an external heat exchanger will be added to the existing concentrators to preheat the liquor with steam prior to entry into the concentrators. This will allow for increased evaporation surface, providing for a capability that more closely matches the capacity of the Recovery Boiler.

3.3 Requested Emission Limits

The Mill is not proposing to increase the throughput that has been established in past permitting actions for the Recovery Boiler. In fact, in order to avoid PSD review for sulfur dioxide, the Mill is requesting an annual limit of 12 parts per million by volume (ppmv) (at 8% oxygen). This is a significant reduction over the current limit that is based on 37.5 ppmv. The Mill is also proposing to reduce the maximum sulfur content of fuel oil from 2.35% to 2.1%. As discussed further in Section 5.2, there is a possibility that the addition of the crystallizer will lead to an increase in the maximum hourly throughput level for the Recovery Boiler, causing the unit to become subject to federal New Source Performance Standards. As such, a 12-hour block average of 5 ppmv (at 8% oxygen) is proposed for total reduced sulfur (TRS) compounds.

For sulfur dioxide, a request was submitted to the FDEP in April 2004 to modify the short-term (3-hour and 24-hour average) emission rates for the Recovery Boiler. As explained in that submittal, the Mill's Recovery Boiler has been subject to a number of permitting activities in the past and the history can be traced back to permits that were issued in the early- and mid-1980s. Varying sulfur dioxide emission limits have been imposed over time.

Air Operating Permit AO54-54072, dated June 1982, specified allowable sulfur dioxide emission rates for the Recovery Boiler of 277.5 lbs/hour and 1,189 tpy. Subsequently, Air Operating Permit AO54-131787, dated May 1987, specified allowable sulfur dioxide emission limits of

314.97 lbs/hour and 1,375.79 tpy. As part of the PSD permitting action in 1991, the Mill demonstrated that it could net out of PSD review for sulfur dioxide based on emission limits of 219.7 lbs/hour and 962.3 tpy for the Recovery Boiler. The rates that were proposed by the Mill were derived based on a stack gas concentration of 75 ppmvd, corrected to 8 percent oxygen and a gas flow rate of 210,000 dry standard cubic feet per minute (dscfm) at 2.8 percent oxygen (this also corresponds to a gas flow rate of 294,000 dscfm at 8 percent oxygen). In its technical review of the 1991 application, the Department proposed to establish limits that were approximately one-half of those proposed by the Mill, even though there were no issues with the application of Best Available Control Technology (BACT) since this pollutant had netted out of PSD review, even at the higher rates. The values proposed by the Department were 109.9 lbs/hour and 481.4 tpy, based on a concentration of 37.5 ppmvd, corrected to 8 percent oxygen. To GP's knowledge, these lower limits had nothing to do with PSD applicability or the 75 ppmvd concentration that was provided in the permit application. Rather, the 37.5 ppmvd concentration limit was an arbitrary multiple of 3.75 times the highest annual average concentration (10 ppmvd) shown by the Mill's uncertified continuous emission monitor (CEM) in prior years.

Subsequently, in a May 1991 letter, the Mill objected to these limits. However, the Mill mistakenly asked that the short-term limit of 109.9 lbs/hour be established "as requested in our application". As discussed previously, the value that was requested in the application was actually 219.7 lbs/hour, not 109.9 lbs/hour. In the May 1991 letter, the Mill intended to ask that the 219.7 lbs/hour value be established "as requested in our application". At any rate, the 109.9 lbs/hour value was included in the final permit (Permit No. PSD-FL-171, issued June 7, 1991), although the concentration limit of 37.5 ppmvd was removed.

The most recent PSD permit issued for the Recovery Boiler (Permit No. PSD-FL-226, issued September 21, 1995) contains a short-term limit of 109.9 lbs/hour, based on an "emission factor" of 75 ppmvd (at 8 percent oxygen). This same limit was carried forward into the Title V permit. As discussed above, the 109.9 value is based on 37.5 ppmvd, not 75 ppmvd. The Mill demonstrates compliance with the mass limit through annual stack testing, as required by the permit.

As mentioned above and as discussed with the FDEP in the past, the Mill operates an uncertified CEM for sulfur dioxide on the Recovery Boiler. The CEM has been used strictly as an operational tool in order to optimize Boiler performance. As disclosed in recent annual compliance certifications, the Mill is aware of hourly periods when the CEM has measured sulfur dioxide concentrations in excess of both 37.5 and 75 ppmvd, corrected to 8 percent oxygen. The Mill did not construe this information as evidence that the Boiler was out of compliance, but disclosed it to the Department nonetheless. This CEM data is not conclusive as to any exceedances for several reasons. First, the CEM is not a "certified" unit. Second, the Mill does not have the necessary continuous stack gas flow data that is needed in order to make a valid comparison to the 109.9 lbs/hour mass emission limit. As an aside, this comparison is conducted annually as required by the Title V Operating Permit using information generated in a stack test. Finally, the permit(s) does not clearly establish the averaging times for the various emission limits. Lastly, the Mill believes that the sulfur dioxide concentrations measured in excess of both 37.5 and 75 ppmvd were due to high levels of salt cake being recycled in the black liquor solids fed into the boiler. The Mill has since reduced the high levels of salt cake in the black liquor fired in the recovery boiler which has resulted in lower sulfur dioxide emission rates.

In reviewing the uncertified CEM data for the period 2004 through 2005, and after removing periods of start-up, shutdown, and malfunction, measured short-term concentrations were found to be within the following ranges (all values are corrected to 8 percent oxygen):

24-Hour Average Values	less than 37.5 ppmvd
3-Hour Average Values	less than 150 ppmvd

Based on this information, the Mill is proposing that the following short-term emission limits be established for the Recovery Boiler (all values are expressed at 8 percent oxygen)

24-Hour Average Permit Limit	37.5 ppmvd (109.9 lbs/hour)
3-Hour Average Permit Limit	150 ppmvd (439.4 lbs/hour)

All other limits for the Recovery Boiler are as contained in current permits.

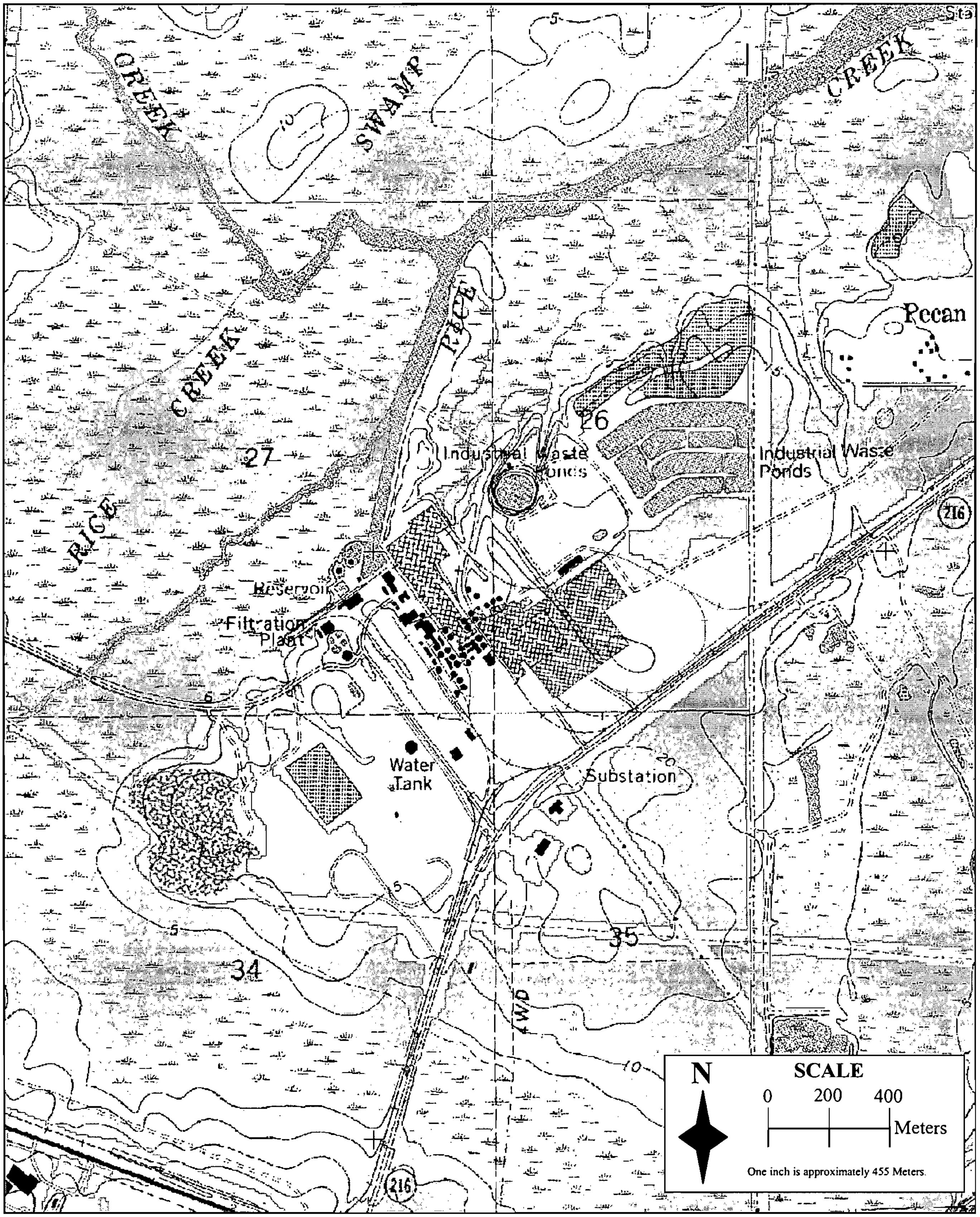

Figure 3-1
Area Map
Georgia-Pacific Corporation, Palatka Mill

Source: Golder, 2004.

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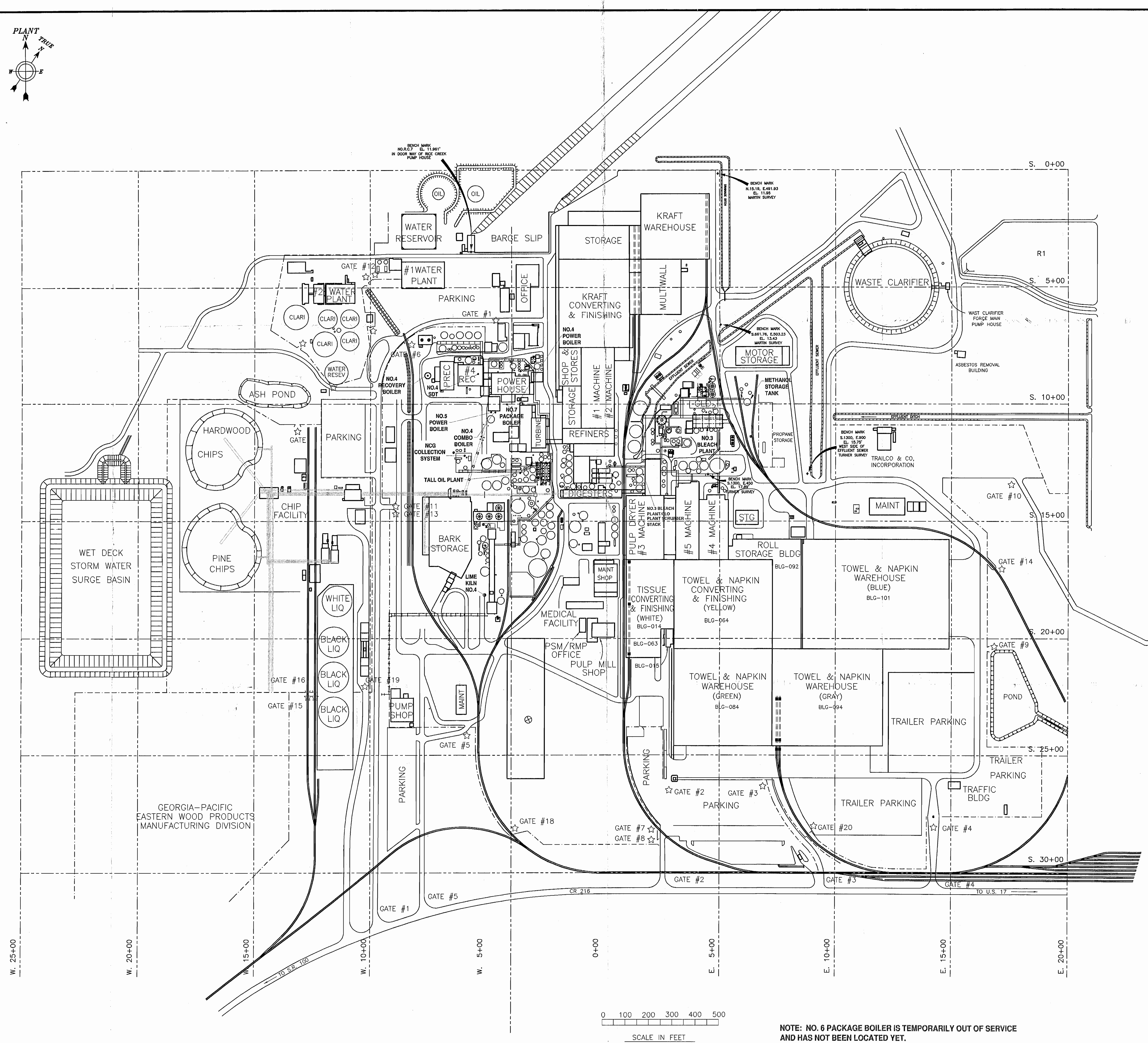
1070005-035



NOTE: NO. 6 PACKAGE BOILER IS TEMPORARILY OUT OF SERVICE AND HAS NOT BEEN LOCATED YET.

NOTES

LEGEND & INFORMATION

☆	GATE
═	RAILROAD TRACK
— — · —	FENCE

GATE #	DESCRIPTION
1	MAIN GATE
2	EAST GATE
3	OLD CONSTRUCTION GATE
4	TRUCK TRAFFIC GATE
5	CONSTRUCTION GATE
6	R.R. GATE
7	R.R. GATE
8	PERIMETER GATE
9	PERIMETER GATE
10	CONSTRUCTION GATE
11	INNER MILL VEHICLE GATE
12	PERSONNEL GATE
13	PERSONNEL GATE
14	R.R. GATE
15	R.R. GATE
16	R.R. GATE
17	CONSTRUCTION GATE
18	R.R. GATE
19	CHIP TRUCK SCALE
20	R.R. GATE

REV.	DATE	DESCRIPTION	DRN. / CH'D.	AP'D
.	.	.	. / .	.
.	.	.	. / .	.
.	.	.	. / .	.
.	.	.	. / .	.
.	.	.	. / .	.
.	.	.	. / .	.
2	12/02/02	GOLDER TITLE V REVISION	DTL / FWH	DAB
1	11/27/02	GOLDER TITLE V REVISION	DTL / FWH	DAB

CROSS–REFERENCE NO.
E–290–8469–1–0105–001

HUDSON NO.
.

Georgia-Pacific

THE GROWTH COMPANY

PALATKA OPERATIONS

FIGURE 3-2

DRAWN H. Trujillo	11/25/02	SCALE 1" = 150'
CHECKED .	.	AFE NO. .
APPROVED .	.	PROJ NO. .
APPROVED .	.	AREA .

G–P DRAWING NO.
290-8464MI -000-0009-006

CONSULTANT:

REV: 0

CONSULTANT NO.
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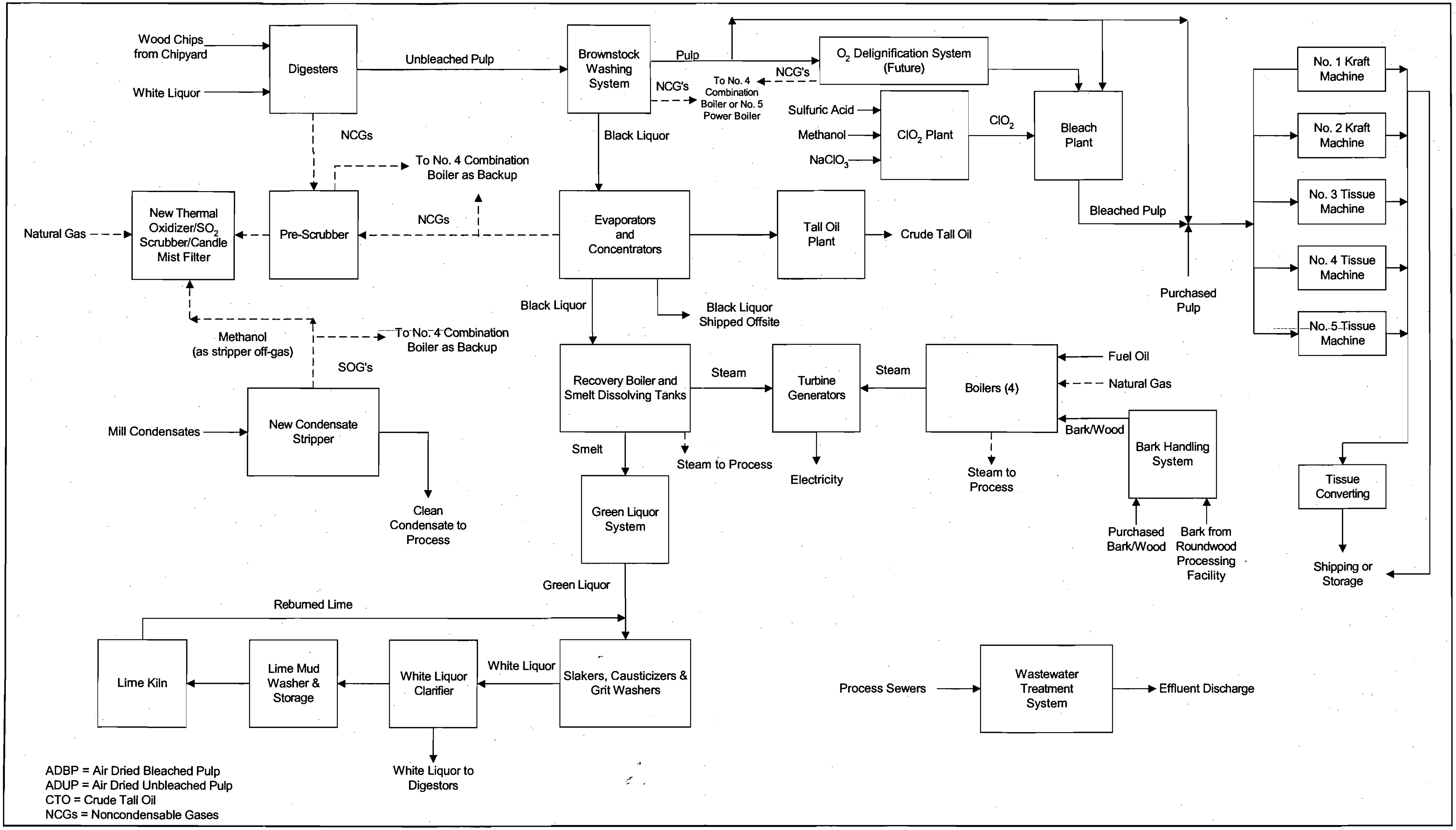
Revised APR, 1997; E-size



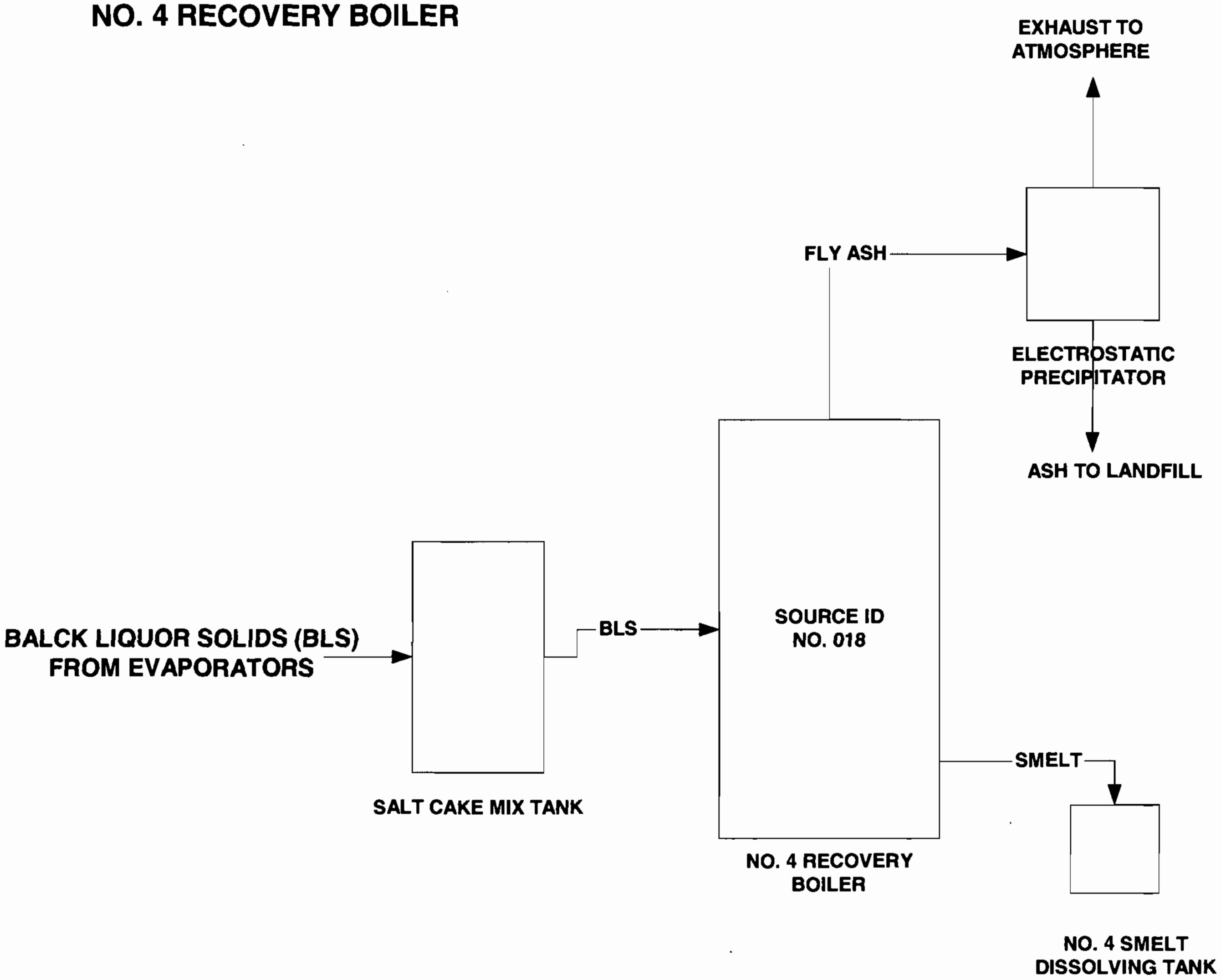
ADBP = Air Dried Bleached Pulp
ADUP = Air Dried Unbleached Pulp
CTO = Crude Tall Oil
NCGs = Noncondensable Gases

Figure 3-3
Facility Simplified Process Flow Diagram
Georgia-Pacific Palatka Operations
Palatka, Florida
April 2005

Process Flow Legend

Solid/Liquid ⟶
Gas - - - ->

FIGURE 3-4
NO. 4 RECOVERY BOILER



Palatka, FL Mill
November 2005

4. EMISSION RATES

Detailed emission rate calculations are provided in Attachment B. The baseline annual throughput that is used in calculating past actual emissions for the No. 4 Recovery Boiler is an average for the two-year period, January 2003 through December 2004. Actual source test results and operating hours were used in calculating the average, annual emissions for the baseline period when test data was available. If testing data was not available, published emission factors or engineering estimates were used.

With the exception of SO_2, SAM and TRS compounds, the emission limits are proposed to remain as they are in the current PSD and Title V permits. For SO_2 emissions, the Mill is requesting a lower annual emission limit of 12 ppmv (equivalent to 35.1 lbs/hr and 153.9 tons/yr), as well as a reduction in the sulfur content in the No. 6 fuel oil burned from 2.35% to 2.1%, to avoid PSD review. The SAM limit is being increased slightly (from 14.2 to 15.9 tons per year (tpy)) based on the use of "standard" temperature and flow conditions, consistent with the other pollutants.

As discussed further in Section 5.2, there is a possibility that the addition of the crystallizer will lead to an increase in the maximum hourly throughput level for the Recovery Boiler, causing the unit to become subject to federal New Source Performance Standards. As such, a 12-hour block average of 5 ppmv (at 8% oxygen) is proposed for TRS compounds as part of this application.

5. REGULATORY APPLICABILITY

5.1 PSD Applicability

The existing Mill, as constructed, and as operated today, is classified as a major stationary source under PSD definitions since it has the potential-to-emit more than 100 tons per year of at least one regulated air pollutant.

This project is being evaluated under the current FDEP PSD regulations. These regulations generally require a comparison of past actual emissions to the proposed permitted emission rates. Downstream sources at the Mill that could potentially be impacted by the proposed projects include the smelt dissolving tanks, green and black liquor tanks, the lime kiln, and other caustic area sources. Past actual and future potential emission rate calculations have only been prepared for the No. 4 Recovery Boiler and other affected sources.

As directed by the FDEP, actual-to-potential emission increases for this project have been added to increases for other past and future projects, even though those projects are unrelated. GP continues to believe this process of aggregating unrelated projects is inconsistent with past guidance on this topic. At any rate, in the interest of time, the combined increases are presented in Table 5-1, along with the full netting analysis. For the Lime Kiln, Table 5-1 presents the increases associated with the upcoming petroleum coke project since those increases are either the same or larger than the increases associated with the Lime Kiln as an affected source for this project.

Based on the comparison of past actual-to-future potential emissions, and taking into account net emission changes that have occurred during the past five years, PSD review is triggered for particulate matter (both total suspended particulate matter and particulate matter less than 10 micrometers in aerodynamic diameter), nitrogen oxides, carbon monoxide, sulfuric acid mist, and ozone (based on a significant increase in volatile organic compound emissions).

5.2 NSPS Applicability

The No. 4 Recovery Boiler is potentially subject to the New Source Performance Standards (NSPS) contained at 40 CFR 60, Subpart BB.

In order to be subject to the federal NSPS contained in 40 CFR 60, an emission unit must be in a listed NSPS category and must have been constructed, modified, or reconstructed after the effective date of the respective NSPS.

In order to evaluate NSPS applicability for the proposed projects, it is important to understand the following definitions that can be found at 40 CFR 60:

Construction	*means fabrication, erection, or installation of an affected facility.*
Modification	*means any physical change in, or change in the method of operation of, an existing facility which increases the amount of any air pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of*

any air pollutant (to which a standard applies) into the atmosphere not previously emitted.

With regard to modifications, 40 CFR 60.14 goes on to specify that the increase in emissions is evaluated on an hourly basis. Comparisons of hourly emission rates (before and after the modification) are made by comparing the capacity of the unit both before and after the modification (*e.g.,* potential-to-potential evaluation). This approach is supported by numerous, and consistent determinations from the US EPA on this issue in the past.

The NSPS, at 40 CFR 60.14, go on to state that certain changes are exempt and do not trigger new source standards. These include, but are not limited to the following:

40 CFR 60.14(e)(1)	*Maintenance, repair, and replacement which the Administrator determines to be routine for a source category...*
40 CFR 60.14(e)(2)	*An increase in production rate of an existing facility, if that increase can be accomplished without a capital expenditure on that facility.*
40 CFR 60.14(e)(3)	*An increase in the hours of operation.*
40 CFR 60.14(e)(6)	*The relocation or change in ownership of an existing facility.*

Reconstruction *means the replacement of components of an existing facility to such an extent that...The fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable entirely new facility, and...It is technologically and economically feasible to meet the applicable standards set forth in this part...*

Initial construction of the Recovery Boiler was started in July 1974, prior to the trigger date of September 24, 1976, as specified in NSPS Subpart BB. Furthermore, as presented in earlier applications, modifications in 1991 and 1995 did not cause the Recovery Boiler to become subject to Subpart BB. However, the July 1974 construction start date is after the trigger date of August 17, 1971, as specified in NSPS Subpart D. Since fossil fuel is not used for the purpose of producing steam, but rather to allow efficient startup/shutdown when the Recovery Boiler is fired with black liquor (not a fossil fuel), the Recovery Boiler is not subject to Subpart D. This is true as long as the fossil fuel "annual capacity factor" does not exceed 10%. The "annual capacity factor" is defined (40 CFR 60.41b) as "the ratio between the actual heat input to a steam generating unit....during a calendar year and the potential heat input to the steam generating unit had it been operated for 8,760 hours during a calendar year at the maximum steady state design heat input capacity". Based on historical records from the Mill's files, the Recovery Boiler has never fired fuel oil, or any other fossil fuel, at a rate that exceeds the 10% "annual capacity factor". In order to prevent questions on the applicability of Subpart D in the future, the Mill requests that FDEP incorporate the 10% "annual capacity factor" (7.86 million gallons per year of No. 6 fuel oil) as a Title V permit limit for the No. 4 Recovery Boiler.

With regard to the applicability of Subpart BB, as discussed in Section 3, the tubes are not being replaced for the purpose of increasing the throughput (or maximum hourly emission rate) of the Recovery Boiler. This is strictly a maintenance project that is being subjected to permitting as a result of having to apply the actual-to-potential accounting scheme. The proposed air system project is not anticipated to change the current maximum hourly black liquor solids throughput rate for the Recovery Boiler, but instead will allow the Boiler to operate at the higher rate for a longer, continuous period. The current black liquor recovery feed system normally operates at a black liquor solids content of approximately 68%. At this solids content, the evaporators cannot remove a sufficient amount of water to operate at the design rate of 210,000 pounds of black liquor solids per hour. In order to operate at the design black liquor solids rate, the Mill will install the crystallizer to increase the solids content of the black liquor from 68% to approximately 75%. This portion of the project could allow for an increase in the maximum hourly emission rates. However, at the same time, as discussed in Section 3, the air system changes will likely decrease the emissions (on a lb/ton BLS basis) for several of the pollutants.

In order to evaluate NSPS applicability for the Recovery Boiler, the Mill proposes to conduct emissions testing both before and after the air system and crystallizer projects are implemented in accordance with the procedures listed in 40 CFR 60 Appendix C, Determination of Emission Rate Change. This testing procedure is commonly used to determine whether a physical or operational change to an existing facility resulted in an increase in the emission rate to the atmosphere when there is some uncertainty regarding emission changes.

The estimated replacement cost of the Recovery Boiler in 2005 dollars is approximately $100 million. The preliminary cost estimate for the tube replacements is in the range of $24 million. The proposed modifications of the combustion air system are estimated at less than $2 million and the cost for the crystallizer installation is estimated to be in the range of $5 to $6 million. Therefore, the total cost of this work, no more than $32 million, represents less than 32% of the replacement cost for the Recovery Boiler, which is much less than the 50 percent threshold, demonstrating that this work will not constitute reconstruction of the unit.

5.3 NESHAP Applicability

The applicability of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) at 40 CFR Parts 61 and 63 is addressed in the following paragraphs for the No. 4 Recovery Boiler.

The final Section 112(d) MACT rule for Recovery Boilers was promulgated on January 12, 2001. This Rule, published as 40 CFR 63, Subpart MM, is known as the "National Emission Standards for Hazardous Air Pollutants for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills". The Rule, commonly referred to as MACT II, applies to both existing and new recovery boilers.

The MACT General Provisions, at 40 CFR 63.2, define a new source as, "...any affected source the construction or reconstruction of which is commenced after the Administrator first proposes a relevant emission standard under this part". As stated previously, the Recovery Boiler was constructed in the mid-1970s. Under the MACT General Provisions (40 CFR 63, Subpart A), the Rule states that reconstruction, "...means the replacement of components of an affected or a previously unaffected stationary source to such an extent that...The fixed capital cost of the new components exceeds 50 percent of the fixed capital cost that would be required to construct a comparable new source..." Since the proposed maintenance project and combustion air project combined only constitute about 28% of the replacement cost, the Recovery Boiler will not be "reconstructed" for the purposes of MACT applicability.

As the Recovery Boiler currently exists, it is considered as an "existing source" for the purposes of MACT applicability. With that designation, the unit had to be in compliance with the provisions of the MACT II rule no later than March 2004. The Mill plans to comply with the MACT II rule by meeting each of the individual emission standards for each piece of recovery equipment, including the No. 4 Recovery Boiler, the No. 4 Smelt Dissolving Tanks, and the No. 4 Lime Kiln. None of the actions being proposed as part of this project will impact the unit's designation as an existing source.

The Mill is requesting the FDEP to specifically incorporate the opacity standards from the MACT II rule into the Title V Permit. As part of the MACT II requirements, the Mill installed a continuous opacity monitoring system (COMS) on the No. 4 Recovery Boiler before the rules went into effect in 2004. The current Title V Permit does not contain any specific conditions for compliance with the use of a COMS and the applicable monitoring, recordkeeping and reporting requirements.

5.4 FDEP Rule Applicability

Additional, potentially applicable requirements contained in FDEP's rules are addressed in the following sections.

There are a number of regulations specifically addressing recovery boilers under Rule 62-296.404 of the FDEP's regulations. These rules are summarized in Table 5-2. However, the No. 4 Recovery Boiler must comply with more stringent rules than those outlined in 62-296.404 since it was previously subjected to PSD and BACT review (PSD Permit No. PSD-FL-226 in 1995).

5.5 Compliance Assurance Monitoring (CAM)

The Compliance Assurance Monitoring (CAM) rule is essentially a companion rule to Title V, requiring that control device operating parameters be monitored in order to demonstrate compliance with a specified emission limitation or standard. In order for the CAM Rule to apply to a specific emission unit/pollutant, the following, four criteria must be met:

1) The emission unit must be located at a major source for which a Part 70 or Part 71 permit is required.
2) The emission unit must be subject to an emission limitation or standard.
3) The emission unit must use a control device to achieve compliance.
4) The emission unit must have potential, pre-controlled emissions of the pollutant of at least 100 percent of the major source threshold.

The CAM Rule defines two classes of emission units. These are "large pollutant-specific emissions units" and "other pollutant-specific emissions units". The "large" units are those, "...with the potential to emit...taking into account control devices...the applicable regulated pollutant in an amount greater than 100 percent of the amount, in tons per year, required for a source to be classified as a major source..." The "other" units are those that are not "large" units.

As such, the primary difference between the two categories is that "large" units are those that are still major (*i.e.*, greater than 100 percent of the major source threshold) after the application of controls, while the "other" units are those that are non-major (*i.e.*, less than or equal to 100 percent of the major source threshold) following the application of controls.

Table 5-2. Applicable FDEP Rules for No. 4 Recovery Boiler

Rule	Applicable Sub-Sections	Brief Description
62-296.404	(1)(a)1. Visible Emissions	45% opacity, six-minute average, except visible emissions up to 60% opacity are allowed for one six-minute period per hour
	(1)(a)2. Visible Emissions	Recovery Boilers equipped with a certified opacity monitor are allowed visible emissions in excess of 45% opacity for up to six percent per quarter. Excess emissions must be reported to the state quarterly.
	(2)(a) Particulate Matter Emissions	3 pounds per 3,000 pounds of black liquor solids fed
	(3)(c)1.a. TRS Emissions	17.5 ppm by volume dry basis corrected to 8% oxygen as a 12-hour average
	(4)(a) Test Methods and Procedures	Visible emissions-EPA Method 9 Particulate emissions-EPA Method 5 TRS emissions-EPA Method 16, 16A, 16B
	(5)(a) Continuous Emissions Monitoring Requirements	Recovery Boilers shall be equipped with a TRS continuous emissions monitoring system
	(5)(b)1 Continuous Determination of TRS Emissions	The TRS continuous emissions monitoring system shall be installed, calibrated, certified and operated pursuant to all of the provisions contained in 1a through 1h (see rules for specific requirements)
	(5)(b)2 Data Reduction and Record keeping Requirements	The TRS continuous emissions monitoring system must meet the data reduction and record keeping requirements contained in 2a through 2e
	(6) Quarterly Reporting Requirements	Reports of TRS emissions shall be submitted within 30 days after the end of each calendar quarter. See rules contained in a through d for specific information to be included with quarterly reports.

The federal regulations, at 40 CFR 64.5(a)(2), state the following with regard to submittal of a CAM Plan for "large pollutant-specific emissions units":

> *"On or after April 20, 1998, the owner or operator shall submit information as part of an application for a significant permit revision under part 70 or 71 of this chapter, but only with respect to those pollutant-specific emissions units for which the proposed permit revision is applicable."*

The regulations, at 40 CFR 64.5(b), state the following with regard to submittal of a CAM Plan for the "other pollutant-specific emissions units":

> *"...the owner or operator shall submit the information required...as part of an application for a renewal of a part 70 or part 71 permit."*

The Recovery Boiler is currently equipped with an ESP for the purpose of controlling particulate matter emissions. No additional controls are proposed as a result of the BACT analysis included with this PSD permit application.

As shown in Attachment B, controlled, and hence uncontrolled, particulate matter emissions for the Recovery Boiler exceed 100 tons per year. As such, with regard to particulate matter, the Recovery Boiler is considered to be large-emitting unit and a CAM Plan would typically be due as part of a significant permit revision.

The federal regulations, at 40 CFR 64.2(b)(i), contain an exemption for, "emission limitations or standards proposed by the Administrator after November 15, 1990 pursuant to section 111 or 112 of the Act". Particulate matter emissions (as a surrogate for HAP metals) from the Recovery Boiler are regulated under Section 112 of the Act. Also, in cases where emission units utilize a continuous compliance demonstration method, such as a continuous emission monitor (CEM) or continuous opacity monitor (COM), 40 CFR 64.2(b)(1)(vi) provides an exemption as long as the method, "Provides data either in units of the standard or correlated directly with the compliance limit".

With regard to these criteria, the following facts are relevant at the Palatka Mill:

- The Palatka Mill is classified as a major source and a Part 70 permit is required
- The Recovery Boiler is subject to existing permit limits contained in the Mill's PSD and Title V permits
- The Recovery Boiler and other chemical recovery combustion sources, are subject to a particulate matter emission limitations contained in 40 CFR 63, Subpart MM. This standard was proposed under section 112 of the Act on April 15, 1998.
- The only control device present on the Recovery Boiler is an ESP for the control of particulate matter; no additional controls are proposed to be added as part of this permitting action

- Both pre-control and post-control particulate matter emissions exceed 100 tons per year, which is the major source threshold for that pollutant
- The Subpart MM monitoring rules require the Recovery Boiler to be equipped with a continuous opacity monitoring system (COMS) that can be used to determine opacity at least once every 10-second period and calculate and record each successive 6-minute average opacity. The Mill installed COMS for the No. 4 Recovery Boiler in December 2003.

As discussed previously (see Section 5.3), final MACT regulations for this source were promulgated by the US EPA on January 12, 2001 (40 CFR 63, Subpart MM, National Emission Standards for Hazardous Air Pollutants for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills). The specific standards and monitoring requirements for this equipment are contained at 40 CFR 63.862 (standards) and 63.864 (monitoring requirements). Since this Rule was proposed and promulgated after November 15, 1990, the Recovery Boiler is exempt from addressing CAM requirements as part of this permit application submittal.

6. BACT ANALYSIS

As part of the PSD permitting process, an applicant is required to conduct a BACT review. This requirement is set forth in the PSD regulations at 40 CFR 52.21(j) as follows:

> *"...an emission limitation based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any...source...which on a case-by-case basis is determined to be achievable taking into account energy, environmental and economic impacts and other costs."*

The BACT analysis for the No. 4 Recovery Boiler were conducted based on the "top-down" approach outlined in US EPA's, December 1, 1987 policy memorandum and their New Source Review Workshop Manual (Draft, October, 1990). A BACT analysis is required only for the pollutants found to be subject to PSD review. The results of the BACT analysis for the No. 4 Recovery Boiler is discussed in detail in Attachment D.

For the proposed maintenance work and project work for the No. 4 Recovery Boiler, the pollutants subject to PSD review include NO_x, CO, PM, PM_{10}, VOCs and SAM. As presented in Attachment D, based on other, recent BACT determinations, the No. 4 Recovery Boiler, as designed and operated with an ESP, employs BACT-level controls and operation for CO, PM, PM_{10}, VOCs and SAM. As such, the Mill is not proposing additional controls for these pollutants in conjunction with this project. However, as a result of the BACT analysis for NO_x emissions from the Recovery Boiler, GP has determined that it is cost effective to either install a fourth level of combustion air or make other combustion modifications that are equivalent to a fourth level of combustion air to further reduce NO_x emissions. Therefore, BACT for NO_x will be the addition of a fourth level of combustion air or other equivalent combustion modifications and a NO_x limit of 80 parts per million by volume (ppmv), corrected to 8% oxygen.

7. AIR QUALITY ANALYSIS

An applicant for a PSD permit is required to conduct an air quality analysis to determine the ambient impacts associated with the modified source. The primary purpose is to demonstrate that new or increased emissions will not cause or contribute to a violation of the National Ambient Air Quality Standards (NAAQS) or a PSD increment. Applicants for a PSD permit are also required to make a demonstration that there will be no adverse impacts upon soils, vegetation, visibility, or growth.

The results of the dispersion modeling analysis, demonstrating compliance with the NAAQS and PSD increments and discussion of additional impacts, are provided in Attachment C.

All PSD permit applicants must prepare an "additional impacts" analysis for each pollutant that will be emitted by the proposed project in significant amounts. The "additional impacts" analysis depends on existing air quality, the quantity of emissions, and the sensitivity of local soils and vegetation, and visibility in the source's impact area. The analysis is presented in three parts: (1) a soils and vegetation impacts analysis, (2) a visibility impairment analysis, and (3) a growth analysis. Each of these is addressed in the following sections.

Impacts Upon Soils and Vegetation

The secondary NAAQS are designed to protect soils and vegetation. As shown in Attachment C, the proposed projects will neither cause nor contribute to a violation of the NAAQS. As such, no adverse impact on soils or vegetation is predicted.

Impacts on Visibility

The project's maximum visibility impairment is predicted at PSD Class I areas to be below the FLM's screening criteria of 5 percent change, excluding unusual weather events. As a result, since the proposed project's regional haze maximum impacts are below the FLM's screening criteria at the PSD Class I area, it is expected the proposed project would not have an adverse impact on the existing regional haze at the PSD Class I areas.

Impacts on Growth

The elements of the growth analysis include a projection of the associated industrial, commercial, and residential growth that will occur in the area due to the source, including the potential impact upon ambient air due to this growth.

During the time that the proposed modifications and maintenance work for the No. 4 Recovery Boiler are made, some additional contract personnel may work at the Mill site. However, there will be no additional, permanent positions added as a result of either of these projects. As such, there is no anticipated increase in industrial, commercial, or residential growth in the area as a result of the proposed work on the No. 4 Recovery Boiler.

There are also expected to be no air quality impacts due to associated commercial and industrial growth given the location of the existing GP Palatka Mill. The existing commercial and industrial infrastructure should be adequate to provide any support services that the project might require and would not increase with the operation of the project.

ATTACHMENT A

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

DIVISION OF AIR RESOURCES MANAGEMENT

APPLICATION FOR AIR PERMIT LONG FORM

Department of
Environmental Protection
Division of Air Resource Management
APPLICATION FOR AIR PERMIT - LONG FORM

I. APPLICATION INFORMATION

Air Construction Permit – Use this form to apply for an air construction permit for a proposed project:

- subject to prevention of significant deterioration (PSD) review, nonattainment area (NAA) new source review, or maximum achievable control technology (MACT) review; or
- where the applicant proposes to assume a restriction on the potential emissions of one or more pollutants to escape a federal program requirement such as PSD review, NAA new source review, Title V, or MACT; or
- at an existing federally enforceable state air operation permit (FESOP) or Title V permitted facility.

Air Operation Permit – Use this form to apply for:

- an initial federally enforceable state air operation permit (FESOP); or
- an initial/revised/renewal Title V air operation permit.

Air Construction Permit & Revised/Renewal Title V Air Operation Permit (Concurrent Processing Option) – Use this form to apply for both an air construction permit and a revised or renewal Title V air operation permit incorporating the proposed project.

To ensure accuracy, please see form instructions.

Identification of Facility

1. Facility Owner/Company Name: **Georgia-Pacific Corporation**
2. Site Name: **Palatka Mill**
3. Facility Identification Number: **1070005**
4. Facility Location...:
   Street Address or Other Locator: **North of CR 216; West of US 17**
   City: **Palatka** County: **Putnam** Zip Code: **32177**
5. Relocatable Facility? ☐ Yes ☒ No
6. Existing Title V Permitted Facility? ☒ Yes ☐ No

Application Contact

1. Application Contact Name: **Myra Carpenter, Superintendent of Environmental Affairs**
2. Application Contact Mailing Address...
   Organization/Firm: **Georgia-Pacific Corporation**
   Street Address: **P.O. Box 919**
   City: **Palatka** State: **FL** Zip Code: **32178-0919**
3. Application Contact Telephone Numbers...
   Telephone: **(386) 325-2001** ext. Fax: **(386) 328-0014**
4. Application Contact Email Address: **mjcarpen@gapac.com**

Application Processing Information (DEP Use)

1. Date of Receipt of Application:	11-18-05
2. Project Number(s):	1070005-035-AC
3. PSD Number (if applicable):	PSD-FL-347
4. Siting Number (if applicable):	

Purpose of Application: Tube Replacement Project and Increase of Efficiency for No. 4 Recovery Boiler

This application for air permit is submitted to obtain: (Check one)

Air Construction Permit
☒ Air construction permit.

Air Operation Permit
☐ Initial Title V air operation permit.
☐ Title V air operation permit revision.
☐ Title V air operation permit renewal.
☐ Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is required.
☐ Initial federally enforceable state air operation permit (FESOP) where professional engineer (PE) certification is not required.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit (Concurrent Processing)
☐ Air construction permit and Title V permit revision, incorporating the proposed project.
☐ Air construction permit and Title V permit renewal, incorporating the proposed project.

Note: By checking one of the above two boxes, you, the applicant, are requesting concurrent processing pursuant to Rule 62-213.405, F.A.C. In such case, you must also check the following box:

☐ I hereby request that the department waive the processing time requirements of the air construction permit to accommodate the processing time frames of the Title V air operation permit.

Application Comment

Tube Replacement Project and Increase of Efficiency for No. 4 Recovery Boiler:

First, the Mill plans to replace a large percentage of the tubes in the No. 4 Recovery Boiler (Emission Unit ID No. 018). This includes tubes in the superheater, economizer, and generating banks of the Boiler. This major tube work is estimated to commence in April 2006 and conclude in 2008. The total cost of this work is estimated to be in the range of $24 million. Many of the tubes to be replaced are originals that have been in place since the Boiler was constructed in the mid-1970s. For these reasons, it is GP's opinion that this work does not constitute routine maintenance, repair, and replacement.

Although still in the preliminary engineering phase, the Mill is also considering replacement of, or changes to, the combustion air system for the Boiler. The objective of this part of the project is to lower peak furnace exit gas temperature and velocity into the superheater in an effort to reduce the potential for corrosion and pluggage of the superheater in the future. The new air system is also expected to reduce carry over and fouling in the Boiler convection banks. Through the staging of air, it is anticipated that emissions of some pollutants (*e.g.*, total reduced sulfur compounds and carbon monoxide) will be more consistently controlled. The Mill plans to install a fourth level of combustion air to the Recovery Boiler to help maintain NO_x emission rates at their current levels. The Mill is in the process of receiving vendor quotations for this work, including suggested scope. As such, the exact scope of this work is not available at this time. The estimated cost for this project is less than $2 million.

A third project involves a modification to the black liquor evaporation system (No. 4 Evaporator Set). This change would increase the solids concentration of the black liquor to the Recovery Boiler from 65 percent solids to approximately 75 percent solids. When the new system is operational, the liquor from the concentrator will pass through a Crystallizer vessel to raise the temperature of the liquor. The liquor will then enter a storage/flash tank at lower pressure where the moisture will "flash off". The "flash" vapors will then be routed to the existing evaporator system and collected as part of the existing non-condensible gas (NCG) collection system. The purpose of the project is to increase Boiler efficiency by reducing the amount of water entering the Boiler with the liquor solids. By reducing the amount of water vaporization being performed by the Boiler, less supplemental fuel will be required to process the same amount of black liquor solids (BLS). Furthermore, the increase in solids will improve the efficiency of the Boiler for steam production per pound of BLS, thus reducing the amount of steam produced from oil in the other boilers. The estimated cost for this project is between $5-6 million.

Finally, the Mill is considering the removal of some internal baffles and resizing some downcomer piping in the existing concentrators. The unit currently has scaling problems, leading to frequent "boil outs". The proposed changes will improve liquor circulation and increase velocity through the tubes, which should reduce scaling and fouling. This will increase the time between "boil outs". In addition, an external heat exchanger will be added to the existing concentrators to preheat the liquor with steam prior to entry into the concentrators. This will allow for increased evaporation surface, providing for a capability that more closely matches the capacity of the Recovery Boiler.

Scope of Application

Emissions Unit ID Number	Description of Emissions Unit	Air Permit Type	Air Permit Proc. Fee
018	No. 4 Recovery Boiler	AC1A	$7,500

Application Processing Fee

Check one: ☒ Attached - Amount: $7,500 ☐ Not Applicable

Owner/Authorized Representative Statement

Complete if applying for an air construction permit or an initial FESOP.

1. Owner/Authorized Representative Name :
Theodore D. Kennedy, Vice President, Palatka Operations

2. Owner/Authorized Representative Mailing Address...
Organization/Firm: **Georgia-Pacific Corporation**
Street Address: **P.O. Box 919**
City: **Palatka** State: **FL** Zip Code: **32178**

3. Owner/Authorized Representative Telephone Numbers...
Telephone: **(386) 325-2001** ext. Fax: **(386) 328-0014**

4. Owner/Authorized Representative Email Address: **tdkenned@gapac.com**

5. Owner/Authorized Representative Statement:

I, the undersigned, am the owner or authorized representative of the facility addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other requirements identified in this application to which the facility is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit.

Theodore D Kennedy
Signature

11/14/05
Date

Application Responsible Official Certification

Complete if applying for an initial/revised/renewal Title V permit or concurrent processing of an air construction permit and a revised/renewal Title V permit. If there are multiple responsible officials, the "application responsible official" need not be the "primary responsible official."

1. Application Responsible Official Name:

2. Application Responsible Official Qualification (Check one or more of the following options, as applicable):

   ☐ For a corporation, the president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is responsible for the overall operation of one or more manufacturing, production, or operating facilities applying for or subject to a permit under Chapter 62-213, F.A.C.

   ☐ For a partnership or sole proprietorship, a general partner or the proprietor, respectively.

   ☐ For a municipality, county, state, federal, or other public agency, either a principal executive officer or ranking elected official.

   ☐ The designated representative at an Acid Rain source.

3. Application Responsible Official Mailing Address...
   Organization/Firm:
   Street Address:
   City: State: Zip Code:

4. Application Responsible Official Telephone Numbers...
   Telephone: ( ) - ext. Fax: ( ) -

5. Application Responsible Official Email Address:

6. Application Responsible Official Certification:

   I, the undersigned, am a responsible official of the Title V source addressed in this air permit application. I hereby certify, based on information and belief formed after reasonable inquiry, that the statements made in this application are true, accurate and complete and that, to the best of my knowledge, any estimates of emissions reported in this application are based upon reasonable techniques for calculating emissions. The air pollutant emissions units and air pollution control equipment described in this application will be operated and maintained so as to comply with all applicable standards for control of air pollutant emissions found in the statutes of the State of Florida and rules of the Department of Environmental Protection and revisions thereof and all other applicable requirements identified in this application to which the Title V source is subject. I understand that a permit, if granted by the department, cannot be transferred without authorization from the department, and I will promptly notify the department upon sale or legal transfer of the facility or any permitted emissions unit. Finally, I certify that the facility and each emissions unit are in compliance with all applicable requirements to which they are subject, except as identified in compliance plan(s) submitted with this application.

   Signature Date

Professional Engineer Certification

1. Professional Engineer Name: **Mark J. Aguilar**
   Registration Number: **52248**

2. Professional Engineer Mailing Address:
   Organization/Firm: **Georgia-Pacific Corporation**
   Street Address: **133 Peachtree St**
   City: **Atlanta** State: **GA** Zip Code: **30303**

3. Professional Engineer Telephone Numbers...
   Telephone: **(404) 652-4293** ext. Fax: **(404) 654-4706**

4. Professional Engineer Email Address: **mjaguila@gapac.com**

5. Professional Engineer Statement:

I, the undersigned, hereby certify, except as particularly noted herein, that:*

(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this application for air permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and

(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.

(3) If the purpose of this application is to obtain a Title V air operation permit (check here ☐, if so), I further certify that each emissions unit described in this application for air permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance plan and schedule is submitted with this application.

(4) If the purpose of this application is to obtain an air construction permit (check here ☒, if so) or concurrently process and obtain an air construction permit and a Title V air operation permit revision or renewal for one or more proposed new or modified emissions units (check here ☐, if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.

(5) If the purpose of this application is to obtain an initial air operation permit or operation permit revision or renewal for one or more newly constructed or modified emissions units (check here ☐, if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.

Signature

Date 11/11/2005

(seal)

MARK AGUILAR
NO. 52248

* Attach any exception to certification statement.

Professional Engineer Certification

1. Professional Engineer Name: **Mark J. Aguilar**
   Registration Number: **52248**
2. Professional Engineer Mailing Address:
   Organization/Firm: **Georgia-Pacific Corporation**
   Street Address: **133 Peachtree St**
   City: **Atlanta** State: **GA** Zip Code: **30303**
3. Professional Engineer Telephone Numbers...
   Telephone: **(404) 652-4293** ext. Fax: **(404) 654-4706**
4. Professional Engineer Email Address: **mjaguila@gapac.com**
5. Professional Engineer Statement:

I, the undersigned, hereby certify, except as particularly noted herein, that:*

(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this application for air permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and

(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.

(3) If the purpose of this application is to obtain a Title V air operation permit (check here ☐, if so), I further certify that each emissions unit described in this application for air permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance plan and schedule is submitted with this application.

(4) If the purpose of this application is to obtain an air construction permit (check here ☒, if so) or concurrently process and obtain an air construction permit and a Title V air operation permit revision or renewal for one or more proposed new or modified emissions units (check here ☐, if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.

(5) If the purpose of this application is to obtain an initial air operation permit or operation permit revision or renewal for one or more newly constructed or modified emissions units (check here ☐, if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.

Signature　　　　　　Date

(seal)

* Attach any exception to certification statement.

II. FACILITY INFORMATION

A. GENERAL FACILITY INFORMATION

Facility Location and Type

1. Facility UTM Coordinates... Zone **17** East (km) **434.0** North (km) **3283.4**		2. Facility Latitude/Longitude... Latitude (DD/MM/SS) **29/41/0** Longitude (DD/MM/SS) **81/40/45**	
3. Governmental Facility Code: **0**	4. Facility Status Code: **A**	5. Facility Major Group SIC Code: **26**	6. Facility SIC(s): **2611, 2621**
7. Facility Comment :			

Facility Contact

1. Facility Contact Name:
Myra Carpenter, Superintendent of Environmental Affairs

2. Facility Contact Mailing Address...
Organization/Firm: **Georgia-Pacific Corporation**
Street Address: **P.O. Box 919**
City: **Palatka** State: **FL** Zip Code: **32178-0919**

3. Facility Contact Telephone Numbers:
Telephone: **(386) 325-2001** ext. Fax: **(386) 328-0014**

4. Facility Contact Email Address: **mjcarpen@gapac.com**

Facility Primary Responsible Official

Complete if an "application responsible official" is identified in Section I. that is not the facility "primary responsible official."

1. Facility Primary Responsible Official Name:

2. Facility Primary Responsible Official Mailing Address...
Organization/Firm:
Street Address:
City: State: Zip Code:

3. Facility Primary Responsible Official Telephone Numbers...
Telephone: ( ) - ext. Fax: ( ) -

4. Facility Primary Responsible Official Email Address:

Facility Regulatory Classifications

Check all that would apply *following* completion of all projects and implementation of all other changes proposed in this application for air permit. Refer to instructions to distinguish between a "major source" and a "synthetic minor source."

1. ☐ Small Business Stationary Source ☐ Unknown
2. ☐ Synthetic Non-Title V Source
3. ☒ Title V Source
4. ☒ Major Source of Air Pollutants, Other than Hazardous Air Pollutants (HAPs)
5. ☐ Synthetic Minor Source of Air Pollutants, Other than HAPs
6. ☒ Major Source of Hazardous Air Pollutants (HAPs)
7. ☐ Synthetic Minor Source of HAPs
8. ☒ One or More Emissions Units Subject to NSPS (40 CFR Part 60)
9. ☐ One or More Emissions Units Subject to Emission Guidelines (40 CFR Part 60)
10. ☒ One or More Emissions Units Subject to NESHAP (40 CFR Part 61 or Part 63)
11. ☐ Title V Source Solely by EPA Designation (40 CFR 70.3(a)(5))
12. Facility Regulatory Classifications Comment:

List of Pollutants Emitted by Facility

1. Pollutant Emitted	2. Pollutant Classification	3. Emissions Cap [Y or N]?
PM (Particulate Matter - Total)	**A**	**N**
PM_{10} (Particulate Matter - PM)	**A**	**N**
SO_2 (Sulfur Dioxide)	**A**	**N**
NO_x (Nitrogen Oxides)	**A**	**N**
CO (Carbon Monoxide)	**A**	**N**
VOC (Volatile Organic Compounds)	**A**	**N**
Pb (Lead)	**A**	**N**
SAM (Sulfuric Acid Mist)	**A**	**N**
TRS (Total Reduced Sulfur)	**A**	**N**
H001 (Acetaldehyde)	**A**	**N**
H015 (Arsenic)	**A**	**N**
H017 (Benzene)	**A**	**N**
H021 (Beryllium)	**A**	**N**
H027 (Cadmium)	**A**	**N**
H043 (Chloroform)	**A**	**N**
H047 (Cobalt)	**A**	**N**
H095 (Formaldehyde)	**A**	**N**
H104 (n-Hexane)	**A**	**N**
H106 (Hydrogen Chloride)	**A**	**N**
H113 (Manganese	**A**	**N**
H114 (Mercury)	**A**	**N**
H115 (Methanol)	**A**	**N**
H120 (Methyl Ethyl Ketone)	**A**	**N**
H123 (Methyl Isobutyl Ketone)	**A**	**N**
H128 (Methylene Chloride)	**A**	**N**
H132 (Naphthalene)	**A**	**N**
H133 (Nickel)	**A**	**N**
H162 (Selenium)	**A**	**N**
H163 (Styrene)	**A**	**N**
H167 (Tetrachloroethylene)	**A**	**N**
H169 (Toluene)	**A**	**N**
H174 (1,2,4-Trichlorobenzene)	**A**	**N**
H187 (o-Xylene)	**A**	**N**
H188 (m-Xylene)	**A**	**N**

B. EMISSIONS CAPS

Facility-Wide or Multi-Unit Emissions Caps

1. Pollutant Subject to Emissions Cap	2. Facility Wide Cap [Y or N]? (all units)	3. Emissions Unit ID No.s Under Cap (if not all units)	4. Hourly Cap (lb/hr)	5. Annual Cap (ton/yr)	6. Basis for Emissions Cap

7. Facility-Wide or Multi-Unit Emissions Cap Comment:

C. FACILITY ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Facility Plot Plan: (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☒ Attached, Document ID:**Figure 3-2** ☐ Previously Submitted, Date:____

2. Process Flow Diagram(s): (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☒ Attached, Document ID:**Figure 3-3** ☐ Previously Submitted, Date:_____

3. Precautions to Prevent Emissions of Unconfined Particulate Matter: (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☒ **See comment at bottom of Page A-12** ☐ Previously Submitted, Date:_____

Additional Requirements for Air Construction Permit Applications

1. Area Map Showing Facility Location:
☒ Attached, Document ID: **See Figure 3-1** ☐ Not Applicable (existing permitted facility)

2. Description of Proposed Construction or Modification:
☒ Attached, Document ID: **See Introduction Section 3.0 of PSD Permit Application**

3. Rule Applicability Analysis:
☒ Attached, Document ID: **See Introduction Section 5.0 of PSD Permit Application**

4. List of Exempt Emissions Units (Rule 62-210.300(3)(a) or (b)1., F.A.C.):
☐ Attached, Document ID: ☒ **Not Applicable (no exempt units at facility)**

5. Fugitive Emissions Identification (Rule 62-212.400(2), F.A.C.):
☒ Attached, Document ID: **See Attachment B** ☐ Not Applicable

6. Preconstruction Air Quality Monitoring and Analysis (Rule 62-212.400(5)(f), F.A.C.):
☒ Attached, Document ID: **See Attachment C** ☐ Not Applicable

7. Ambient Impact Analysis (Rule 62-212.400(5)(d), F.A.C.):
☒ Attached, Document ID: **See Attachment C** ☐ Not Applicable

8. Air Quality Impact since 1977 (Rule 62-212.400(5)(h)5., F.A.C.):
☒ Attached, Document ID: **See Attachment C** ☐ Not Applicable

9. Additional Impact Analyses (Rules 62-212.400(5)(e)1. and 62-212.500(4)(e), F.A.C.):
☒ Attached, Document ID: **See Attachment C** ☐ Not Applicable

10. Alternative Analysis Requirement (Rule 62-212.500(4)(g), F.A.C.):
☐ Attached, Document ID:_____ ☒ Not Applicable

Additional Requirements for FESOP Applications

1. List of Exempt Emissions Units (Rule 62-210.300(3)(a) or (b)1., F.A.C.):
   ☐ Attached, Document ID:_____ ☐ Not Applicable (no exempt units at facility)

Additional Requirements for Title V Air Operation Permit Applications

1. List of Insignificant Activities (Required for initial/renewal applications only):
   ☐ Attached, Document ID:_____ ☐ Not Applicable (revision application)
2. Identification of Applicable Requirements (Required for initial/renewal applications, and for revision applications if this information would be changed as a result of the revision being sought):
   ☐ Attached, Document ID:_____
   ☐ Not Applicable (revision application with no change in applicable requirements)
3. Compliance Report and Plan (Required for all initial/revision/renewal applications):
   ☐ Attached, Document ID:_____
   Note: A compliance plan must be submitted for each emissions unit that is not in compliance with all applicable requirements at the time of application and/or at any time during application processing. The department must be notified of any changes in compliance status during application processing.
4. List of Equipment/Activities Regulated under Title VI (If applicable, required for initial/renewal applications only):
   ☐ Attached, Document ID:_____
   ☐ Equipment/Activities On site but Not Required to be Individually Listed
   ☐ Not Applicable
5. Verification of Risk Management Plan Submission to EPA (If applicable, required for initial/renewal applications only) :
   ☐ Attached, Document ID:_____ ☐ Not Applicable
6. Requested Changes to Current Title V Air Operation Permit:
   ☐ Attached, Document ID: ☐ Not Applicable

Additional Requirements Comment

Under Additional Requirements for All Applications, Except as Otherwise Stated, No. 3 :

The emission limitations contained in Rule 62-296.320 F.A.C., pertain to visible emissions and reasonable precautions to prevent fugitive PM emissions.

III. EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Application - For Title V air operation permitting only, emissions units are classified as regulated, unregulated, or insignificant. If this is an application for Title V air operation permit, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each regulated and unregulated emissions unit addressed in this application for air permit. Some of the subsections comprising the Emissions Unit Information Section of the form are optional for unregulated emissions units. Each such subsection is appropriately marked. Insignificant emissions units are required to be listed at Section II, Subsection C.

Air Construction Permit or FESOP Application - For air construction permitting or federally enforceable state air operation permitting, emissions units are classified as either subject to air permitting or exempt from air permitting. The concept of an "unregulated emissions unit" does not apply. If this is an application for air construction permit or FESOP, a separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air permitting are required to be listed at Section II, Subsection C.

Air Construction Permit and Revised/Renewal Title V Air Operation Permit Application – Where this application is used to apply for both an air construction permit and a revised/renewal Title V air operation permit, each emissions unit is classified as either subject to air permitting or exempt from air permitting for air construction permitting purposes and as regulated, unregulated, or insignificant for Title V air operation permitting purposes. **The air construction permitting classification must be used to complete the Emissions Unit Information Section of this application for air permit.** A separate Emissions Unit Information Section (including subsections A through I as required) must be completed for each emissions unit subject to air permitting addressed in this application for air permit. Emissions units exempt from air construction permitting and insignificant emissions units are required to be listed at Section II, Subsection C.

If submitting the application form in hard copy, the number of this Emissions Unit Information Section and the total number of Emissions Unit Information Sections submitted as part of this application must be indicated in the space provided at the top of each page.

EMISSIONS UNIT INFORMATION

Section [1] of [1]

No. 4 Recovery Boiler

A. GENERAL EMISSIONS UNIT INFORMATION

Title V Air Operation Permit Emissions Unit Classification

1. Regulated or Unregulated Emissions Unit? (Check one, if applying for an initial, revised or renewal Title V air operation permit. Skip this item if applying for an air construction permit or FESOP only.)

☒ The emissions unit addressed in this Emissions Unit Information Section is a regulated emissions unit.

☐ The emissions unit addressed in this Emissions Unit Information Section is an unregulated emissions unit.

Emissions Unit Description and Status

1. Type of Emissions Unit Addressed in this Section: (Check one)

☒ This Emissions Unit Information Section addresses, as a single emissions unit, a single process or production unit, or activity, which produces one or more air pollutants and which has at least one definable emission point (stack or vent).

☐ This Emissions Unit Information Section addresses, as a single emissions unit, a group of process or production units and activities which has at least one definable emission point (stack or vent) but may also produce fugitive emissions.

☐ This Emissions Unit Information Section addresses, as a single emissions unit, one or more process or production units and activities which produce fugitive emissions only.

2. Description of Emissions Unit Addressed in this Section: **No. 4 Recovery Boiler**

3. Emissions Unit Identification Number: **018**

4. Emissions Unit Status Code: **A**	5. Commence Construction Date: **April 2006**	6. Initial Startup Date: **May 2006**	7. Emissions Unit Major Group SIC Code: **26**	8. Acid Rain Unit? ☐ Yes ☒ No

9. Package Unit:
Manufacturer: Model Number:

10. Generator Nameplate Rating: MW

11. Emissions Unit Comment: **The No. 4 Recovery Boiler is an existing piece of equipment. The upgrades to the boiler to increase efficiency will begin in April 2006. The boiler tube replacement project will also begin in April 2006. The boiler upgrades and tube replacements will be conducted over several different shutdown phases with all work to be finished by the end of 2008.**

EMISSIONS UNIT INFORMATION

Section [1] of [1]
No. 4 Recovery Boiler

Emissions Unit Control Equipment

1. Control Equipment/Method(s) Description:
Electrostatic Precipitator for control of PM/PM_{10} emissions

2. Control Device or Method Code(s): **010**

B. EMISSIONS UNIT CAPACITY INFORMATION

(Optional for unregulated emissions units.)

Emissions Unit Operating Capacity and Schedule

1. Maximum Process or Throughput Rate: **5.04 MM lbs/day black liquor solids**

2. Maximum Production Rate: **N/A**

3. Maximum Heat Input Rate: **1,346.0 MM Btu/hr**

4. Maximum Incineration Rate: pounds/hr
tons/day

5. Requested Maximum Operating Schedule:
24 hours/day **7** days/week
52 weeks/year **8,760** hours/year

6. Operating Capacity/Schedule Comment:

EMISSIONS UNIT INFORMATION
Section [1] of [1]
No. 4 Recovery Boiler

C. EMISSION POINT (STACK/VENT) INFORMATION
(Optional for unregulated emissions units.)

Emission Point Description and Type

1. Identification of Point on Plot Plan or Flow Diagram: **See Figure 3-3**	2. Emission Point Type Code: **1**	
3. Descriptions of Emission Points Comprising this Emissions Unit for VE Tracking: **See Figure 3-4**		
4. ID Numbers or Descriptions of Emission Units with this Emission Point in Common: **N/A**		
5. Discharge Type Code: **V**	6. Stack Height: **230 feet**	7. Exit Diameter: **12.0 feet**
8. Exit Temperature: **425 °F**	9. Actual Volumetric Flow Rate: **447,000 acfm**	10. Water Vapor:
11. Maximum Dry Standard Flow Rate: **294,000 dscfm @ 8% oxygen**	12. Nonstack Emission Point Height: feet	
13. Emission Point UTM Coordinates... Zone: **17** East (km): **433902.5 m** North (km): **3283644.2 m**	14. Emission Point Latitude/Longitude... Latitude (DD/MM/SS) Longitude (DD/MM/SS)	
15. Emission Point Comment:		

D. SEGMENT (PROCESS/FUEL) INFORMATION

Segment Description and Rate: Segment 1 of 2

1. Segment Description (Process/Fuel Type): **Pulp and Paper, Pulp & Paper Manufacturing, Paper/Board Forming** **No. 4 Recovery Boiler supplies steam for the pulp & paper mill**		
2. Source Classification Code (SCC): **3-07-001-04**	3. SCC Units: **Air-dried tons pulp (ADTP) per hour**	
4. Maximum Hourly Rate: **210,000 lbs black liquor solids (BLS)**	5. Maximum Annual Rate: **1,839.6 MM lbs BLS**	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur: **N/A**	8. Maximum % Ash: **N/A**	9. Million Btu per SCC Unit: **11.4**
10. Segment Comment: **Maximum annual firing rate is based on the maximum daily firing rate of 5.04 MM lbs BLS/day and assuming 365 days of operation per year.** **Capacity of Pulp Mill = 118 ADTP per hour and 1,850 ADTFP per day** **Max. Heat input rating of boiler = 1,346 MM Btu/hr (based on 210,000 lb BLS/hr x 6,410 Btu/lb BLS)**		

Segment Description and Rate: Segment of

1. Segment Description (Process/Fuel Type):		
2. Source Classification Code (SCC):	3. SCC Units:	
4. Maximum Hourly Rate:	5. Maximum Annual Rate:	6. Estimated Annual Activity Factor:
7. Maximum % Sulfur:	8. Maximum % Ash:	9. Million Btu per SCC Unit:
10. Segment Comment:		

EMISSIONS UNIT INFORMATION
Section [1] of [1]
No. 4 Recovery Boiler

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control	3. Secondary Control Device Code	4. Pollutant
PM/PM$_{10}$	010		EL
SO$_2$			EL
NO$_X$			EL
CO			EL
VOC			EL
Pb	010		EL
SAM			EL
TRS			EL
(H001) Acetaldehyde			NS
(H015) Arsenic			NS
(H021) Beryllium			EL
(H017) Benzene			NS
(H027) Cadmium			NS
(H043) Chloroform			NS
(H047) Cobalt			NS
(H095) Formaldehyde			NS
(H104) n-Hexane			NS
(H106) Hydrogen Chloride			NS
(H113) Manganese			NS
(H114) Mercury			EL
(H115) Methanol			NS
(H120) Methyl Ethyl Ketone			NS
(H123) Methyl Isobutyl Ketone			NS
(H128) Methylene Chloride			NS
(H132) Naphthalene			NS
(H133) Nickel			NS
(H162) Selenium			NS
(H163) Styrene			NS

E. EMISSIONS UNIT POLLUTANTS

List of Pollutants Emitted by Emissions Unit

1. Pollutant Emitted	2. Primary Control	3. Secondary Control Device Code	4. Pollutant
(H167) Tetrachloroethylene			**NS**
(H169) Toluene			**NS**
(H174) 1,2,4-Trichlorobenzene			**NS**
(H187) o-Xylene			**NS**
(H188) m-Xylene			**NS**

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **PM/PM_{10}**
2. Total Percent Efficiency of Control: **99+**
3. Potential Emissions: **75.6** lb/hour **331.1** tons/year
4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year
6. Emission Factor: **0.03 grains/dscf @ 8 % oxygen**
Reference: **BACT determination-see Attachment D**
7. Emissions Method Code: **5**
8. Calculation of Emissions:

PM (hourly) = 294,000 dscfm x 0.03 grains/dscf x 60 min/hr x 1 lb/7,000 grains = 75.6 lb/hr

PM (annual) = 75.6 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 331.1 ton/yr

PM_{10} (hourly) = 75.6 lb/hr x 0.75 (PM_{10} = 75% of PM) = 56.7 lb/hr
PM_{10} (annual) = 56.7 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 248.3 ton/yr

9. **Pollutant Potential/Estimated Fugitive Emissions Comment:**

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **75.6 lb/hr and 331.1 tons/year**	4. Equivalent Allowable Emissions: lb/hour

5. Method of Compliance: **Stack testing must be performed once per fiscal year**

6. Allowable Emissions Comment (Description of Operating Method): **Based on BACT analysis (see Attachment D) and Rule 62-212.400(5)(c)**

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method):

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method):

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: SO_2	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: **439.4** lb/hour **(3-hr avg.)** **153.9** tons/year	4. Synthetically Limited? ☒ Yes ☐ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **12.0 ppmv @ 8 % oxygen (annual avg.); 37.5 ppmv @ 8 % oxygen (24-hr avg.); 150.0 ppmv @ 8 % oxygen (3-hr avg.)** Reference: **PSD avoidance and compliance with regional visibility**	7. Emissions Method Code: **5**

8. Calculation of Emissions:

SO_2 (3-hour) = (150 $ft^3/10^6$ ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 64 lb-lb-n x 60 min/hr = 439.4 lb/hr

SO_2 (24-hour) = (37.5 $ft^3/10^6$ ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 64 lb-lb-n x 60 min/hr = 109.9 lb/hr

SO_2 (hourly-annual average) = (12 $ft^3/10^6$ ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 64 lb-lb-n x 60 min/hr = 35.1 lb/hr

SO_2 (annual) = 35.1 lb/hr x 8,760 hr/yr x 1 ton/2,000 lb = 153.9 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

The Mill is requesting an annual capacity limit for No. 6 fuel oil burned in the Recovery Boiler to avoid being subject to NSPS standard Subpart D. The annual capacity limit is equivalent to 7,860,640 gallons per year.

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 3

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **35.1 lb/hr (annual avg.)**	4. Equivalent Allowable Emissions: lb/hour **153.9 tons/year**

5. Method of Compliance: **Stack testing must be performed once per fiscal year**

6. Allowable Emissions Comment (Description of Operating Method): **Annual average based on taking voluntary restriction to avoid PSD.**

Allowable Emissions Allowable Emissions 2 of 3

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **109.9 lb/hr (24-hour average)**	4. Equivalent Allowable Emissions: **109.9** lb/hour tons/year

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method): **24-hour average based on taking voluntary restriction of SO_2 emissions to assure compliance with regional visibility.**

Allowable Emissions Allowable Emissions 3 of 3

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **439.4 lb/hr (3-hour average)**	4. Equivalent Allowable Emissions: **439.4** lb/hour tons/year

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method):

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: NO_x	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: **168.5 lb/hour and 738.1 tons/year**	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **80 ppmv @ 8 % oxygen** Reference: **BACT determination-see Attachment D**	7. Emissions Method Code: **5**

8. Calculation of Emissions: **See Attachment B of PSD Application**

NO_x = (80 $ft^3/10^6$ ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 46 lb-lb-n x 60 min/hr = 168.5 lb/hr
NO_x (annual) = 168.5 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 738.1 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **168.5 lb/hr and 738.1 tons/year**	4. Equivalent Allowable Emissions: **168.5** lb/hour
5. Method of Compliance: **Stack testing must be performed once per fiscal year**	
6. Allowable Emissions Comment (Description of Operating Method): **Based on BACT analysis (see Attachment D) and Rule 62-212.400(5)(c)**	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **CO**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **1,025.4 lb/hour (3-hr avg.) 2,245.6 tons/year**	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **400 ppmv @ 8 % oxygen (24-hr avg.); 800 ppmv @ 8 % oxygen (3-hr avg.)** Reference: **BACT determination-see Attachment D**	7. Emissions Method Code: **5**

8. Calculation of Emissions: **See Attachment B of PSD Application**

CO (3-hr avg.) = (800 ft^3/10^6 ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 28 lb-lb-n x 60 min/hr = 1,025.4 lb/hr

CO (24-hr avg. and annual average) = (400 ft^3/10^6 ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 28 lb-lb-n x 60 min/hr = 512.7 lb/hr

CO (annual) = 512.7 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 2,245.6 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **1,025.4 lb/hr (3-hr avg.)**	4. Equivalent Allowable Emissions: lb/hour **2,245.6 tons/year**
5. Method of Compliance: **Stack testing must be performed once per fiscal year**	
6. Allowable Emissions Comment (Description of Operating Method): **Based on BACT analysis (see Attachment D) and Rule 62-212.400(5)(c)**	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **VOC**
2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **31.5** lb/hour **138.0** tons/year
4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year
6. Emission Factor: **0.3 lb/ton BLS**

Reference: **BACT determination-see Attachment D**

7. Emissions Method Code: **5**
8. Calculation of Emissions: **See Attachment B of PSD Application**

VOC (hourly) = 0.3 lb/ton BLS x 210,000 lb BLS/hr / 2,000 lb/ton = 31.5 lb/hr
VOC (annual) = 31.5 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 138.0 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **31.5 lb/hr and 138.0 tons/year**	4. Equivalent Allowable Emissions: lb/hour
5. Method of Compliance: **Stack testing must be performed once per fiscal year**	
6. Allowable Emissions Comment (Description of Operating Method): **Based on BACT analysis (see Attachment D) and Rule 62-212.400(5)(c)**	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **Pb**	2. Total Percent Efficiency of Control: 99+
3. Potential Emissions: **0.0033** lb/hour **0.014** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **31.3 lb / MM ton BLS** Reference: **NCASI TB No. 701, Tables 12 C & 12 D.**	7. Emissions Method Code: **5**

8. Calculation of Emissions: **See Attachment B of PSD Application**

Pb (hourly) = 31.3 lb / MM ton BLS fired x 210,000 lb/hr BLS / 2,000 lb/ton x 1 MM ton/10^6 ton = 0.0033 lb/hr
Pb (annual) = 0.0033 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.014 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

__Allowable Emissions__ Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **0.0033 lb/hr and 0.014 tons/year**	4. Equivalent Allowable Emissions: lb/hour

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method):

__Allowable Emissions__ Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method):

__Allowable Emissions__ Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year

5. Method of Compliance:

6. Allowable Emissions Comment (Description of Operating Method):

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **SAM**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **3.6 lb/hour 15.9 tons/year**	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.8 ppmv, corrected to 8% oxygen** Reference: **BACT determination (see Attachment D)**	7. Emissions Method Code: **5**

9. Calculation of Emissions: **See Attachment B of PSD Application**

SAM (1-hour) = (0.8 $ft^3/10^6\ ft^3$) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 98 lb-lb-n x 60 min/hr = 3.6 lb/hr

SAM (annual) = 3.6 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 15.9 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

Allowable Emissions Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **3.6 lb/hour 15.9 tons/year**	4. Equivalent Allowable Emissions: lb/hour
5. Method of Compliance: **Stack testing must be performed once per fiscal year**	
6. Allowable Emissions Comment (Description of Operating Method):): **Based on BACT analysis (see Attachment D) and Rule 62-212.400(5)(c).**	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

Allowable Emissions Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **TRS**	2. Total Percent Efficiency of Control: *0.0*
3. Potential Emissions: **7.8 lb/hr and 34.2 tons/year**	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **5.0 ppmv @ 8 % oxygen 12-hour average** Reference: **Voluntary limit to avoid PSD**	7. Emissions Method Code: **5**

10. Calculation of Emissions: **See Attachment B of PSD Application**

TRS (12-hr average) = (5 $ft^3/10^6$ ft^3) x 294,000 dscf/min x 2,116.8 lb/ft^2 x 1 lb-n-°R/1,545.6 ft-lb x 1/528 °R x 34 lb-lb-n x 60 min/hr = 7.8 lb/hr

TRS (annual) = 7.8 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 34.2 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F2. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION - ALLOWABLE EMISSIONS

Complete if the pollutant identified in Subsection F1 is or would be subject to a numerical emissions limitation.

<u>Allowable Emissions</u> Allowable Emissions 1 of 1

1. Basis for Allowable Emissions Code: **RULE**	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units: **7.8 lb/hr (12-hr avg.) and 34.2 tons/year**	4. Equivalent Allowable Emissions: lb/hour
5. Method of Compliance: **Stack testing must be performed once per fiscal year**	
6. Allowable Emissions Comment (Description of Operating Method): **Based on taking voluntary restriction of TRS emissions to avoid PSD**	

<u>Allowable Emissions</u> Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

<u>Allowable Emissions</u> Allowable Emissions _____ of _____

1. Basis for Allowable Emissions Code:	2. Future Effective Date of Allowable Emissions:
3. Allowable Emissions and Units:	4. Equivalent Allowable Emissions: lb/hour tons/year
5. Method of Compliance:	
6. Allowable Emissions Comment (Description of Operating Method):	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H001**	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: **5.25** lb/hour **22.9** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **.05 lb/ton BLS** Reference:	7. Emissions Method Code: **5**

11. Calculation of Emissions:

(hourly) = 0.5 lb/ton BLS x 105 ton BLS/hr = 5.25 lb/hr
(annual) = 1.4 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 22.9 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H015**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.057** lb/hour **0.25** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.00054 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**
12. Calculation of Emissions: **(hourly) = 0.00054 lb/ton BLS x 105 ton BLS/hr = 0.057 lb/hr** **(annual) = 0.057 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.25 ton/yr**	
9. Pollutant Potential/Estimated Fugitive Emissions Comment:	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H017**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **2.6** lb/hour **296.1** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.025 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**
13. Calculation of Emissions: **(hourly) = 0.025 lb/ton BLS x 105 ton BLS/hr = 2.6 lb/hr** **(annual) = 2.6 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 296.1 ton/yr**	
9. Pollutant Potential/Estimated Fugitive Emissions Comment:	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H021**	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: **0.000126** lb/hour **0.00055** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0000012 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

14. Calculation of Emissions:

(hourly) = 0.0000012 lb/ton BLS x 105 ton BLS/hr = 0.000126 lb/hr
(annual) = 0.000126 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.00055 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H027**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.0016** lb/hour **0.007** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.000015 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**
15. Calculation of Emissions: **(hourly) = 0.000015 lb/ton BLS x 105 ton BLS/hr = 0.0016 lb/hr** **(annual) = 0.0016 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.007 ton/yr**	
9. Pollutant Potential/Estimated Fugitive Emissions Comment:	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H043**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.056** lb/hour **0.25** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.00053 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

16. Calculation of Emissions:

(hourly) = 0.00053 lb/ton BLS x 105 ton BLS/hr = 0.056 lb/hr
(annual) = 0.056 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.25 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H047**	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: **0.00033** lb/hour **0.0014** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0000031 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

17. Calculation of Emissions:

(hourly) = 0.0000031 lb/ton BLS x 105 ton BLS/hr = 0.00033 lb/hr
(annual) = 0.00033 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.0014 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H095**

2. Total Percent Efficiency of Control: **0.0**

3. Potential Emissions: **1.26** lb/hour **5.52** tons/year

4. Synthetically Limited? ☐ Yes ☒ No

5. Range of Estimated Fugitive Emissions (as applicable): to tons/year

6. Emission Factor: **0.012 lb/ton BLS**
Reference: **NCASI TB No. 858, Table 14A**

7. Emissions Method Code: **5**

18. Calculation of Emissions:

(hourly) = 0.012 lb/ton BLS x 105 ton BLS/hr = 1.26 lb/hr
(annual) = 1.26 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 5.52 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: H104	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: 0.38 lb/hour 1.7 tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: 0.0036 lb/ton BLS Reference: NCASI TB No. 858, Table 14A	7. Emissions Method Code: 5

19. Calculation of Emissions:

(hourly) = 0.0036 lb/ton BLS x 105 ton BLS/hr = 0.38 lb/hr
(annual) = 0.38 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 1.7 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions
Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H106**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **6.3** lb/hour **27.6** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.06 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**
20. Calculation of Emissions: **(hourly) = 0.06 lb/ton BLS x 105 ton BLS/hr = 6.3 lb/hr** **(annual) = 6.3 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 27.6 ton/yr**	
9. Pollutant Potential/Estimated Fugitive Emissions Comment:	

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H113**

2. Total Percent Efficiency of Control: **0.0**

3. Potential Emissions: **0.0055** lb/hour **0.024** tons/year

4. Synthetically Limited? ☐ Yes ☒ No

5. Range of Estimated Fugitive Emissions (as applicable): to tons/year

6. Emission Factor: **0.0000525 lb/ton BLS**

Reference: **NCASI TB No. 858, Table 14A**

7. Emissions Method Code: **5**

21. Calculation of Emissions:

(hourly) = 0.0000525 lb/ton BLS x 105 ton BLS/hr = 0.0055 lb/hr
(annual) = 0.0055 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.024 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H114**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.00074** lb/hour **0.0032** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.000007 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

22. Calculation of Emissions:

(hourly) = 0.000007 lb/ton BLS x 105 ton BLS/hr = 0.00074 lb/hr
(annual) = 0.00074 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.0032 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: H115	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: 5.7 lb/hour 25 tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0545 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

23. Calculation of Emissions:

Phenol (hourly) = 0.0545 lb/ton BLS x 105 ton BLS/hr = 5.7 lb/hr
Phenol (annual) = 5.7 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 25 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H120**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.75** lb/hour **3.29** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0071 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

24. Calculation of Emissions:

(hourly) = 0.0071 lb/ton BLS x 105 ton BLS/hr = 0.75 lb/hr
(annual) = 0.75 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 3.29 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H123**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.54** lb/hour **2.4** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0051 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

25. Calculation of Emissions:

(hourly) = 0.0051 lb/ton BLS x 105 ton BLS/hr = 0.54 lb/hr
(annual) = 0.54 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 2.4 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H128**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.66** lb/hour **2.9** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0063 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14A**	7. Emissions Method Code: **5**

26. Calculation of Emissions:

(hourly) = 0.0063 lb/ton BLS x 105 ton BLS/hr = 0.66 lb/hr
(annual) = 0.66 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 2.9 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H132**

2. Total Percent Efficiency of Control: **0.0**

3. Potential Emissions: **0.027** lb/hour **0.12** tons/year

4. Synthetically Limited? ☐ Yes ☒ No

5. Range of Estimated Fugitive Emissions (as applicable): to tons/year

6. Emission Factor: **0.00026**

Reference: **NCASI TB No. 858, Table 14A**

7. Emissions Method Code: **5**

27. Calculation of Emissions:

(hourly) = 0.00026 lb/ton BLS x 105 ton BLS/hr = 0.027 lb/hr
(annual) = 0.027 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.12 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H133**
2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.0034** lb/hour **0.015** tons/year
4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year
6. Emission Factor: **0.000032 lb/ton BLS**

   Reference: **NCASI TB No. 858, Table 14A**
7. Emissions Method Code: **5**

28. Calculation of Emissions:

(hourly) = 0.000032 lb/ton BLS x 105 ton BLS/hr = 0.0034 lb/hr
(annual) = 0.0034 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.015 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: H162	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: 0.0012 lb/hour 0.0053 tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: 0.000011 lb/ton BLS Reference: NCASI TB No. 858, Table 14B	7. Emissions Method Code: 5

29. Calculation of Emissions:

(hourly) = 0.000011 lb/ton BLS x 105 ton BLS/hr = 0.0012 lb/hr
(annual) = 0.0012 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.0053 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H163**

2. Total Percent Efficiency of Control: **0.0**

3. Potential Emissions: **0.15** lb/hour **0.66** tons/year

4. Synthetically Limited? ☐ Yes ☒ No

5. Range of Estimated Fugitive Emissions (as applicable): to tons/year

6. Emission Factor: **0.00145 lb/ton BLS**

Reference: **NCASI TB No. 858, Table 14B**

7. Emissions Method Code: **5**

30. Calculation of Emissions:

Cobalt (hourly) = 0.00145 lb/ton BLS x 105 ton BLS/hr = 0.15 lb/hr
Cobalt (annual) = 0.15 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.66 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H167**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.32** lb/hour **1.4** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.003 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14B**	7. Emissions Method Code: **5**

31. Calculation of Emissions:

(hourly) = 0.003 lb/ton BLS x 105 ton BLS/hr = 0.32 lb/hr
(annual) = 0.32 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 1.4 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: H169	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: 0.12 lb/hour 0.53 tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: 0.0011 lb/ton BLS Reference: NCASI TB No. 858, Table 14B	7. Emissions Method Code: 5

32. Calculation of Emissions:

(hourly) = 0.0011 lb/ton BLS x 105 ton BLS/hr = 0.12 lb/hr
(annual) = 0.12 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.53 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H174**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.91** lb/hour **4.0** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0087 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14B**	7. Emissions Method Code: **5**

33. Calculation of Emissions:

(hourly) = 0.0087 lb/ton BLS x 105 ton BLS/hr = 0.91 lb/hr
(annual) = 0.91 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 4.0 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: **H187**	2. Total Percent Efficiency of Control: **0.0**
3. Potential Emissions: **0.13** lb/hour **0.57** tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: **0.0012 lb/ton BLS** Reference: **NCASI TB No. 858, Table 14B**	7. Emissions Method Code: **5**

34. Calculation of Emissions:

(hourly) = 0.0012 lb/ton BLS x 105 ton BLS/hr = 0.13 lb/hr
(annual) = 0.13 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.57 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

F1. EMISSIONS UNIT POLLUTANT DETAIL INFORMATION – POTENTIAL/ESTIMATED FUGITIVE EMISSIONS

(Optional for unregulated emissions units.)

Potential/Estimated Fugitive Emissions

Complete for each pollutant identified in Subsection E if applying for an air construction permit or concurrent processing of an air construction permit and a revised or renewal Title V permit. Complete for each emissions-limited pollutant identified in Subsection E if applying for an air operation permit.

1. Pollutant Emitted: H188	2. Total Percent Efficiency of Control: 0.0
3. Potential Emissions: 0.18 lb/hour 0.79 tons/year	4. Synthetically Limited? ☐ Yes ☒ No
5. Range of Estimated Fugitive Emissions (as applicable): to tons/year	
6. Emission Factor: 0.0017 lb/ton BLS Reference: NCASI TB No. 858, Table 14B	7. Emissions Method Code: 5

35. Calculation of Emissions:

(hourly) = 0.0017 lb/ton BLS x 105 ton BLS/hr = 0.18 lb/hr
(annual) = 0.18 lb/hr x 8,760 hr/yr / 2,000 lb/ton = 0.79 ton/yr

9. Pollutant Potential/Estimated Fugitive Emissions Comment:

G. VISIBLE EMISSIONS INFORMATION

Complete if this emissions unit is or would be subject to a unit-specific visible emissions limitation.

Visible Emissions Limitation: Visible Emissions Limitation __ of ___

1. Visible Emissions Subtype: **VE20**	2. Basis for Allowable Opacity: x Rule Other

3. Allowable Opacity: **35%**
Normal Conditions: **20 %** Exceptional Conditions: %
Maximum Period of Excess Opacity Allowed: **less than 6% of time during any calendar quarter** min/hour

4. Method of Compliance: **EPA Method 9 performed once each fiscal year concurrently with PM performance test**

5. Visible Emissions Comment: **Opacity requirements based on MACT II standards under 40 CFR 63.864 (Monitoring Requirements)**

Visible Emissions Limitation: Visible Emissions Limitation ___ of __

1. Visible Emissions Subtype:	2. Basis for Allowable Opacity: Rule Other

3. Allowable Opacity:
Normal Conditions: % Exceptional Conditions: %
Maximum Period of Excess Opacity Allowed: min/hour

4. Method of Compliance:

5. Visible Emissions Comment:

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: Continuous Monitor 1 of 3

1. Parameter Code: EM	2. Pollutant(s): TRS

3. CMS Requirement: X Rule Other

4. Monitor Information.
Manufacturer: TMI
Model Number: Thermo 43-C Serial Number: 43C-67324-356

5. Installation Date: December 2000	6. Performance Specification Test Date: 2/2001

7. Continuous Monitor Comment: Rule 62-296.404(5)

Continuous Monitoring System: Continuous Monitor 2 of 3

1. Parameter Code: O_2	2. Pollutant(s): TRS

3. CMS Requirement: x Rule Other

4. Monitor Information...
Manufacturer: Citicell
Model Number: F2O Serial Number: None

5. Installation Date: 12/2000	6. Performance Specification Test Date: 2/2001

7. Continuous Monitor Comment: Oxygen is a diluent for TRS monitoring required by Rule 62-296.404(5)

H. CONTINUOUS MONITOR INFORMATION

Complete if this emissions unit is or would be subject to continuous monitoring.

Continuous Monitoring System: **Continuous Monitor 3 of 3**

1. Parameter Code: **VE**	2. Pollutant(s): **Opacity**
3. CMS Requirement:	**X Rule** Other
4. Monitor Information. Manufacturer: **TEI** Model Number: **440-TEI-Opacity**	Serial Number: **440-R-74895-377**
5. Installation Date: **Dec. 2003**	6. Performance Specification Test Date: **March 2004**
7. Continuous Monitor Comment: **Required under Rule 62.204.800 (11)(b)29 and 40 CFR 63.864**	

Continuous Monitoring System:

1. Parameter Code:	2. Pollutant(s):
3. CMS Requirement:	Rule Other
4. Monitor Information... Manufacturer: Model Number:	Serial Number:
5. Installation Date:	6. Performance Specification Test Date:
7. Continuous Monitor Comment:	

EMISSIONS UNIT INFORMATION
Section [1] of [1]
No. 4 Recovery Boiler

I. EMISSIONS UNIT ADDITIONAL INFORMATION

Additional Requirements for All Applications, Except as Otherwise Stated

1. Process Flow Diagram (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☒ Attached, Document ID: **Figure 3-3** ☐ Previously Submitted, Date _____

2. Fuel Analysis or Specification (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☒ Attached, Document ID: **Attachment B** ☐ Previously Submitted, Date _____

3. Detailed Description of Control Equipment (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☒ Attached, Document ID: **Attachment D** ☐ Previously Submitted, Date _____

4. Procedures for Startup and Shutdown (Required for all operation permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☐ Attached, Document ID: _____ ☐ Previously Submitted, Date _____
☒ Not Applicable (construction application)

5. Operation and Maintenance Plan (Required for all permit applications, except Title V air operation permit revision applications if this information was submitted to the department within the previous five years and would not be altered as a result of the revision being sought)
☐ Attached, Document ID: _____ ☐ Previously Submitted, Date _____
☒ Not Applicable

6. Compliance Demonstration Reports/Records
☐ Attached, Document ID: _____
Test Date(s)/Pollutant(s) Tested: _____

☐ Previously Submitted, Date: _____
Test Date(s)/Pollutant(s) Tested: _____

☐ To be Submitted, Date (if known): _____
Test Date(s)/Pollutant(s) Tested: _____

☒ Not Applicable

Note: For FESOP applications, all required compliance demonstration records/reports must be submitted at the time of application. For Title V air operation permit applications, all required compliance demonstration reports/records must be submitted at the time of application, or a compliance plan must be submitted at the time of application.

7. Other Information Required by Rule or Statute
☒ Attached, Document ID: **Attachment C** ☐ Not Applicable

Attachment B
Emission Estimates.

Chemical Recovery

No. 4 Recovery Boiler- Emissions Unit ID # 018 - Rated capacity of 210,000 lb/hr of BLS or 5.04 MM lb BLS/day. Maximum dry standard cubic feet per minute (dscfm) at 2.8% oxygen = 210,000 dscfm = 294,000 dscfm @ 8% oxygen. Maximum CaO = 38,889 lb/hr or 170,334 ton CaO/yr.

	Current Title V Limits 1070005-029-AV		**Proposed Title V Limits**	
Pollutant	**lb/hr**	**TPY**	**lb/hr**	**TPY**
PM	75.6	331.1	75.6	331.1
PM_{10}	-	-	56.7	248.3
VOC	31.5	138.0		
SO_2	109.9	481.4	439.4 (3-hr) 109.9 (24-hr) 35.1 (annual)	153.9
SAM	3.2	14.2	3.6	15.9
CO	1,025.4 (3-hr) 512.7 (24-hr)	2,245.6 (24-hr)	1,025.4 (3-hr) 512.7 (24-hr)	2,245.6 (24-hr)
TRS	10.9 (12-mo) 17.5 (12-hr)	47.7 (12-mo)	7.8 (12-hr)	34.2
Lead	-	-	0.0033	0.014
Be	$6x10^{-4}$	$2.8x10^{-3}$	$6x10^{-4}$	$2.8x10^{-3}$

Oxygen correction from 210,000 dscfm at 2.8% oxygen to 8% oxygen is shown in the calculations below.

$$\text{Correction Factor} = \text{Actual}\left[\frac{(21-8)}{(21-2.8)}\right] = \text{Actual}(1.4)$$

$$\text{Corrected Oxygen} = 210{,}000\,\text{dscfm}(1.4) = 294{,}000\,\text{dscfm at 8\% oxygen}$$

Particulate Matter Emissions - 75.6 lb/hr and 331.1 TPY - Current Title V Permit Limits (Section III Subsection E.4).

$$\text{PM (hourly)} = \left(\frac{0.03\text{ grains}}{\text{dscf}}\right)\left(\frac{294{,}000\text{ dscf}}{\text{min}}\right)\left(\frac{1\text{ lb}}{7{,}000\text{ grains}}\right)\left(\frac{60\text{ min}}{\text{hr}}\right) = 75.6\frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = \left(75.6\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 331.1\,\text{TPY}$$

Proposed PM_{10} limits of 56.7 lb/hr and 248.3 TPY based on PM_{10} as 75% of PM from AP-42, Table 10.2-3 (9/90).

$$\text{PM}_{10}\text{(hourly)} = 0.75\left(75.6\frac{\text{lb}}{\text{hr}}\right) = 56.7\frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = \left(56.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 248.3\,\text{TPY}$$

Sulfur Dioxide Emissions - 109.9 lb/hr and 481.4 TPY - Current Title V Permit Limits (Section III Subsection E.7). Proposed SO_2 limits based on annual average = 12 ppmvd @ 8% oxygen; 24-hr average = 75 ppmvd @ 8% oxygen; 3-hr average = 150 ppmvd @ 8% oxygen.

3-hour average:

$$\mathrm{SO_2(hourly)} = \left(\frac{150\ \mathrm{ft}^3}{10^6\ \mathrm{ft}^3}(\mathrm{ppmvd})\right)\left(\frac{294{,}000\ \mathrm{dscf}}{\mathrm{min}}\right)\left(\frac{2{,}116.8\ \mathrm{lb}}{\mathrm{ft}^2}\right)\left(\frac{\mathrm{lb-mole-R}}{1{,}545.6\ \mathrm{ft-lb_f}}\right)\left(\frac{1}{528\ \mathrm{R}}\right)\left(\frac{64\ \mathrm{lb}}{\mathrm{lb-mole}}\right)\left(\frac{60\ \mathrm{min}}{\mathrm{hr}}\right) = 439.4\,\frac{\mathrm{lb}}{\mathrm{hr}}$$

24-hour average:

$$SO_2(hourly) = \left(\frac{37.5\ ft^3}{10^6\ ft^3}(ppmvd)\right)\left(\frac{294{,}000\ dscf}{\mathrm{min}}\right)\left(\frac{2{,}116.8\ lb}{ft^2}\right)\left(\frac{lb-mole-R}{1{,}545.6\ ft-lb_f}\right)\left(\frac{1}{528\ R}\right)\left(\frac{64\ lb}{lb-mole}\right)\left(\frac{60\ \mathrm{min}}{hr}\right) = 109.9\,\frac{lb}{hr}$$

Annual average:

$$\mathrm{SO_2(hourly)} = \left(\frac{12\ \mathrm{ft}^3}{10^6\mathrm{ft}^3}(\mathrm{ppmvd})\right)\left(\frac{294{,}000\ \mathrm{dscf}}{\mathrm{min}}\right)\left(\frac{2{,}116.8\ \mathrm{lb}}{\mathrm{ft}^2}\right)\left(\frac{\mathrm{lb-mole-R}}{1{,}545.6\ \mathrm{ft-lb_f}}\right)\left(\frac{1}{528\ \mathrm{R}}\right)\left(\frac{64\ \mathrm{lb}}{\mathrm{lb-mole}}\right)\left(\frac{60\ \mathrm{min}}{\mathrm{hr}}\right) = 35.14\,\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{SO_2(annual)} = \left(35.14\,\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 153.9\,\mathrm{TPY}$$

Sulfuric Acid Mist Emissions - 3.2 lb/hr and 14.2 TPY - Current Title V Permit Limits (Section III Subsection E.11) based on a limit of 0.81 ppmvd. Proposed Title V Permit Limits of 3.6 lb/hr and 15.8 TPY based on concentration of 0.8 ppmv, corrected to 8% oxygen.

1-hour average:

$$SAM\ (hourly) = \left(\frac{0.8\ ft^3}{10^6\ ft^3}(ppmvd)\right)\left(\frac{294{,}000\ dscf}{\mathrm{min}}\right)\left(\frac{2{,}116.8\ lb}{ft^2}\right)\left(\frac{lb-mole-R}{1{,}545.6\ ft-lb_f}\right)\left(\frac{1}{528\ R}\right)\left(\frac{98\ lb}{lb-mole}\right)\left(\frac{60\ \mathrm{min}}{hr}\right) = 3.6\,\frac{lb}{hr}$$

Annual average:

$$SAM(annual) = \left(3.6\,\frac{lb}{hr}\right)\left(\frac{8{,}760\,hr}{yr}\right)\left(\frac{ton}{2{,}000\,lb}\right) = 15.9\,TPY$$

Nitrogen Oxide Emissions - 168.5 lb/hr and 738.1 TPY - Current Title V Permit Limits (Section III Subsection E.8).

$NOx_x(hourly) =$

$$\left(\frac{80\ ft^3}{10^6\ ft^3}(ppmvd)\right)\left(\frac{294{,}000\ dscf}{min}\right)\left(\frac{2{,}116.8\ lb}{ft^2}\right)\left(\frac{lb-mole-R}{1{,}545.6\ ft-lb_f}\right)\left(\frac{1}{528\ R}\right)\left(\frac{46\ lb}{lb-mole}\right)\left(\frac{60\ min}{hr}\right) = 168.5\frac{lb}{hr}$$

$$NO_x(annual) = \left(168.5\frac{lb}{hr}\right)\left(\frac{8{,}760\ hr}{yr}\right)\left(\frac{ton}{2{,}000\ lb}\right) = 738.1\ TPY$$

Carbon Monoxide Emissions - 1,025.4 lb/hr (3-hr block average), 512.7 lb/hr (24-hr block average), and 2,245.6 TPY - Current Title V Permit Limits (Section III Subsection E.9).

3-hour average:

$\mathrm{CO(hourly)} =$

$$\left(\frac{800\ \mathrm{ft}^3}{10^6\ \mathrm{ft}^3}(\mathrm{ppmvd})\right)\left(\frac{294{,}000\ \mathrm{dscf}}{\mathrm{min}}\right)\left(\frac{2{,}116.8\ \mathrm{lb}}{\mathrm{ft}^2}\right)\left(\frac{\mathrm{lb-mole-R}}{1{,}545.6\ \mathrm{ft-lb_f}}\right)\left(\frac{1}{528\ \mathrm{R}}\right)\left(\frac{28\ \mathrm{lb}}{\mathrm{lb-mole}}\right)\left(\frac{60\ \mathrm{min}}{\mathrm{hr}}\right) = 1{,}025.4\frac{\mathrm{lb}}{\mathrm{hr}}$$

24-hour and annual average:

$\mathrm{CO(hourly)} =$

$$\left(\frac{400\ \mathrm{ft}^3}{10^6\ \mathrm{ft}^3}(\mathrm{ppmvd})\right)\left(\frac{294{,}000\ \mathrm{dscf}}{\mathrm{min}}\right)\left(\frac{2{,}116.8\ \mathrm{lb}}{\mathrm{ft}^2}\right)\left(\frac{\mathrm{lb-mole-R}}{1{,}545.6\ \mathrm{ft-lb_f}}\right)\left(\frac{1}{528\ \mathrm{R}}\right)\left(\frac{28\ \mathrm{lb}}{\mathrm{lb-mole}}\right)\left(\frac{60\ \mathrm{min}}{\mathrm{hr}}\right) = 512.7\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{CO(annual)} = \left(512.7\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\ \mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\ \mathrm{lb}}\right) = 2{,}245.6\ \mathrm{TPY}$$

Volatile Organic Compound Emissions - 31.5 lb/hr and 138.0 TPY - Current Title V Permit Limits (Section III Subsection E.10). Proposed Title V Permit limits of 31.5 lb/hr and 138.0 TPY are based on previous BACT determination.

$$\mathrm{VOC(hourly)} = \left(0.30\frac{\mathrm{lb}}{\mathrm{ton}}\right)\left(\frac{210{,}000\ \mathrm{lb\,BLS}}{\mathrm{hr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\ \mathrm{lb}}\right) = 31.5\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{VOC(annual)} = \left(31.5\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\ \mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\ \mathrm{lb}}\right) = 138.0\ \mathrm{TPY}$$

Total Reduced Sulfur Emissions – Current Title V Permit Limits:

7.0 ppmvd @ 8% O_2, 10.9 lb/hr and 47.7 TPY as H_2S (12-month rolling average)
11.2 ppmvd @ 8% O_2, 17.5 lb/hr as H_2S (12-hour block average)

Proposed limit is 5 ppmvd @ 8% O_2, 7.8 lb/hr and 34.2 TPY as H_2S (12-hr block average)

12-hour block average:

$$\text{TRS (hourly)} =$$

$$\left(\frac{5\,\text{ft}^3}{10^6\,\text{ft}^3}(\text{ppmvd})\right)\left(\frac{294{,}000\ \text{dscf}}{\text{min}}\right)\left(\frac{2{,}116.8\ \text{lb}}{\text{ft}^2}\right)\left(\frac{\text{lb}-\text{mole}-\text{R}}{1{,}545.6\,\text{ft}-\text{lb}_f}\right)\left(\frac{1}{528\ \text{R}}\right)\left(\frac{34\ \text{lb}}{\text{lb}-\text{mole}}\right)\left(\frac{60\ \text{min}}{\text{hr}}\right)=7.8\frac{\text{lb}}{\text{hr}}$$

Annual average:

$$\text{TRS(annual)}=\left(7.8\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right)=34.2\,\text{TPY}$$

Lead Emissions – Proposed Title V permit limits of 0.0033 lb/hr and 0.014 TPY based on emission factor for BLS firing of 31.3 lb/MM ton BLS from NCASI TB # 701, Tables 12 C & 12 D.

$$\text{Pb(hourly)}=\left(31.3\frac{\text{lb}}{\text{MMton}}\right)\left(\frac{\text{MMton}}{10^6\,\text{ton}}\right)\left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right)=0.0033\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)}=\left(0.0033\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right)=0.014\,\text{TPY}$$

Beryllium Emissions - 0.5 lb/10^{12} Btu or $6.4\text{x}10^{-4}$ lb/hr and $2.8\text{x}10^{-3}$ TPY - Current Title V Permit Limits (Section III Subsection E.12).

$$\text{Be(hourly)}=\left(\frac{0.5\,\text{lb}}{10^{12}\,\text{Btu}}\right)\left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right)\left(\frac{6{,}084\,\text{Btu}}{\text{lb}}\right)=6.4\text{x}10^{-4}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Be(annual)}=\left(6.4\text{x}10^{-4}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right)=2.8\text{x}10^{-3}\,\text{TPY}$$

Mercury Emissions: Emission factor of $1.8\text{x}10^{-7}$ lb/ton BLS from NCASI TB 858, Table 14B.

$$\text{Hg(hourly)}=1.8\text{x}10^{-7}\,\frac{\text{lb}}{\text{ton}}\left(\frac{210{,}000\,\text{lb}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right)=1.9\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)}=\left(1.9\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right)=8.3\text{x}10^{-5}\,\text{TPY}$$

Other HAP emission estimates are contained in Attachment A of this application.

No. 4 Smelt Dissolving Tank - Emissions Unit ID # 019 - Rated capacity of 210,000 lb BLS/hr (24-hr average).

Particulate Matter Emissions: 0.12 lb/ton BLS (based on BACT limit established in 1991 PSD permit application) or 12.6 lb/hr and 55.2 TPY – Current Title V Permit Limits.

$$\mathrm{PM(hourly)} = \left(0.12\frac{\mathrm{lb}}{\mathrm{ton\,BLS}}\right)\left(\frac{210{,}000\,\mathrm{lb\,BLS}}{\mathrm{hr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 12.6\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{PM(annual)} = \left(12.6\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 55.2\,\mathrm{TPY}$$

Particulate Matter (PM_{10}) Emissions: AP-42, Table 10.2-7 (9/90), indicates that PM_{10} emissions from smelt dissolving tanks are equivalent to 90% of PM emissions.

$$\mathrm{PM_{10}(hourly)} = (0.90)\left(12.6\frac{\mathrm{lb}}{\mathrm{hr}}\right) = 11.3\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{PM_{10}(annual)} = (0.90)(55.2\,\mathrm{TPY}) = 49.7\,\mathrm{TPY}$$

Sulfur Dioxide Emissions: Emission factor - 0.073 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB # 884, Table 4.15, August 2004.

$$\mathrm{SO_2(hourly)} = \left(0.073\frac{\mathrm{lb}}{\mathrm{ton\,BLS}}\right)\left(\frac{210{,}000\,\mathrm{lb\,BLS}}{\mathrm{hr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 7.7\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{SO_2(annual)} = \left(7.7\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 33.7\,\mathrm{TPY}$$

Nitrogen Oxides Emissions: Emission factor - 0.151 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB # 884, Table 4.15, August 2004.

$$\mathrm{NO_x(hourly)} = \left(0.151\frac{\mathrm{lb}}{\mathrm{ton\,BLS}}\right)\left(\frac{210{,}000\,\mathrm{lb\,BLS}}{\mathrm{hr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 15.9\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{NO_x(annual)} = \left(15.9\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 69.6\,\mathrm{TPY}$$

Volatile Organic Compound Emissions: Emission factor - 0.25 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB # 884, Table 4.15, August 2004.

$$\text{VOC(hourly)} = \left(0.25\frac{\text{lb}}{\text{ton BLS}}\right)\left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 26.25\frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = \left(26.25\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 115.0\,\text{TPY}$$

Carbon Monoxide Emissions: Emission factor - 0.025 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB # 884, Table 4.15, August 2004.

$$\text{CO(hourly)} = \left(0.025\frac{\text{lb}}{\text{ton BLS}}\right)\left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.6\frac{\text{lb}}{\text{hr}}$$

$$\text{CO(annual)} = \left(2.6\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 11.4\,\text{TPY}$$

Total Reduced Sulfur Emissions: Current Title V permit limit: 0.048 lb TRS/3,000 lb BLS as H_2S (FL DEP state rule 296.404(3)(d)(1)) or 3.4 lb/hr and 14.9 ton/yr.

$$\text{TRS(hourly)} = \left(\frac{0.048\,\text{lb TRS}}{3{,}000\,\text{lb BLS}}\right)\left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right) = 3.4\,\text{lb/hr}$$

$$\text{TRS(annual)} = \left(3.4\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 14.9\,\text{TPY}$$

Lead Emissions: Emission factor - 28 lb/MM ton BLS (mean value for smelt dissolving tanks with scrubbers); NCASI TB # 701, Table 15B, October 1995.

$$\text{Pb(hourly)} = \left(\frac{28\,\text{lb}}{\text{MMton BLS}}\right)\left(\frac{1.05\text{x}10^{-4}\,\text{MMton BLS}}{\text{hr}}\right) = 2.9\text{x}10^{-3}\,\text{lb/hr}$$

$$\text{Pb(annual)} = \left(2.9\text{x}10^{-3}\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.013\,\text{TPY}$$

Mercury Emissions: Emission factor – $1.8\text{x}10^{-7}$ lb/ton BLS (mean value for smelt dissolving tanks with all ND = 0); NCASI TB #701, Table 15B, October 1995.).

$$\text{Hg(hourly)} = 1.8\text{x}10^{-7}\frac{\text{lb}}{\text{ton}}\left(\frac{210{,}000\,\text{lb}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.9\text{x}10^{-5}\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = \left(1.9\text{x}10^{-5}\ \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 8.3\text{x}10^{-5}\ \text{TPY}$$

HAP Emission Factors taken from NCASI Technical Bulletin No. 701, Table Nos. 15A and 15B, Oct. 1995, median values

HAP	Emission Factor (lb/ton BLS)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	5.5E-04	5.78E-02	2.53E-01
Acrolein	6.6E-06	6.93E-04	3.04E-03
Benzene	5.6E-07	5.88E-05	2.58E-04
Carbon Disulfide	2.6E-06	2.73E-04	1.20E-03
Chlorobenzene	2.0E-06	2.10E-04	9.20E-04
Chloroform	2.3E-06	2.42E-04	1.06E-03
Cumene	2.9E-07	3.05E-05	1.33E-04
Di-n-butylphthalate	2.5E-04	2.63E-02	1.15E-01
Ethyl Benzene	1.5E-08	1.58E-06	6.90E-06
Formaldehyde	5.2E-03	5.46E-01	2.39E+00
Hexachloropentadiene	8.0E-05	8.40E-03	3.68E-02
n-Hexane	6.1E-07	6.41E-05	2.81E-04
Methanol	0.01	1.05E+00	4.60E+00
Methyl Ethyl Ketone	8.4E-07	8.82E-05	3.86E-04
Methylene Chloride	1.5E-06	1.58E-04	6.90E-04
Methyl Isobutyl Ketone	3.0E-07	3.15E-05	1.38E-04
Styrene	1.2E-04	1.26E-02	5.52E-02
Tetrachloroethylene	3.7E-06	3.89E-04	1.70E-03
Toluene	1.9E-06	2.00E-04	8.74E-04
1,2,4-Trichlorobenzene	1.0E-04	1.05E-02	4.60E-02
1,1,1-Trichloroethane	6.0E-07	6.30E-05	2.76E-04
1,1,2-Trichloroethane	6.8E-06	7.14E-04	3.13E-03
Trichloroethylene	1.5E-05	1.58E-03	6.90E-03
o-Xylene	2.5E-07	2.63E-05	1.15E-04
m,p-Xylene	4.7E-08	4.94E-06	2.16E-05
Antimony	8.7E-06	9.14E-04	4.00E-03
Arsenic	3.0E-06	3.15E-04	1.38E-03
Beryllium	9.6E-07	1.01E-04	4.42E-04
Cadmium	3.0E-06	3.15E-04	1.38E-03
Chromium	1.5E-05	1.58E-03	6.90E-03
Manganese	3.8E-05	3.99E-03	1.75E-02
Mercury	1.8E-07	1.89E-05	8.28E-05
Nickel	6.0E-06	6.30E-04	2.76E-03
Phosphorous	1.2E-04	1.26E-02	5.52E-02
Selenium	3.0E-06	3.15E-04	1.38E-03
Silver	3.5E-06	3.68E-04	1.61E-03

Black Liquor, Green Liquor Cycle-Emissions Unit ID # 042-This area includes a number of miscellaneous fugitive and point emission sources as listed below:

Digester Area Black Liquor Storage Tanks:

Insignificant emission sources include the two, 65% Black Liquor day tanks, the 300,000 gallon Black Liquor tank, the 50% Black Liquor tank, the unfiltered strong Black Liquor Tank, the filtered Black Liquor tank, the million gallon weak Black Liquor tank, the 157,000 gallon weak liquor tank, the Strong Black Liquor Charge Tank, and the Tissue Black Liquor Charge Tank. The only information available for these emission sources is from NCASI TB # 677 (9/1994), Table V.A.1. Emissions data are provided only in the units of pounds per hour and not an emission factor. Therefore, it is not possible to estimate the increase in VOC emissions attributable to this project for these emission sources.

North & South Precipitator Tanks:

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.17 = 0.003 lb/ton BLS.

$$\text{Potential ton BLS processed/yr} = \left(\frac{210{,}000\,\text{lb}\,\text{BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 105\,\frac{\text{ton BLS}}{\text{hr}}$$

$$\text{VOC(hourly)} = \left(0.003\,\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{105\,\text{ton BLS}}{\text{hr}}\right) = 0.315\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.315\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.4\,\text{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-24.

Dimethyl disulfide – $1.2\text{x}10^{-3}$ lb/ton BLS
Dimethyl sulfide – $2.6\text{x}10^{-3}$ lb/ton BLS
Methyl mercaptan – $9.8\text{x}10^{-5}$ lb/ton BLS

Total TRS Compounds = 0.004 lb/ton BLS

$$\text{Potential ton BLS processed/yr} = \left(\frac{210{,}000\,\text{lb}\,\text{BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 105\,\frac{\text{ton BLS}}{\text{hr}}$$

$$\text{TRS(hourly)} = \left(0.004\,\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{105\,\text{ton BLS}}{\text{hr}}\right) = 0.42\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.42\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.84\,\text{TPY}$$

Hazardous Air Pollutants (emission factors – NCASI TB 858, Table A-24); emission factors listed as below the detection limit are not used

HAP	Emission	Hourly	Annual

	Factor (lb/ton BLS)	Emission Rate (lbs/hour)	Emission Rate (tons/year)
Acetaldehyde	1.7E-04	1.79E-02	7.82E-02
Acrolein	3.5E-06	3.68E-04	1.61E-03
Benzene	2.1E-08	2.21E-06	9.66E-06
Chlorobenzene	2.7E-07	2.84E-05	1.24E-04
Formaldehyde	1.1E-05	1.16E-03	5.06E-03
n-Hexane	1.3E-07	1.37E-05	5.98E-05
Methanol	3.1E-03	3.26E-01	1.43E+00
Methyl Ethyl Ketone	3.8E-05	3.99E-03	1.75E-02
Methyl Isobutyl Ketone	1.2E-06	1.26E-04	5.52E-04
Styrene	1.6E-06	1.68E-04	7.36E-04
Tetrachloroethylene	2.9E-07	3.05E-05	1.33E-04
Toluene	1.2E-05	1.26E-03	5.52E-03
1,1,2-Trichloroethane	1.3E-06	1.37E-04	5.98E-04
1,2,4-Trichlorobenzene	5.0E-06	5.25E-04	2.30E-03
o-Xylene	7.5E-07	7.88E-05	3.45E-04
m,p-Xylene	5.4E-07	5.67E-05	2.48E-04

Salt Cake Mix Tank:

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.17 = 0.003 lb/ton BLS.

$$\text{Potential ton BLS processed/yr} = \left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 105\,\frac{\text{ton BLS}}{\text{hr}}$$

$$\text{VOC(hourly)} = \left(0.003\,\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{105\,\text{ton BLS}}{\text{hr}}\right) = 0.315\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.315\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.4\,\text{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-24.

Dimethyl disulfide – $1.2\text{x}10^{-3}$ lb/ton BLS
Dimethyl sulfide – $2.6\text{x}10^{-3}$ lb/ton BLS
Methyl mercaptan – $9.8\text{x}10^{-5}$ lb/ton BLS

Total TRS Compounds = 0.004 lb/ton BLS

$$\text{Potential ton BLS processed/yr} = \left(\frac{210{,}000\,\text{lb BLS}}{\text{hr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 105\,\frac{\text{ton BLS}}{\text{hr}}$$

$$\text{TRS(hourly)} = \left(0.004\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{105\,\text{ton BLS}}{\text{hr}}\right) = 0.42\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.42\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.84\,\text{TPY}$$

Hazardous Air Pollutants (emission factors – NCASI TB 858, Table A-24); emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton BLS)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	1.7E-04	1.79E-02	7.82E-02
Acrolein	3.5E-06	3.68E-04	1.61E-03
Benzene	2.1E-08	2.21E-06	9.66E-06
Chlorobenzene	2.7E-07	2.84E-05	1.24E-04
Formaldehyde	1.1E-05	1.16E-03	5.06E-03
n-Hexane	1.3E-07	1.37E-05	5.98E-05
Methanol	3.1E-03	3.26E-01	1.43E+00
Methyl Ethyl Ketone	3.8E-05	3.99E-03	1.75E-02
Methyl Isobutyl Ketone	1.2E-06	1.26E-04	5.52E-04
Styrene	1.6E-06	1.68E-04	7.36E-04
Tetrachloroethylene	2.9E-07	3.05E-05	1.33E-04
Toluene	1.2E-05	1.26E-03	5.52E-03
1,1,2-Trichloroethane	1.3E-06	1.37E-04	5.98E-04
1,2,4-Trichlorobenzene	5.0E-06	5.25E-04	2.30E-03
o-Xylene	7.5E-07	7.88E-05	3.45E-04
m,p-Xylene	5.4E-07	5.67E-05	2.48E-04

Green Liquor Clarifier:

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.14 = 0.066 lb/ton CaO.

Potential quantity of CaO processed = 170,334 TPY or 19.44 ton/hr

$$\text{VOC(hourly)} = \left(0.066\frac{\text{lb}}{\text{ton CaO}}\right)\left(\frac{170{,}334\text{ ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\text{ hr}}\right) = 1.3\text{ lb/hr}$$

$$\text{VOC(annual)} = \left(1.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 5.6\text{ TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-17.

Dimethyl disulfide – $2\text{x}10^{-4}$ lb/ton CaO
Dimethyl sulfide – Not Detected
Methyl mercaptan – $4.2\text{x}10^{-4}$ lb/ton CaO

Total TRS Compounds = $6.2\text{x}10^{-4}$ lb/ton CaO

$$\text{TRS(hourly)} = \left(6.2\text{x}10^{-4}\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{170{,}334\text{ ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\text{ hr}}\right) = 0.012\text{ lb/hr}$$

$$\text{TRS(annual)} = \left(0.012\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 0.053\text{ TPY}$$

Hazardous Air Pollutants (emission factors – NCASI TB 858, Table A-17); emission factors listed as below the detection limit are not used.

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	5.8E-05	1.13E-03	4.94E-03
Benzene	4.7E-06	9.14E-05	4.00E-04
Chlorobenzene	1.9E-07	3.69E-06	1.62E-05
Chloroform	2.0E-06	3.89E-05	1.70E-04
1,2-Dichloroethane	1.2E-06	2.33E-05	1.02E-04
n-Hexane	1.1E-06	2.14E-05	9.37E-05
Methanol	1.1E-03	2.14E-02	9.37E-02
Methyl Ethyl Ketone	2.0E-05	3.89E-04	1.70E-03
Methyl Isobutyl Ketone	2.9E-06	5.64E-05	2.47E-04
Tetrachlorethylene	1.4E-06	2.72E-05	1.19E-04
1,1,2-Trichloroethane	6.5E-06	1.26E-04	5.53E-04
o-Xylene	3.4E-07	6.61E-06	2.90E-05

Green Liquor Tanks (North, South, and 280,000 gallon Units):

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.14 = 0.066 lb/ton CaO.

Potential quantity of CaO processed = 170,334 TPY or 19.44 ton/hr

$$\text{VOC(hourly)} = \left(0.066\frac{\text{lb}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 1.3\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 5.6\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-17.

Dimethyl disulfide – $3.1\text{x}10^{-5}$ lb/ton CaO
Dimethyl sulfide – $4.8\text{x}10^{-5}$ lb/ton CaO
Methyl mercaptan – $2.1\text{x}10^{-6}$ lb/ton CaO

Total TRS Compounds = $8.1\text{x}10^{-5}$ lb/ton CaO

$$\text{TRS(hourly)} = \left(8.1\text{x}10^{-5}\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 0.0016\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.0016\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 0.0069\ \text{TPY}$$

Hazardous Air Pollutants (emission factors – NCASI TB 858, Table A-17); emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	5.8E-05	1.13E-03	4.94E-03
Benzene	4.7E-06	9.14E-05	4.00E-04
Chlorobenzene	1.9E-07	3.69E-06	1.62E-05
Chloroform	2.0E-06	3.89E-05	1.70E-04
1,2-Dichloroethane	1.2E-06	2.33E-05	1.02E-04
n-Hexane	1.1E-06	2.14E-05	9.37E-05
Methanol	1.1E-03	2.14E-02	9.37E-02
Methyl Ethyl Ketone	2.0E-05	3.89E-04	1.70E-03
Methyl Isobutyl Ketone	2.9E-06	5.64E-05	2.47E-04
Tetrachlorethylene	1.4E-06	2.72E-05	1.19E-04
1,1,2-Trichloroethane	6.5E-06	1.26E-04	5.53E-04
o-Xylene	3.4E-07	6.61E-06	2.90E-05

Recausticizing

No. 4 Lime Kiln- Emissions Unit ID # 017 - The permitted input capacity of this unit is 82,986 pounds per hour (lb/hr) (of $CaCO_3$ & inerts)(24-hr block average). This equates to 19.44 tons/hr CaO produced. This unit has a venturi scrubber to control particulate matter (PM/PM_{10}) emissions and sulfur dioxide (SO_2) emissions (90% assumed). This unit will fire No. 6 fuel oil with a maximum sulfur content of 2.1% (by weight) to support combustion in the kiln. The kiln will be modified to burn petroleum coke.

Particulate Matter Emissions: 26.0 lb/hr and 113.9 tons per year (TPY) - Current Title V Permit Limits
Proposed Title V Permit Limits of 29.7 lb/hr and 130.2 TPY shown by the calculations listed below.

Flow rate at 10% O_2 = 54,200 dscfm as explained in letter dated January 4, 2005 written by GP.

PM limit = 0.064 grains/dscf is based on MACT II limit.
dscfm = dry standard cubic feet per minute

$$\text{PM(hourly)} = \left(\frac{54{,}200\ \text{dscf}}{\text{min}}\right)\left(\frac{0.064\ \text{grains}}{\text{dscf}}\right)\left(\frac{\text{lb}}{7{,}000\ \text{grains}}\right)\left(\frac{60\,\text{min}}{\text{hr}}\right) = 29.7\ \text{lb/hr}$$

$$\text{PM(annual)} = \left(29.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 130.2\ \text{TPY}$$

PM_{10} assumed to be 100% PM, based on AP-42 Table 10.2-4 (9/90-reformatted 1/95) for a lime kiln with a venturi scrubber for control.

$$\text{PM}_{10}\text{(hourly)} = (1)\left(29.7\frac{\text{lb}}{\text{hr}}\right) = 29.7\ \text{lb/hr}$$

$$\text{PM}_{10}\text{(annual)} = (1)(130.2\ \text{TPY}) = 130.2\ \text{TPY}$$

TRS Emissions: 4.0 lb/hr (12-hr average) and 17.5 TPY as H_2S - Current Title V Permit Limits

Proposed Title V Permit Limits of 3.7 lb/hr and 16.3 TPY shown by the calculations listed below, based on 13 ppmvd @ 10% O_2.

$$\text{TRS(hourly)} =$$

$$\left(\frac{13\,\text{ft}^3}{10^6\,\text{ft}^3}\text{(ppmvd)}\right)\left(\frac{2{,}116.8\ \text{lb}}{\text{ft}^2}\right)\left(\frac{\text{lb}-\text{mole}-\text{R}}{1{,}545.6\ \text{ft}-\text{lb}_f}\right)\left(\frac{1}{528\ \text{R}}\right)\left(\frac{34\ \text{lb}}{\text{lb}-\text{mole}}\right)\left(\frac{54{,}200\ \text{dscf}}{\text{min}}\right)\left(\frac{60\ \text{min}}{\text{hr}}\right) = 3.7\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(3.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 16.3\ \text{TPY}$$

Sulfur Dioxide Emissions:

Proposed Title V Permit Limits of 34.5 lb/hr and 151.1 TPY shown by the calculations listed below. The lime kiln, which has an 80% inherent SO_2 removal efficiency, is equipped with a scrubber with 90% SO_2 removal efficiency. The petroleum coke has a maximum 7% sulfur content. Calculations assume burning 100% petroleum coke.

Normal Kiln Operation-Oil Firing:

Based on emission factor of 0.23 lbs/ton CaO (NCASI TB 646, February 1993 – from Table 13, average of all the kilns).

$$SO_2(\text{hourly}) = \left(\frac{19.44 \text{ ton CaO}}{\text{hr}}\right)\left(\frac{0.23 \text{ lb}}{\text{ton CaO}}\right) = 4.5 \text{ lb/hr}$$

$$SO_2(\text{annual}) = \left(4.5 \, \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760 \text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000 \text{ lb}}\right) = 19.7 \text{ TPY}$$

Petroleum Coke Firing:

$$SO_2(\text{hourly}) =$$

$$\left(\frac{150 \text{ MMBtu}}{\text{hr}}\right)\left(\frac{\text{lb coke}}{14{,}000 \text{ Btu}}\right)\left(\frac{10^6 \text{Btu}}{\text{MMBtu}}\right)\left(\frac{7 \text{ lb S}}{100 \text{ lb coke}}\right)\left(\frac{\text{lb}-\text{mole S}}{32 \text{ lb S}}\right)\left(\frac{\text{lb}-\text{mole } SO_2}{\text{lb}-\text{mole S}}\right)\left(\frac{64 \text{ lb } SO_2}{\text{lb}-\text{mole } SO_2}\right)(0.10)\,(0.20) = 30.0 \text{ lb/hr}$$

$$SO_2(\text{annual}) = \left(30.0 \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760 \text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000 \text{ lb}}\right) = 131.4 \text{ TPY}$$

Total:

$$SO_2(\text{hourly}) = 4.5 \, \frac{\text{lb}}{\text{hr}} + 30.0 \, \frac{\text{lb}}{\text{hr}} = 34.5 \text{ lb/hr}$$

$$SO_2(\text{annual}) = 19.7 \text{ TPY} + 131.4 \text{ TPY} = 151.1 \text{ TPY}$$

Sulfuric Acid Mist Emissions:

Proposed Title V Permit Limits of 1.5 lb/hr and 6.7 TPY, as shown by the calculations listed below, are based on AP-42 emission factors of 5.7S lb/10^3 gal for SO_3 and 157S lb/10^3 gal for SO_2 (Table 1.3-1 (9/98)). The ratio of SO_3 to SO_2 is 3.6%, and then SO_3 was converted to sulfuric acid mist (SAM) by multiplying by ratio of molecular weights (x 98/80).

$$\text{SAM(hourly)} =$$

$$\left(34.5 \frac{\text{lb}}{\text{hr}}\right)\left(\frac{3.6\%}{100\%}\right) = \left(1.24 \frac{\text{lb}}{\text{hr}} \, SO_3\right)\left(\frac{98 \text{ lb SAM}}{\text{lb}-\text{mole SAM}}\right)\left(\frac{\text{lb}-\text{mole SAM}}{\text{lb}-\text{mole } SO_3}\right)\left(\frac{\text{lb}-\text{mole } SO_3}{80 \text{ lb } SO_3}\right) = 1.5 \text{ lb/hr}$$

$$\text{SAM(annual)} = \left(1.5\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 6.7\text{ TPY}$$

Nitrogen Oxides Emissions: 50.3 lb/hr and 223.3 TPY - Current Title V Permit Limits

Proposed Title V Permit Limits of 97.5 lb/hr and 427.0 TPY based on an emission factor of 0.65 lb/MMBtu, which is based on a study by Arcadis (December 4, 2003) that predicted NO_x at 0.65 lb/MMBtu for a mixture of 80% petroleum coke and 20% natural gas.

$$NO_x\text{(hourly)} = \left(\frac{150\text{ MMBtu}}{\text{hr}}\right)\left(\frac{0.65\text{ lb}}{\text{MMBtu}}\right) = 97.5\text{ lb/hr}$$

$$NO_x\text{(annual)} = \left(97.5\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 427.0\text{ TPY}$$

Carbon Monoxide Emissions: 7.3 lb/hr and 32.0 TPY (based on 69 ppmvd @ 10% oxygen – previous BACT determination – permit issued 5/31/1992) - Current Title V Permit Limits

Proposed Title V Permit Limits of 16.3 lb/hr and 71.5 TPY (See Lime Kiln Shell Replacement Permit Application, dated 8/2004) shown by the calculations listed below.

$$\text{CO(hourly)} =$$
$$\left(\frac{69\text{ ft}^3}{10^6\text{ ft}^3}\text{(ppmvd)}\right)\left(\frac{2{,}116.8\text{ lb}}{\text{ft}^2}\right)\left(\frac{\text{lb}-\text{mole}-\text{R}}{1{,}545.6\text{ ft}-\text{lb}_f}\right)\left(\frac{1}{528\text{ R}}\right)\left(\frac{28\text{ lb}}{\text{lb}-\text{mole}}\right)\left(\frac{54{,}200\text{ dscf}}{\text{min}}\right)\left(\frac{60\text{ min}}{\text{hr}}\right) = 16.3\text{ lb/hr}$$

$$\text{CO(annual)} = \left(16.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 71.5\text{ TPY}$$

Volatile Organic Compound Emissions: 17.2 lb/hr and 75.3 TPY (based on 185 ppmvd @ 10% oxygen) - Current Title V Permit Limits.

Proposed Title V Permit Limits of 9.4 lb/hr and 41.4 TPY shown by the calculations listed below. As negotiated for the Lime Kiln shell replacement project, GP agreed to meet a VOC limit of 70 ppmvd. GP will agree to meet this limitation with the addition of pet coke.

$$\text{VOC(hourly)} =$$
$$\left(\frac{70\text{ ft}^3}{10^6\text{ ft}^3}\text{(ppmvd)}\right)\left(\frac{2{,}116.8\text{ lb}}{\text{ft}^2}\right)\left(\frac{\text{lb}-\text{mole}-\text{R}}{1{,}545.6\text{ ft}-\text{lb}_f}\right)\left(\frac{1}{528\text{ R}}\right)\left(\frac{16\text{ lb}}{\text{lb}-\text{mole}}\right)\left(\frac{54{,}200\text{ dscf}}{\text{min}}\right)\left(\frac{60\text{ min}}{\text{hr}}\right) = 9.4\text{ lb/hr}$$

$$\text{VOC(annual)} = \left(9.4\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 41.4\text{ TPY}$$

Lead Emissions:

Maximum emissions of 0.056 lb/hr and 0.25 TPY shown by the calculations listed below. Emission factor = 2.9×10^{-3} lb/ton CaO from NCASI TB #858, Table 16C, February 2003, using median of all oil-fired kilns.

$$\text{Pb(hourly)} = \left(\frac{2.9\text{x}10^{-3}\ \text{lb}}{\text{ton CaO}}\right)\left(\frac{19.44\ \text{ton CaO}}{\text{hr}}\right) = 0.056\ \text{lb/hr}$$

$$\text{Pb(annual)} = \left(0.056\ \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 0.25\ \text{TPY}$$

Lime Kiln HAP Emission Estimates are included as Table B-1 in Attachment B of this application.

Caustic Area- Emissions Unit ID # 042 - This area includes a number of miscellaneous fugitive and point emission sources as listed below:

Lime (White Liquor) Slakers (Nos. 1 & 2)

Particulate Matter Emissions: Emission factor – NCASI TB 884, Table 4.14; mean = 0.031 lb/ton CaO. 170,334 ton CaO processed in both slakers.

$$\text{PM(hourly)} = \left(0.031\frac{\text{lb PM}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 0.60\ \text{lb/hr}$$

$$\text{PM(annual)} = \left(0.60\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 2.6\ \text{TPY}$$

Volatile Organic Compound Emissions: Emission factor = 0.041 lb/ton CaO, NCASI TB 676, Table VII.A.5, Mill M (only mill with separate slaker and cauticizer exhausts); mean value.

$$\text{VOC(hourly)} = \left(0.041\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 0.8\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.8\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 3.5\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factor = 0.045 lb/ton CaO, NCASI TB 849, Table 24, mean value.

$$\text{TRS(hourly)} = \left(0.045\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 0.875\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.875\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 3.8\,\text{TPY}$$

Hazardous Air Pollutants Emission factors – NCASI TB 676, Table VII.A.5, Mill M (only mill with separate slaker and cauticizer exhausts); emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	5.30E-02	1.03E+00	4.51E+00
Methanol	5.30E-02	1.03E+00	4.51E+00
Methyl Ethyl Ketone	1.20E-03	2.33E-02	1.02E-01
Benzene	1.30E-04	2.53E-03	1.11E-02
Toluene	3.10E-04	6.03E-03	2.64E-02
Styrene	1.10E-03	2.14E-02	9.37E-02

White Liquor Storage Tanks (5 units)

Volatile Organic Compound Emissions: Emission factor – NCASI TB 858, Table A-17 = 0.0056 lb/ton CaO.

$$\text{VOC(hourly)} = \left(0.0056\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{170{,}334\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.11\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.11\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.48\,\text{TPY}$$

Hazardous Air Pollutants Emission factors – NCASI TB 858, Table A-17); factors scaled up using 20% safety factor; emission rates are potential-to-emit; emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Benzene	2.9E-05	5.64E-04	2.47E-03
Formaldehyde	2.2E-03	4.28E-02	1.87E-01
Methanol	1.5E-02	2.92E-01	1.28E+00
Methyl Ethyl Ketone	1.6E-04	3.11E-03	1.36E-02
Styrene	4.9E-05	9.53E-04	4.17E-03
o-Xylene	6.2E-05	1.21E-03	5.28E-03

White Liquor Clarifiers (East and West Units)

Volatile Organic Compound Emissions: Emission factor – NCASI TB 858, Table A-17 = 0.0056 lb/ton CaO.

$$\text{VOC(hourly)} = \left(0.0056\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{170{,}334\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.11\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.11\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.48\,\text{TPY}$$

Hazardous Air Pollutants Emission factors – NCASI TB 858, Table A-17); factors scaled up using 20% safety factor; emission rates are potential-to-emit; emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Benzene	2.9E-05	5.64E-04	2.47E-03
Formaldehyde	2.2E-03	4.28E-02	1.87E-01
Methanol	1.5E-02	2.92E-01	1.28E+00
Methyl Ethyl Ketone	1.6E-04	3.11E-03	1.36E-02
Styrene	4.9E-05	9.53E-04	4.17E-03
o-Xylene	6.2E-05	1.21E-03	5.28E-03

Lime Mud Washer Tanks (4 units)

Volatile Organic Compound Emissions: Emission factor = 0.085 lb VOC/ton CaO processed NCASI TB #676, Table VIII.A.1-DCA3.

$$\text{VOC(hourly)} = \left(0.085\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{170{,}334\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 1.65\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.65\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 7.2\,\text{TPY}$$

Total Reduced Sulfur Emissions: Emission factor from NCASI TB# 676, Table VIII.A.1-DCA3 with values less than the detection limit represented as zero.

Dimethyl sulfide – $1.2\text{x}10^{-3}$ lb/ton CaO
Methyl mercaptan – $7.4\text{x}10^{-4}$ lb/ton CaO

Total TRS Compounds = $1.9\text{x}10^{-3}$ lb/ton CaO

$$\text{TRS(hourly)} = \left(0.0019\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 0.04\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.04\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 0.18\ \text{TPY}$$

HAP Emissions: Emission factors NCASI TB # 676, Table VIII.A.1-DCA3; emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	2.00E-04	3.89E-03	1.70E-02
Benzene	1.40E-05	2.72E-04	1.19E-03
Methanol	9.30E-02	1.81E+00	7.92E+00
Methyl Ethyl Ketone	2.60E-04	5.05E-03	2.21E-02
Methyl Isobutyl Ketone	1.20E-05	2.33E-04	1.02E-03
Styrene	9.90E-05	1.92E-03	8.43E-03
Toluene	3.50E-05	6.80E-04	2.98E-03
m, p-Xylene	1.40E-05	2.72E-04	1.19E-03
o-Xylene	1.60E-05	3.11E-04	1.36E-03

Lime Mud Splitter Box Tank

Volatile Organic Compound Emissions: Emission factor = 0.085 lb VOC/ton CaO processed NCASI TB #676, Table VIII.A.1-DCA3.

$$\text{VOC(hourly)} = \left(0.085\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{170{,}334\ \text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\ \text{hr}}\right) = 1.65\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.65\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\ \text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\ \text{lb}}\right) = 7.2\ \text{TPY}$$

HAP Emissions: Emission factors NCASI TB # 676, Table VIII.A.1-DCA3; emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	2.00E-04	3.89E-03	1.70E-02
Benzene	1.40E-05	2.72E-04	1.19E-03
Methanol	9.30E-02	1.81E+00	7.92E+00
Methyl Ethyl Ketone	2.60E-04	5.05E-03	2.21E-02
Methyl Isobutyl Ketone	1.20E-05	2.33E-04	1.02E-03
Styrene	9.90E-05	1.92E-03	8.43E-03
Toluene	3.50E-05	6.80E-04	2.98E-03
m, p-Xylene	1.40E-05	2.72E-04	1.19E-03
o-Xylene	1.60E-05	3.11E-04	1.36E-03

Causticizer Tanks (Nos. 1A, 1B, 2,3)

Volatile Organic Compound Emissions: Emission factor – NCASI TB 676, Table VII.A.5, Mill M (only mill with separate slaker and cauticizer exhausts); mean = 0.00083 lb/ton CaO.

$$\text{VOC(hourly)} = \left(0.00083\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{170{,}334\text{ ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\text{ hr}}\right) = 0.016\text{ lb/hr}$$

$$\text{VOC(annual)} = \left(0.016\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 0.07\text{ TPY}$$

Total Reduced Sulfur Emissions: Emission factor – NCASI TB 849, Table 24; mean = 0.019 lb/ton CaO (as sulfur); factor as hydrogen sulfide = 0.019 x 34/32 = 0.020 lb/ton CaO.

$$\text{TRS(hourly)} = \left(0.020\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{170{,}334\text{ ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\text{ hr}}\right) = 0.39\text{ lb/hr}$$

$$\text{TRS(annual)} = \left(0.39\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\text{ hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\text{ lb}}\right) = 1.7\text{ TPY}$$

Hazardous Air Pollutants Emission factors – NCASI TB 676, Table VII.A.5, Mill M (only mill with separate slaker and cauticizer exhausts); emission factors listed as below the detection limit are not used

HAP	Emission Factor (lb/ton CaO)	Hourly Emission Rate (lbs/hour)	Annual Emission Rate (tons/year)
Acetaldehyde	1.0E-03	1.94E-02	8.51E-02
Methanol	5.5E-04	1.07E-02	4.68E-02
Methyl Ethyl Ketone	7.0E-06	1.36E-04	5.96E-04
Benzene	6.8E-07	1.32E-05	5.79E-05
Methyl Isobutyl Ketone	1.6E-06	3.11E-05	1.36E-04
m,p-Xylene	1.2E-06	2.33E-05	1.02E-04
Styrene	2.2E-05	4.28E-04	1.87E-03

Table B-1

Emission Factors and Emission Rates for Organic Hazardous Air Pollutants, Lime Kiln

		Available Emission Factors (lb/ton CaO)							
	Test Result	Est. mean		ND as 0	ND as 1/2 DL			Selected Factor	
Compound	Range	>50% NDs		Median[1]	Median[2]	Mean[2]		(lb/ton CaO)	PTE(tpy)
1,1,1-Trichloroethane	--	--		8.00E-05	8.00E-05	8.00E-05	d	8.00E-05	0.0068
1,1,2-Trichloroethane	--	--		3.80E-04	3.80E-04	3.80E-04	d	3.80E-04	0.032
1,2,4-Trichlorobenzene	ND to 4.7E-02	1.30E-04	c					4.70E-02	4.00
1,2-Dichloroethane	--	--		3.70E-04	3.70E-04	3.70E-04	d	3.70E-04	0.032
Acetaldehyde	ND to 1.2E-02			9.60E-04	5.50E-03	5.10E-03	a	9.60E-04	0.082
Acetophenone	--	--		5.50E-03	5.50E-03	5.50E-03	d	5.50E-03	0.47
Acrolein	ND to 2.1E-03	2.10E-05	b					2.10E-03	0.18
Benzene	ND to 6.6E-03	3.30E-04	b					6.60E-03	0.56
Carbon Tetrachloride	--	--		1.50E-03	1.50E-03	1.50E-03	d	1.50E-03	0.13
Carbonyl Sulfide	--	--		3.90E-03	3.90E-03	3.90E-03	d	3.90E-03	0.33
Chlorobenzene	ND to 4.6E-04	1.10E-05	c					4.60E-04	0.039
Chloroform	ND to 2.1E-04	3.60E-06	c					2.10E-04	0.018
Chloromethane	27 to 187 ppb	--		1.70E-03	1.70E-03	1.70E-03		1.70E-03	0.14
m-Cresol	--	--		9.50E-03	9.50E-03	9.50E-03	d	9.50E-03	0.81
o-Cresol	--	--		4.70E-03	4.70E-03	4.70E-03	d	4.70E-03	0.40
Cumene	--	--		5.50E-03	5.50E-03	5.50E-03	d	5.50E-03	0.47
Ethyl Benzene	--	--		1.50E-03	5.50E-03	8.50E-03	a	1.50E-03	0.13
Formaldehyde	ND to 4.2E-02			1.20E-02	1.20E-02	1.20E-02	d	1.20E-02	1.02
Hexachlorocyclopentadiene	--	--		1.00E-02	1.00E-02	1.00E-02	d	1.00E-02	0.85
n-Hexane	ND to 4.8E-04	2.10E-05	c	--	--	--		4.80E-04	0.041
Hydrogen Chloride	ND to 1.9E-03	2.10E-04	c	--	--	--		1.90E-03	0.16
Methanol	ND to 0.98	--		8.00E-03	1.20E-02	3.10E-02	a	8.00E-03	0.68
Methyl Ethyl Ketone	ND to 0.174	4.30E-05	b	--	--	--		1.74E-01	14.8
Methyl Isobutyl Ketone	ND to 1.3E-03	2.00E-04	b	--	--	--		1.30E-03	0.11
Methylene Chloride	ND to 2.3E-04	4.20E-06	c	--	--	--		2.30E-04	0.020
Naphthalene	ND to 4.8E-03	--		1.30E-02	1.30E-02	1.30E-02		1.30E-02	1.11
Phenol	ND to 0.016	2.70E-04	c	--	--	--		1.60E-02	1.36
Styrene	ND to 1.6E-03	5.70E-05	c	--	--	--		1.60E-03	0.14
Tetrachloroethylene	ND to 5.3E-03	2.60E-04	c	--	--	--		5.30E-03	0.45
Toluene	ND to 2.4E-02	1.50E-05	b	--	--	--		2.40E-02	2.04
Trichloroethylene	--	--		3.70E-04	3.70E-04	3.70E-04	d	3.70E-04	0.032
Vinyl Acetate	--	--		8.00E-05	8.00E-05	8.00E-05	d	8.00E-05	0.0068
m,p-Xylene	ND to 5.7E-03	6.80E-06	b	--	--	--		5.70E-03	0.49
o-Xylene	ND to 0.132	2.10E-04	b	--	--	--		1.32E-01	11.2

Notes:

ND = Not detected; DL = Detection Limit

This sheet compiles the most current NCASI emission factors and selects the most appropriate factor using the following priority:
First - ND as 0 Median values. Second - For compounds which do not have at least >50% detects, then select the max from all tests.
NCASI tested but found no detection of hexachloroethane, iodomethane, and isooctane.

1. Median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)
2. Median/mean based upon assuming ND = ½ detection limit (DL)
3. From NCASI Technical Bull. No. 849 – all NDs were assumed at ½ the DL when estimating averages

a. Trimmed Mean for data sets with 15 to 50% NDs;
b. NOR-PLOT Average;
c. SDln Average; The "NOR-PLOT Average"
d "SDln Average" are statistically derived sample averages applicable to all data sets with greater than 50% NDs; when more than 1 source is tested and all observations are ND, averages shown correspond to ½ of the lowest detection limit.

Emission Factors and Emission Rates for Metal Hazardous Air Pollutants, Lime Kiln

	Computed Factor (lb/ton CaO) Scrubber						
	Max	Est. Mean >50% NDs	ND as 0 Median [1]	ND as 1/2 DL Median [2]	Mean [2]		PTE(tpy)
As	1.20E-04	6.10E-07					0.010
Be	1.00E-05	2.40E-08					0.00085
Cd	3.30E-05		5.80E-06	1.30E-05	1.40E-05		0.00049
Cr	9.60E-04		2.00E-04	2.00E-04	2.70E-04		0.017
Co	3.60E-05		2.30E-06	1.00E-05	1.00E-05	a	0.00020
Pb	1.70E-02		2.10E-04	1.60E-04	3.20E-03		0.018
Mn	8.30E-03		3.00E-04	3.00E-04	1.70E-03		0.026
Hg	5.20E-06	6.20E-07					0.000053
Ni	1.30E-03		9.50E-05	9.50E-05	3.10E-04		0.0081
Se	1.20E-04	2.60E-06					0.00022
Cr+6	7.60E-05	1.80E-05					0.0065

ND= Not detected DL= Detection Limit
This sheet compiles the most current NCASI emission factors and selects the most appropriate factor using the following priority:
First - ND as 0 Median values.
Second - For compounds which do not have at least >50% detects, then select the max from all tests.

1. Median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)
2. Median/mean based upon assuming ND = ½ detection limit (DL)

a. Trimmed Mean for data sets with 15 to 50% NDs

ATTACHMENT B

BASELINE AND POTENTIAL EMISSION CALCULATIONS FOR PROJECT-AFFECTED SOURCES

Baseline Emission Rate Calculations for Project-Affected Sources

General Assumptions:

Baseline emission calculations have been calculated by taking the average values of either Mill production and/or combustion equipment fuel usage data for calendar years 2003 and 2004 and multiplying these average values by the appropriate emission factors. Emission factors used include those published in US Environmental Protection Agency (EPA) Manual AP-42, various technical bulletins and other reports published by the National Council for Air and Stream Improvement (NCASI). Additionally, some of the baseline emission data is taken directly from stack tests that have been performed. Some of the production and/or fuel usage data come from the Mill's 2003 and 2004 Annual Operating Reports submitted to the state while some of the data comes from other Mill records.

The pollutants considered for emission estimating purposes include: particulate matter (total particulate matter and PM_{10}), nitrogen oxides, sulfur dioxide, carbon monoxide, volatile organic compounds, lead, total reduced sulfur, sulfuric acid mist, mercury and beryllium.

Chemical Recovery

No. 4 Recovery Boiler- Emissions Unit ID # 018 - Rated capacity of 210,000 lb/hr of BLS or 5.04 MM lb BLS/day. Unit uses an ESP with a particulate matter collection efficiency of 99%.

2003: 552,260 tons air-dried unbleached pulp or 768,021 tons BLS
Hours of operation: 8,278

2004: 525,988 tons air-dried unbleached pulp or 744,438 tons BLS
Hours of operation: 8,082

Particulate Matter Emissions:

2003:

$$\text{PM(hourly)} = 15.4\ \frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 2003}$$

$$\text{PM(annual)} = \left(15.4\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 63.7\ \text{TPY}$$

2004:

$$\text{PM(hourly)} = 52.7\ \frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 3/2004}$$

$$\text{PM(annual)} = \left(52.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 213.0\ \text{TPY}$$

Average:

$$\text{PM(hourly)} = 33.5\ \frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = 138.4\ \text{TPY}$$

Particulate Matter (PM_{10}) Emissions: AP-42, Table 10.2-3 (9/90), indicates that PM_{10} emissions from recovery boilers without a direct contact evaporator and with an ESP control device are equivalent to 75% of PM emissions.

2003:

$$\text{PM(hourly)} = 0.75\left(15.4\frac{\text{lb}}{\text{hr}}\right) = 11.6\ \frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = 0.75(63.7\,\text{TPY}) = 47.8\ \text{TPY}$$

2004:

$$\text{PM(hourly)} = 0.75\left(52.7\frac{\text{lb}}{\text{hr}}\right) = 39.5\ \frac{\text{lb}}{\text{hr}}$$

$$\text{PM}_{10}\text{(annual)} = 0.75(213\,\text{TPY}) = 159.75\ \text{TPY}$$

Average:

$$\text{PM}_{10}\text{(hourly)} = 25.5\ \frac{\text{lb}}{\text{hr}}$$

$$\text{PM}_{10}\text{(annual)} = 103.8\ \text{TPY}$$

Sulfur Dioxide Emissions:

2003:

$$\text{SO}_2\text{(hourly)} = 1.5\ \frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 1/2003}$$

$$\text{SO}_2\text{(annual)} = \left(1.5\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 6.2\ \text{TPY}$$

2004:

$$\text{SO}_2\text{(hourly)} = 4.3\ \frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 3/2004}$$

$$\text{SO}_2\text{(annual)} = \left(4.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 17.4\ \text{TPY}$$

Average:

$$\text{SO}_2\text{(hourly)} = 2.9\ \frac{\text{lb}}{\text{hr}}$$

$$\text{SO}_2\text{(annual)} = 11.8\ \text{TPY}$$

Sulfuric Acid Mist Emissions:

2003:

$$\text{SAM(hourly)} = 0.32\ \frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/2003

$$\text{SAM(annual)} = \left(0.32\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.3\ \text{TPY}$$

2004:

$$\text{SAM(hourly)} = 0.6\ \frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 3/2004

$$\text{SAM(annual)} = \left(0.6\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.4\ \text{TPY}$$

Average:

$$\text{SAM(hourly)} = 0.46\ \frac{\text{lb}}{\text{hr}}$$

$$\text{SAM(annual)} = 1.85\ \text{TPY}$$

Nitrogen Oxides Emissions:

2003:

$$\text{NO}_x\text{(hourly)} = 93.3\ \frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/2003

$$\text{NO}_x\text{(annual)} = \left(93.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 386.2\ \text{TPY}$$

2004:

$$\text{NO}_x\text{(hourly)} = 115.0\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 3/2004

$$\text{NO}_x\text{(annual)} = \left(115.0\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 464.7\ \text{TPY}$$

Average:

$$\text{NO}_x\text{(hourly)} = 104.2\ \frac{\text{lb}}{\text{hr}}$$

$$\text{NO}_x\text{(annual)} = 425.4\ \text{TPY}$$

Carbon Monoxide Emissions:

2003:

$$\text{CO(hourly)} = 226.0\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/2003

$$\text{CO(annual)} = \left(226.0\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 935.4\,\text{TPY}$$

2004:

$$\text{CO(hourly)} = 318.0\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 3/2004

$$\text{CO(annual)} = \left(318.0\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1{,}285\,\text{TPY}$$

Average:

$$\text{CO(hourly)} = 272.0\ \frac{\text{lb}}{\text{hr}}$$

$$\text{CO(annual)} = 1{,}110.2\ \text{TPY}$$

Volatile Organic Compound Emissions:

2003:

$$\text{VOC(hourly)} = 3.7\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/2003

$$\text{VOC(annual)} = \left(3.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 15.3\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = 0.3\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 3/2004

$$\text{VOC(annual)} = \left(0.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.2\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 2.0\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 8.3\ \text{TPY}$$

Total Reduced Sulfur Emissions:

2003:

$$\text{TRS(hourly)} = 0.64\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/2003

$$\text{TRS(annual)} = \left(0.64\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.65\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = 2.2\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 3/2004

$$\text{TRS(annual)} = \left(2.2\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 8.9\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 1.4\,\frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 5.8\ \text{TPY}$$

Lead Emissions: Emission factor - NCASI TB 701, Table 12D = 31.3 lbs Pb/MM ton BLS (median value).

2003:

$$\text{Pb(hourly)} = 31.3\frac{\text{lb}}{\text{MMton}}\left(\frac{768{,}021\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{MMton}}{10^6\,\text{ton}}\right)\left(\frac{\text{yr}}{8{,}278\,\text{hr}}\right) = 0.0029\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = \left(0.0029\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.012\,\text{TPY}$$

2004:

$$\text{Pb(hourly)} = 31.3\frac{\text{lb}}{\text{MMton}}\left(\frac{744{,}438\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{MMton}}{10^6\,\text{ton}}\right)\left(\frac{\text{yr}}{8{,}082\,\text{hr}}\right) = 0.0029\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = \left(0.0029\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.012\,\text{TPY}$$

Average:

$$\text{Pb(hourly)} = 0.0029\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = 0.012\ \text{TPY}$$

Mercury Emissions: Emission factor - NCASI TB 858, Table 14B = $1.8\text{x}10^{-7}$ lb/ton BLS (median value).

2003:

$$\text{Hg(hourly)} = 1.8\text{x}10^{-7}\,\frac{\text{lb}}{\text{ton}}\left(\frac{768{,}021\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}278\,\text{hr}}\right) = 1.67\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = \left(1.67\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 6.9\text{x}10^{-5}\ \text{TPY}$$

2004:

$$\text{Hg(hourly)} = 1.8\text{x}10^{-7}\,\frac{\text{lb}}{\text{ton}}\left(\frac{744{,}438\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}082\,\text{hr}}\right) = 1.66\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = \left(1.66\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 6.7\text{x}10^{-5}\ \text{TPY}$$

Average:

$$\text{Hg(hourly)} = 1.67\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = 6.8\text{x}10^{-5}\ \text{TPY}$$

Highest Daily PM_{10}, SO_2, SAM, NO_x, CO, and TRS Emission Rates – Used for Modeling Purposes

Highest daily emission rates based on stack test data:

lb/hr PM_{10} = 39.5 lb/hr (2004)
lb/hr SO_2 = 4.3 lb/hr (2004)
lb/hr SAM = 0.6 lb/hr (2004)
lb/hr NO_x = 115.0 lb/hr (2004)
lb/hr CO = 318.0 lb/hr (2004)
lb/hr TRS = 2.2 lb/hr (2004)

No. 4 Smelt Dissolving Tanks- Emissions Unit ID # 019 - Rated capacity of 210,000 lb BLS/hr (24-hr average).

2003: 552,260 tons air-dried unbleached pulp or 768,021 tons BLS
Hours of operation: 8,278

2004: 525,988 tons air-dried unbleached pulp or 744,438 tons BLS
Hours of operation: 8,082

Unit has a wet scrubber with rated efficiency of 95-99.9%

Particulate Matter Emissions:

2003:

$$\text{PM(hourly)} = 9.15\frac{\text{lb}}{\text{hr}} \text{ - Stack Test Data 2003}$$

$$\text{PM(annual)} = \left(9.15\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 37.9\,\text{TPY}$$

2004:

$$\text{PM(hourly)} = 10.2\frac{\text{lb}}{\text{hr}} \text{ - Stack Test Data 8/27/2004}$$

$$\text{PM(annual)} = \left(10.2\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 41.2\,\text{TPY}$$

Average:

$$\text{PM(hourly)} = 9.7\,\frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = 39.6\ \text{TPY}$$

Particulate Matter (PM_{10}) Emissions: AP-42, Table 10.2-7 (9/90), indicates that PM_{10} emissions from smelt dissolving tanks with venturi scrubbers are equivalent to 90% of PM emissions.

2003:

$$PM_{10}(\text{hourly}) = (0.90)\left(9.15\frac{\text{lb}}{\text{hr}}\right) = 8.2\frac{\text{lb}}{\text{hr}}$$

$$PM_{10}(\text{annual}) = (0.90)(37.9\,\text{TPY}) = 34.1\,\text{TPY}$$

2004:

$$PM_{10}(\text{hourly}) = (0.90)\left(10.2\frac{\text{lb}}{\text{hr}}\right) = 9.2\frac{\text{lb}}{\text{hr}}$$

$$PM_{10}(\text{annual}) = (0.90)(41.2\,\text{TPY}) = 37.1\,\text{TPY}$$

Average:

$$PM_{10}(\text{hourly}) = 8.7\ \frac{\text{lb}}{\text{hr}}$$

$$PM_{10}(\text{annual}) = 35.6\ \text{TPY}$$

Sulfur Dioxide Emissions: Emission factor - 0.073 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB #884, Table 4.15, August 2004.

2003:

$$SO_2(\text{hourly}) = 0.073\frac{\text{lb}}{\text{ton}}\left(\frac{768{,}021\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}278\,\text{hr}}\right) = 6.8\frac{\text{lb}}{\text{hr}}$$

$$SO_2(\text{annual}) = \left(6.8\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 28.0\,\text{TPY}$$

2004:

$$SO_2(\text{hourly}) = 0.073\frac{\text{lb}}{\text{ton}}\left(\frac{744{,}438\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}082\,\text{hr}}\right) = 6.7\frac{\text{lb}}{\text{hr}}$$

$$SO_2(\text{annual}) = \left(6.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 27.2\,\text{TPY}$$

Average:

$$SO_2(\text{hourly}) = 6.7\ \frac{\text{lb}}{\text{hr}}$$

$$SO_2(\text{annual}) = 27.6\ \text{TPY}$$

Nitrogen Oxides Emissions: Emission factor - 0.151 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB #884, Table 4.15, August 2004.

2003:

$$\mathrm{NO_x\,(hourly)} = 0.151\frac{\mathrm{lb}}{\mathrm{ton}}\left(\frac{768{,}021\,\mathrm{ton}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}278\,\mathrm{hr}}\right) = 14.0\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{NO_x\,(annual)} = \left(14.0\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}278\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 58.0\,\mathrm{TPY}$$

2004:

$$\mathrm{NO_x\,(hourly)} = 0.151\frac{\mathrm{lb}}{\mathrm{ton}}\left(\frac{744{,}438\,\mathrm{ton}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}082\,\mathrm{hr}}\right) = 13.9\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{NO_x\,(annual)} = \left(13.9\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}082\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 56.2\,\mathrm{TPY}$$

Average:

$$\mathrm{NO_x\,(hourly)} = 14.0\ \frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{NO_x\,(annual)} = 57.1\ \mathrm{TPY}$$

Volatile Organic Compound Emissions: Emission factor - 0.25 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB #884, Table 4.15, August 2004.

2003:

$$\mathrm{VOC(hourly)} = 0.25\frac{\mathrm{lb}}{\mathrm{ton}}\left(\frac{768{,}021\,\mathrm{ton}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}278\,\mathrm{hr}}\right) = 23.2\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{VOC(annual)} = \left(23.2\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}278\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 96.0\,\mathrm{TPY}$$

2004:

$$\mathrm{VOC(hourly)} = 0.25\frac{\mathrm{lb}}{\mathrm{ton}}\left(\frac{744{,}438\,\mathrm{ton}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}082\,\mathrm{hr}}\right) = 23.0\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{VOC(annual)} = \left(23.0\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}082\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 93.1\,\mathrm{TPY}$$

Average:

$$\mathrm{VOC(hourly)} = 23.1\ \frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{VOC(annual)} = 94.6\ \mathrm{TPY}$$

Carbon Monoxide Emissions: Emission factor - 0.025 lb/ton BLS (highest reported value for smelt dissolving tanks with scrubbers); NCASI TB #884, Table 4.15, August 2004.

2003:

$$\mathrm{CO(hourly)} = 0.025\frac{\mathrm{lb}}{\mathrm{ton}}\left(\frac{768{,}021\,\mathrm{ton}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}278\,\mathrm{hr}}\right) = 2.3\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{CO(annual)} = \left(2.3\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}278\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 9.6\,\mathrm{TPY}$$

2004:

$$\mathrm{CO(hourly)} = 0.025\frac{\mathrm{lb}}{\mathrm{ton}}\left(\frac{744{,}438\,\mathrm{ton}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}082\,\mathrm{hr}}\right) = 2.3\frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{CO(annual)} = \left(2.3\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}082\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 9.3\,\mathrm{TPY}$$

Average:

$$\mathrm{CO(hourly)} = 2.3\ \frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{CO(annual)} = 9.5\ \mathrm{TPY}$$

Total Reduced Sulfur Emissions:

2003:

$$\mathrm{TRS(hourly)} = 1.5\frac{\mathrm{lb}}{\mathrm{hr}}\ \text{- Stack Test Data 2003}$$

$$\mathrm{TRS(annual)} = \left(1.5\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}278\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 6.2\,\mathrm{TPY}$$

2004:

$$\mathrm{TRS(hourly)} = 1.5\frac{\mathrm{lb}}{\mathrm{hr}}\ \text{- Stack Test Data 2004}$$

$$\mathrm{TRS(annual)} = \left(1.5\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}082\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 6.1\,\mathrm{TPY}$$

Average:

$$\mathrm{TRS(hourly)} = 1.5\ \frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{TRS(annual)} = 6.2\ \mathrm{TPY}$$

Lead Emissions: Emission factor - 28 lb/MM ton BLS (mean value for smelt dissolving tanks with scrubbers); NCASI TB #701, Table 15B, October 1995.

2003:

$$\text{Pb(hourly)} = 28\frac{\text{lb}}{\text{MMton}}\left(\frac{768{,}021\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{MMton}}{10^6\,\text{ton}}\right)\left(\frac{\text{yr}}{8{,}278\,\text{hr}}\right) = 2.6\text{x}10^{-3}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = \left(2.6\text{x}10^{-3}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.011\,\text{TPY}$$

2004:

$$\text{Pb(hourly)} = 28\frac{\text{lb}}{\text{MMton}}\left(\frac{744{,}438\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{MMton}}{10^6\,\text{ton}}\right)\left(\frac{\text{yr}}{8{,}082\,\text{hr}}\right) = 2.6\text{x}10^{-3}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = \left(2.6\text{x}10^{-3}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.010\,\text{TPY}$$

Average:

$$\text{Pb(hourly)} = 2.6\text{x}10^{-3}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = 0.011\ \text{TPY}$$

Mercury Emissions: Emission factor - NCASI TB 701, Table 15B, October 1995 = 1.8x10^{-7} lb/ton BLS (median value).

2003:

$$\text{Hg(hourly)} = 1.8\text{x}10^{-7}\,\frac{\text{lb}}{\text{ton}}\left(\frac{768{,}021\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}278\,\text{hr}}\right) = 1.67\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = \left(1.67\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}278\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 6.9\text{x}10^{-5}\,\text{TPY}$$

2004:

$$\text{Hg(hourly)} = 1.8\text{x}10^{-7}\,\frac{\text{lb}}{\text{ton}}\left(\frac{744{,}438\,\text{ton}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}082\,\text{hr}}\right) = 1.66\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = \left(1.66\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}082\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 6.7\text{x}10^{-5}\,\text{TPY}$$

Average:

$$\text{Hg(hourly)} = 1.67\text{x}10^{-5}\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Hg(annual)} = 6.8\text{x}10^{-5}\ \text{TPY}$$

Highest Daily PM_{10}, SO_2, NO_x, CO, and TRS Emission Rates – Used for Modeling Purposes

Highest daily emission rates:

lb/hr PM_{10} = 9.2 lb/hr (2004)
lb/hr SO_2 = 6.8 lb/hr (2003)
lb/hr NO_x = 14.0 lb/hr (2003)
lb/hr CO = 2.3 lb/hr (2003, 2004)
lb/hr TRS = 1.5 lb/hr (2003)

Black Liquor, Green Liquor Cycle-Emissions Unit ID # 042 - This area includes a number of miscellaneous fugitive and point emission sources as listed below:

Digester Area Black Liquor Storage Tanks:

Insignificant emission sources include the two, 65% Black Liquor day tanks, the 300,000 gallon Black Liquor tank, the 50% Black Liquor tank, the unfiltered strong Black Liquor Tank, the filtered Black Liquor tank, the million gallon weak Black Liquor tank, the 157,000 gallon weak liquor tank, the Strong Black Liquor Charge Tank, and the Tissue Black Liquor Charge Tank. The only information available for these emission sources is from NCASI TB # 677 (9/1994), Table V.A.1. Emissions data are provided only in the units of pounds per hour and not an emission factor. Therefore, it is not possible to estimate the increase in VOC emissions attributable to this project for these emission sources.

North & South Precipitator Tanks:

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.17 = 0.003 lb/ton BLS.

2003:

$$\text{VOC(hourly)} = \left(0.003\frac{\text{lb VOC}}{\text{ton BLS}}\right)\left(\frac{768{,}021\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.26\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.26\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.15\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.003\frac{\text{lb VOC}}{\text{ton BLS}}\right)\left(\frac{744{,}438\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.25\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.25\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.11\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.26\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 1.13\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-24.

Dimethyl disulfide – $1.2\text{x}10^{-3}$ lb/ton BLS
Dimethyl sulfide – $2.6\text{x}10^{-3}$ lb/ton BLS
Methyl mercaptan – $9.8\text{x}10^{-5}$ lb/ton BLS

Total TRS Compounds = 0.004 lb/ton BLS

2003:

$$\text{TRS(hourly)} = \left(0.004\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{768{,}021\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.34\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.34\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.5\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = \left(0.004\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{744{,}438\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.33\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.33\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.45\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 0.34\ \frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 1.5\ \text{TPY}$$

<u>Salt Cake Mix Tank:</u>

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.17 = 0.003 lb/ton BLS.

2003:

$$\text{VOC(hourly)} = \left(0.003\frac{\text{lb VOC}}{\text{ton BLS}}\right)\left(\frac{768{,}021\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.26\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.26\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.15\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.003\frac{\text{lb VOC}}{\text{ton BLS}}\right)\left(\frac{744{,}438\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.25\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.25\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.11\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.26\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 1.13\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-24.

Dimethyl disulfide – $1.2\text{x}10^{-3}$ lb/ton BLS
Dimethyl sulfide – $2.6\text{x}10^{-3}$ lb/ton BLS
Methyl mercaptan – $9.8\text{x}10^{-5}$ lb/ton BLS

Total TRS Compounds = 0.004 lb/ton BLS

2003:

$$\text{TRS(hourly)} = \left(0.004\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{768{,}021\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.34\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.34\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.5\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = \left(0.004\frac{\text{lb TRS}}{\text{ton BLS}}\right)\left(\frac{744{,}438\,\text{ton BLS}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.33\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.33\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.45\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 0.34\ \frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 1.5\ \text{TPY}$$

<u>Green Liquor Clarifier:</u>

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.14 = 0.066 lb/ton CaO.

2003:

$$\text{VOC(hourly)} = \left(0.066\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.85\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.85\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 3.7\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.066\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.84\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.84\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 3.7\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.85\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 3.7\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-17.

Dimethyl disulfide – $2\text{x}10^{-4}$ lb/ton CaO
Dimethyl sulfide – Not Detected
Methyl mercaptan – $4.2\text{x}10^{-4}$ lb/ton CaO

Total TRS Compounds = $6.2\text{x}10^{-4}$ lb/ton CaO

2003:

$$\text{TRS(hourly)} = \left(6.2\text{x}10^{-4}\ \frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 8.0\text{x}10^{-3}\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(8.0\text{x}10^{-3}\ \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 3.5\text{x}10^{-2}\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = \left(6.2\text{x}10^{-4}\ \frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 7.9\text{x}10^{-3}\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(7.9\text{x}10^{-3}\ \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 3.5\text{x}10^{-2}\ \text{TPY}$$

Average:

$$\text{TRS(hourly)} = 8.0\text{x}10^{-3}\ \frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 3.5\text{x}10^{-2}\ \text{TPY}$$

__Green Liquor Tanks (North, South, and 280,000 gallon units):__

Volatile Organic Compound Emissions: Emission factor – NCASI TB 884, Table 4.14 = 0.066 lb/ton CaO.

2003:

$$\mathrm{VOC(hourly)} = \left(0.066\frac{\mathrm{lb\,VOC}}{\mathrm{ton\,CaO}}\right)\left(\frac{112{,}423\,\mathrm{ton\,CaO}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}760\,\mathrm{hr}}\right) = 0.85\ \mathrm{lb/hr}$$

$$\mathrm{VOC(annual)} = \left(0.85\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 3.7\,\mathrm{TPY}$$

2004:

$$\mathrm{VOC(hourly)} = \left(0.066\frac{\mathrm{lb\,VOC}}{\mathrm{ton\,CaO}}\right)\left(\frac{111{,}731\,\mathrm{ton\,CaO}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}760\,\mathrm{hr}}\right) = 0.84\ \mathrm{lb/hr}$$

$$\mathrm{VOC(annual)} = \left(0.84\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 3.7\,\mathrm{TPY}$$

Average:

$$\mathrm{VOC(hourly)} = 0.85\ \frac{\mathrm{lb}}{\mathrm{hr}}$$

$$\mathrm{VOC(annual)} = 3.7\ \mathrm{TPY}$$

Total Reduced Sulfur Emissions: Emission factors – NCASI Technical Bulletin 858, Table A-17.

Dimethyl disulfide – $3.1\mathrm{x}10^{-5}$ lb/ton CaO
Dimethyl sulfide – $4.8\mathrm{x}10^{-5}$ lb/ton CaO
Methyl mercaptan – $2.1\mathrm{x}10^{-6}$ lb/ton CaO

Total TRS Compounds = $8.1\mathrm{x}10^{-5}$ lb/ton CaO

2003:

$$\mathrm{TRS(hourly)} = \left(8.1\mathrm{x}10^{-5}\,\frac{\mathrm{lb\,TRS}}{\mathrm{ton\,CaO}}\right)\left(\frac{112{,}423\,\mathrm{ton\,CaO}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}760\,\mathrm{hr}}\right) = 1.0\mathrm{x}10^{-3}\ \mathrm{lb/hr}$$

$$\mathrm{TRS(annual)} = \left(1.0\mathrm{x}10^{-3}\,\frac{\mathrm{lb}}{\mathrm{hr}}\right)\left(\frac{8{,}760\,\mathrm{hr}}{\mathrm{yr}}\right)\left(\frac{\mathrm{ton}}{2{,}000\,\mathrm{lb}}\right) = 4.6\mathrm{x}10^{-3}\,\mathrm{TPY}$$

2004:

$$\mathrm{TRS(hourly)} = \left(8.1\mathrm{x}10^{-5}\,\frac{\mathrm{lb\,TRS}}{\mathrm{ton\,CaO}}\right)\left(\frac{111{,}731\,\mathrm{ton\,CaO}}{\mathrm{yr}}\right)\left(\frac{\mathrm{yr}}{8{,}760\,\mathrm{hr}}\right) = 1.0\mathrm{x}10^{-3}\ \mathrm{lb/hr}$$

$$\text{TRS(annual)} = \left(1.0\text{x}10^{-3}\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 4.5\text{x}10^{-3}\ \text{TPY}$$

Average:

$$\text{TRS(hourly)} = 1.0\text{x}10^{-3}\ \frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 4.6\text{x}10^{-3}\ \text{TPY}$$

Highest Daily TRS Emission Rates – Used for Modeling Purposes

Highest daily emission rate:

North and South Precipitator Tanks: TRS = 0.34 lb/hr
Salt Cake Mix Tank: TRS = 0.34 lb/hr
Green Liquor Clarifier: TRS = 0.008 lb/hr
Green Liquor Tanks: TRS = 0.001 lb/hr

Total TRS = 0.7 lb/hr

Recausticizing

 # 4 Lime Kiln- Emissions Unit ID # 017 - The permitted input capacity of this unit is 82,986 lb/hr (of $CaCO_3$ & inerts)(24-hr block average). This equates to 19.44 tons/hr CaO produced. This unit has a venturi scrubber to control particulate matter emissions. This unit fires No. 6 fuel oil with a maximum sulfur content of 2.35% (by weight) to support combustion in the kiln.

2003: 552,260 tons air-dried unbleached pulp	6,118 M gallons No. 6 fuel oil @ 2.12% sulfur
Hours of operation: 7,763	112,423 tons CaO processed
2004: 525,988 tons air-dried unbleached pulp	6,335 M gallons No. 6 fuel oil @ 2.14% sulfur
Hours of operation: 7,688	111,731 tons CaO processed

Particulate Matter Emissions:

2003:

$$\text{PM(hourly)} = 11.94\frac{\text{lb}}{\text{hr}} \text{ - Stack Test Data 1/14/2003}$$

$$\text{PM(annual)} = \left(11.94\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 46.3\,\text{TPY}$$

2004:

$$\text{PM(hourly)} = 7.9\frac{\text{lb}}{\text{hr}} \text{ - Stack Test Data 2004 – Average of two tests – 4.2 lb/hr and 11.5 lb/hr.}$$

$$\text{PM(annual)} = \left(7.9\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 30.4\,\text{TPY}$$

Average:

$$\text{PM(hourly)} = 9.9\,\frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = 38.3\ \text{TPY}$$

Particulate Matter (PM_{10}) Emissions: PM_{10} assumed to be 100% PM, based on AP-42 Table 10.2-4 (9/90-reformatted 1/95) for a lime kiln with a venturi scrubber for control.

2003:

$$\text{PM}_{10}\text{(hourly)} = (1)\left(11.94\frac{\text{lb}}{\text{hr}}\right) = 11.94\frac{\text{lb}}{\text{hr}}$$

$$\text{PM}_{10}\text{(annual)} = (1)(46.3\,\text{TPY}) = 46.3\,\text{TPY}$$

2004:

$$PM_{10}\text{(hourly)} = (1)\left(7.9\frac{\text{lb}}{\text{hr}}\right) = 7.9\frac{\text{lb}}{\text{hr}}$$

$$PM_{10}\text{(annual)} = (1)(30.4\,\text{TPY}) = 30.4\,\text{TPY}$$

Average:

$$PM_{10}\text{(hourly)} = 9.9\,\frac{\text{lb}}{\text{hr}}$$

$$PM_{10}\text{(annual)} = 38.3\text{ TPY}$$

Sulfur Dioxide Emissions:

2003:

$$SO_2\text{(hourly)} = 4.3\frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 1/14/2003}$$

$$SO_2\text{(annual)} = \left(4.3\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 16.7\,\text{TPY}$$

2004:

$$SO_2\text{(hourly)} = 0.1\frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 2/26/2004}$$

$$SO_2\text{(annual)} = \left(0.1\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.38\,\text{TPY}$$

Average:

$$SO_2\text{(hourly)} = 2.2\,\frac{\text{lb}}{\text{hr}}$$

$$SO_2\text{(annual)} = 8.6\text{ TPY}$$

Sulfuric Acid Mist Emissions: Assume 3.6% of sulfur dioxide is sulfates. AP-42 emission factors of 5.7S lb/10^3 gal for SO_3 and 157S lb/10^3 gal for SO_2 (Table 1.3-1 (9/98)). The ratio of SO_3 to SO_2 is 3.6%, and then SO_3 was converted to sulfuric acid mist (SAM) by multiplying by ratio of molecular weights (x 98/80).

2003:

$$\text{SAM(hourly)} = \left(\frac{3.6\%}{100\%}\right)\left(4.3\frac{\text{lb}}{\text{hr}}\right) = 0.15\frac{\text{lb}\,SO_3}{\text{hr}}\left(\frac{98\,\text{lb}\,\text{SAM}}{\text{lb}-\text{mole}\,\text{SAM}}\right)\left(\frac{\text{lb}-\text{mole}\,\text{SAM}}{\text{lb}-\text{mole}\,SO_3}\right)\left(\frac{\text{lb}-\text{mole}\,SO_3}{80\,\text{lb}\,SO_3}\right)$$

$$= 0.19\frac{\text{lb}}{\text{hr}}$$

$$\text{SAM(annual)} = \left(0.19\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.74\,\text{TPY}$$

2004:

$$\text{SAM(hourly)} = \left(\frac{3.6\%}{100\%}\right)\left(0.1\frac{\text{lb}}{\text{hr}}\right) = 0.004\frac{\text{lb}\,SO_3}{\text{hr}}\left(\frac{98\,\text{lb}\,\text{SAM}}{\text{lb}-\text{mole}\,\text{SAM}}\right)\left(\frac{\text{lb}-\text{mole}\,\text{SAM}}{\text{lb}-\text{mole}\,SO_3}\right)\left(\frac{\text{lb}-\text{mole}\,SO_3}{80\,\text{lb}\,SO_3}\right)$$

$$= 0.004\frac{\text{lb}}{\text{hr}}$$

$$\text{SAM(annual)} = \left(0.004\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.017\,\text{TPY}$$

Average:

$$\text{SAM(hourly)} = 0.1\,\frac{\text{lb}}{\text{hr}}$$

$$\text{SAM(annual)} = 0.4\ \text{TPY}$$

Total Reduced Sulfur Emissions:

2003:

$$\text{TRS(hourly)} = 0.556\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/14/2003

$$\text{TRS(annual)} = \left(0.556\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.2\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = 0.6\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 3/3/2004

$$\text{TRS(annual)} = \left(0.6\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.3\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 0.6\,\frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 2.3\ \text{TPY}$$

Nitrogen Oxides Emissions:

2003:

$$\text{NO}_x\,\text{(hourly)} = 32.0\frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 1/14/2003}$$

$$\text{NO}_x\,\text{(annual)} = \left(32.0\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 124.2\,\text{TPY}$$

2004:

$$\text{NO}_x\,\text{(hourly)} = 33.7\frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 2/26/2004}$$

$$\text{NO}_x\,\text{(annual)} = \left(33.7\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 129.5\,\text{TPY}$$

Average:

$$\text{NO}_x\,\text{(hourly)} = 32.9\,\frac{\text{lb}}{\text{hr}}$$

$$\text{NO}_x\,\text{(annual)} = 126.9\ \text{TPY}$$

Carbon Monoxide Emissions:

2003:

$$\text{CO(hourly)} = 1.8\frac{\text{lb}}{\text{hr}}\ \text{- Stack Test Data 1/14/2003}$$

$$\text{CO(annual)} = \left(1.8\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 7.0\,\text{TPY}$$

2004:

$$\text{CO(hourly)} = 1.4\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 2/26/2004

$$\text{CO(annual)} = \left(1.4\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 5.4\,\text{TPY}$$

Average:

$$\text{CO(hourly)} = 1.6\ \frac{\text{lb}}{\text{hr}}$$

$$\text{CO(annual)} = 6.2\ \text{TPY}$$

Volatile Organic Compound Emissions:

2003:

$$\text{VOC(hourly)} = 0.609\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 1/14/2003

$$\text{VOC(annual)} = \left(0.609\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.4\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = 0.6\frac{\text{lb}}{\text{hr}}$$ - Stack Test Data 2/26/2004

$$\text{VOC(annual)} = \left(0.6\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.3\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.6\frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 2.4\ \text{TPY}$$

Lead Emissions: Emission factor = $2.9\text{x}10^{-3}$ lb/ton CaO NCASI, TB # 858, Table 16C, February 2003, using the median of all oil-fired kilns.

2003:

$$\text{Pb(hourly)} = \left(2.9\text{x}10^{-3}\,\frac{\text{lb CaO}}{\text{ton}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{7{,}763\,\text{hr}}\right) = 0.042\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = \left(0.0042\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}763\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.16\,\text{TPY}$$

2004:

$$\text{Pb(hourly)} = \left(2.9\text{x}10^{-3}\frac{\text{lb CaO}}{\text{ton}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{7{,}688\,\text{hr}}\right) = 0.042\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = \left(0.0042\frac{\text{lb}}{\text{hr}}\right)\left(\frac{7{,}688\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.16\,\text{TPY}$$

Average:

$$\text{Pb(hourly)} = 0.042\,\frac{\text{lb}}{\text{hr}}$$

$$\text{Pb(annual)} = 0.16\ \text{TPY}$$

Highest Daily PM_{10}, SO_2, SAM, NO_x, CO, and TRS Emission Rates – Used for Modeling Purposes

Highest daily emission rates based on stack test data:

lb/hr PM_{10} = 11.94 lb/hr (2003)
lb/hr SO_2 = 4.3 lb/hr (2003)
lb/hr SAM = 0.21 lb/hr (2003)
lb/hr NO_x = 33.7 lb/hr (2004)
lb/hr CO = 1.8 lb/hr (2003)
lb/hr TRS = 0.6 lb/hr (2004)

Caustic Area- Emissions Unit ID # 042 - This area includes a number of miscellaneous fugitive and point emission sources as listed below:

Lime (White Liquor) Slakers (Nos. 1 & 2)

Particulate Matter Emissions: Emission factor – NCASI TB 884, Table 4.14; mean = 0.031 lb/ton CaO.

2003:

$$\text{PM(hourly)} = \left(0.031\frac{\text{lb PM}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.4\ \text{lb/hr}$$

$$\text{PM(annual)} = \left(0.4\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.7\,\text{TPY}$$

2004:

$$\text{PM(hourly)} = \left(0.031\frac{\text{lb PM}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.4\,\text{lb/hr}$$

$$\text{PM(annual)} = \left(0.4\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.7\,\text{TPY}$$

Average:

$$\text{PM(hourly)} = 0.4\ \frac{\text{lb}}{\text{hr}}$$

$$\text{PM(annual)} = 1.7\ \text{TPY}$$

Particulate Matter (PM_{10}) Emissions: Assume PM_{10} is 100% PM.

2003:

$$\text{PM}_{10}\text{(hourly)} = (1)\left(0.4\frac{\text{lb}}{\text{hr}}\right) = 0.4\ \text{lb/hr}$$

$$\text{PM}_{10}\text{(annual)} = (1)(1.7\,\text{TPY}) = 1.7\,\text{TPY}$$

2004:

$$\text{PM}_{10}\text{(hourly)} = (1)\left(0.4\frac{\text{lb}}{\text{hr}}\right) = 0.4\ \text{lb/hr}$$

$$\text{PM}_{10}\text{(annual)} = (1)(1.7\,\text{TPY}) = 1.7\,\text{TPY}$$

Average:

$$PM_{10}(\text{hourly}) = 0.4\ \frac{\text{lb}}{\text{hr}}$$

$$PM_{10}(\text{annual}) = 1.7\ \text{TPY}$$

Volatile Organic Compound Emissions: Emission factor – NCASI TB 676, Table VII.A.5, Mill M (only mill with separate slaker and cauticizer exhausts); mean = 0.041 lb/ton CaO.

2003:

$$\text{VOC(hourly)} = \left(0.041\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.53\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.53\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.3\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.041\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.52\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.52\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.3\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.53\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 2.3\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factor – NCASI TB 849, Table 24; mean = 0.045 lb/ton CaO.

2003:

$$\text{TRS(hourly)} = \left(0.045\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.58\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.58\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.5\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = \left(0.045\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.57\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.57\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 2.5\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 0.58\ \frac{\text{lb}}{\text{hr}}$$

TRS(annual) = 2.5 TPY

White Liquor Storage Tanks (5 units)

Volatile Organic Compound Emissions: Emission factor – NCASI TB 858, Table A-17 = 0.0056 lb/ton CaO.

2003:

$$\text{VOC(hourly)} = \left(0.0056\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.07\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.07\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.31\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.0056\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.07\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.07\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.31\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.07\ \frac{\text{lb}}{\text{hr}}$$

VOC(annual) = 0.31 TPY

White Liquor Clarifiers (East and West Units)

Volatile Organic Compound Emissions: Emission factor – NCASI TB 858, Table A-17 = 0.0056 lb/ton CaO.

2003:

$$\text{VOC(hourly)} = \left(0.0056\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.07\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.07\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.31\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.0056\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.07\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.07\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.31\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.07\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 0.31\ \text{TPY}$$

<u>Lime Mud Washer Tanks (4 units)</u>

Volatile Organic Compound Emissions: Emission factor = 0.085 lb VOC/ton CaO processed NCASI TB # 676, Table VIII.A.1-DCA3.

2003:

$$\text{VOC(hourly)} = \left(0.085\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 1.09\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.09\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 4.8\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.085\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 1.08\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.08\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 4.7\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 1.09\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 4.8\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factor from NCASI TB# 676, Table VIII.A.1-DCA3 with values less than the detection limit represented as zero.

Dimethyl sulfide – $1.2\text{x}10^{-3}$ lb/ton CaO
Methyl mercaptan – $7.4\text{x}10^{-4}$ lb/ton CaO

Total TRS Compounds = $1.9\text{x}10^{-3}$ lb/ton CaO

2003:

$$\text{TRS(hourly)} = \left(1.9\text{x}10^{-3}\,\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.025\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.025\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.11\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = \left(1.9\text{x}10^{-3}\,\frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.025\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.025\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.11\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 0.025\,\frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 0.11\ \text{TPY}$$

Lime Mud Splitter Box Tank

Volatile Organic Compound Emissions: Emission factor = 0.085 lb VOC/ton CaO processed NCASI TB # 676, Table VIII.A.1-DCA3.

2003:

$$\text{VOC(hourly)} = \left(0.085\,\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 1.09\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.09\,\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 4.8\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.085\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 1.08\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(1.08\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 4.7\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 1.09\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 4.8\ \text{TPY}$$

<u>Causticizer Tanks (Nos. 1A, 1B, 2,3)</u>

Volatile Organic Compound Emissions: Emission factor – NCASI TB 676, Table VII.A.5, Mill M (only mill with separate slaker and cauticizer exhausts); mean = 0.00083 lb/ton CaO.

2003:

$$\text{VOC(hourly)} = \left(0.00083\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.011\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.011\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.047\,\text{TPY}$$

2004:

$$\text{VOC(hourly)} = \left(0.00083\frac{\text{lb VOC}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.010\ \text{lb/hr}$$

$$\text{VOC(annual)} = \left(0.010\frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 0.046\,\text{TPY}$$

Average:

$$\text{VOC(hourly)} = 0.011\ \frac{\text{lb}}{\text{hr}}$$

$$\text{VOC(annual)} = 0.047\ \text{TPY}$$

Total Reduced Sulfur Emissions: Emission factor – NCASI TB 849, Table 24; mean = 0.019 lb/ton CaO (as sulfur); factor as hydrogen sulfide = 0.019 x 34/32 = 0.020 lb/ton CaO.

2003:

$$\text{TRS(hourly)} = \left(0.020 \frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{112{,}423\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.26\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.26 \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.13\,\text{TPY}$$

2004:

$$\text{TRS(hourly)} = \left(0.020 \frac{\text{lb TRS}}{\text{ton CaO}}\right)\left(\frac{111{,}731\,\text{ton CaO}}{\text{yr}}\right)\left(\frac{\text{yr}}{8{,}760\,\text{hr}}\right) = 0.26\ \text{lb/hr}$$

$$\text{TRS(annual)} = \left(0.26 \frac{\text{lb}}{\text{hr}}\right)\left(\frac{8{,}760\,\text{hr}}{\text{yr}}\right)\left(\frac{\text{ton}}{2{,}000\,\text{lb}}\right) = 1.13\,\text{TPY}$$

Average:

$$\text{TRS(hourly)} = 0.26\ \frac{\text{lb}}{\text{hr}}$$

$$\text{TRS(annual)} = 1.13\ \text{TPY}$$

Highest Daily PM_{10} and TRS Emission Rates – Used for Modeling Purposes

Highest daily TRS emission rates:

Lime Slakers: TRS = 0.58 lb/hr
Lime Mud Washer Tanks: TRS = 0.025 lb/hr
Causticizer Tanks: TRS = 0.26 lb/hr

Total TRS = 0.865 lb/hr

Highest daily PM_{10} emission rates:

Lime Slakers: PM_{10} = 0.4 lb/hr

Total PM_{10} = 0.4 lb/hr

Potential Emission Rate Calculations for Project-Affected Sources

Palatka, Florida Mill Emission Rate Calculations - Comments and Assumptions

Bases for pollutant potential emission estimates are taken from a number of sources. These include Title V Permit limits, general engineering knowledge and assumptions concerning process operations, emission factors published in US EPA Manual AP-42, various technical bulletins and other reports published by NCASI and EPA's FIRE data system. All potential emission calculations are based on the Mill operating 8,760 hours per year, unless specifically noted otherwise.

The pollutants considered for emission estimating purposes include: particulate matter (total particulate matter and PM_{10}), nitrogen oxides, sulfur dioxide, carbon monoxide, volatile organic compounds, lead, total reduced sulfur, sulfuric acid mist, beryllium and mercury.

There are a number of changes in Title V Permit limits that are addressed in the potential emission rate calculations below. A summary of the current Title V Permit limits (as of Title V Permit Revision No. 1070005-029-AV, dated February 7, 2005) and requested changes are listed below. The reasons for the changes are discussed in the detailed emission calculations following this table.

ATTACHMENT C
AIR QUALITY ANALYSIS
PALATKA, FL OPERATIONS

1.0 INTRODUCTION

United States Environmental Protection Agency (EPA) and Florida Department of Environmental Protection (FDEP) rules require major new facilities and major modifications of existing facilities to undergo several analyses for emission increases subject to Prevention of Significant Deterioration (PSD) review. These analyses determine whether significant air quality deterioration will result from the new or modified facility. As described elsewhere in the application, the proposed modifications at the GP Palatka Mill will result in emissions increases above the significant emission rate for several pollutants. Taking into account all contemporaneous emission increases and decreases within the past 5-years (see Section 5, Table 5.1) the following pollutants will have net emission increases above the significant emission rate:

- nitrogen oxides (NO_x),
- carbon monoxide (CO),
- particulate matter - total suspended (PM)
- particulate matter less than or equal to 10 microns in diameter (PM_{10}),
- ozone (based on the increase in volatile organic compound (VOC) emissions), and
- sulfuric acid mist (SAM).

Therefore, the project is subject to PSD review for these pollutants. In addition to an analysis of control technology discussed in other attachments, PSD review requires GP to conduct the following analyses:

- Source impact analysis,
- Good engineering practice stack height (GEP) analysis,
- Air quality analysis (monitoring), and
- Additional impact analyses.

EPA regulations (40 CFR 52.21(k)) require that an applicant perform a source impact analysis for each applicable pollutant. The PSD regulations specifically provide for the use of atmospheric dispersion models in performing impact analyses, estimating baseline and future air quality levels, and determining compliance with National Ambient Air Quality Standards (NAAQS) and allowable PSD increments. Section 2.10 of this attachment presents the Source Impact Analysis results.

PSD regulations require that the modeling analysis, and any emission limits resulting from the analysis, reflect stack heights that do not exceed GEP stack height (refer to 40 CFR 52.21(h)). To demonstrate this, GP performed an analysis of the physical arrangement of stacks and solid physical structures that may affect dispersion and computed GEP stack heights for each stack. All the emission unit stacks at the GP Palatka Mill are existing stacks, and some are affected by building downwash (see results below). Section 3.0 of this attachment presents the GEP analysis.

The third analysis is specified by EPA regulation 40 CFR 52.21(m). In addition to predicting source impacts, a PSD permit application must contain an analysis of continuous ambient air quality data in the area affected by the project. The regulation presents the conditions that require pre-construction and post-construction monitoring of ambient air. Section 4.0 of this attachment presents the Ambient Air Quality Analysis.

Lastly, EPA regulations (40 CFR 52.21(o)) require an analysis of additional impacts. Section 5.0 presents an analysis of the impacts on soils and vegetation, growth, and impairment to visibility that would occur as a result of the project in the vicinity of the Mill. Section 6.0 presents an analysis of the project's impact on existing air quality, visibility, and deposition in the Class I areas.

2.0 SOURCE IMPACT ANALYSIS

GP conducted the Source Impact Analysis in two phases: 1) impact of the project, and 2) full impact analysis. The first phase determines the impact from the change in emissions associated with the proposed GP projects alone. GP compared these impacts to EPA thresholds for significance and ambient monitoring criteria. If the project impacts exceed the Significant Impact Levels (SILs), then GP conducts a full impact analysis. A full impact analysis predicts impacts from the sources across the entire Mill, as well as certain off-site air emission sources. GP compares these impacts to state and national ambient air quality standards. The following sections discuss the methodology, data inputs, and techniques for the Source Impact Analysis.

2.1 AIR MODELING METHODOLOGY

The general modeling approach follows EPA and FDEP modeling guidelines for determining compliance with the state AAQS and PSD Increments. In general, current policies stipulate that the highest annual average and highest, second-highest short-term (*i.e.,* 24 hours or less) concentrations be compared to the applicable standard when 5 years of meteorological data are used. The highest, second-highest concentration (HSH) is calculated for a receptor field by:

1. Eliminating the highest concentration predicted at each receptor,
2. Identifying the second-highest concentration at each receptor, and
3. Selecting the highest concentration among these second-highest concentrations.

This approach is consistent with the air quality standards, which permit a short-term average concentration to be exceeded once per year at each receptor.

2.2 MODEL SELECTION

GP selected an air dispersion model based on the model's ability to simulate air quality impacts in areas surrounding the Palatka Mill. The area surrounding the Mill is mostly rural and flat. The Mill is located on the western side of the St. John's River. A topographic map of the GP Palatka Mill vicinity is presented in Figure C-1. Based on these features, GP selected the AERMOD dispersion model (Version 04300) to evaluate the pollutant impacts due to the GP Palatka facility alone and in combination with other emission sources.

On November 9, 2005, the EPA implemented AERMOD into its *Guideline of Air Quality Models (Appendix W to 40 CFR Part 51)* as the recommended model for regulatory modeling applications. The Florida Department of Environmental Protection (FDEP) has agreed to allow the use of AERMOD for the GP projects, as it is recognized as containing the latest scientific algorithms for simulating plume behavior in all types of terrain.

For evaluating plume behavior within the building wake of structures, the AERMOD model incorporates the Plume Rise Model Enhancement (PRIME) downwash algorithm developed by the Electric Power Research Institute (EPRI). AERMOD can predict pollutant concentrations for averaging times of annual and 24-, 8-, 3-, and 1-hours. The predicted concentrations are compared to applicable significant impact levels, NAAQS and allowable PSD Class II increments that exist for the respective averaging times.

For this analysis, the EPA regulatory default options were used to predict all maximum impacts. These options include:

- Final plume rise at all receptor locations
- Stack-tip downwash
- Buoyancy-induced dispersion
- Default wind speed profile coefficients
- Default vertical potential temperature gradients
- Calm wind processing

2.3 METEOROLOGICAL DATA

Impacts were predicted using an hourly meteorological data record for the five-year period 1986 to 1990. The nearest site to the Palatka Mill for surface observations is located approximately 57 km to the west in Gainesville. However, FDEP has routinely recommended analyses for Palatka apply surface observations from Jacksonville International Airport (JAX). While the distance between GP and JAX is approximately 92 km, GP and FDEP consider JAX to be more representative than Gainesville surface observations. While both JAX and GP are less than 40 km from the Atlantic coastline, Gainesville is over 95 km from the coastline. The analysis applied meteorological data comprised of hourly surface data from JAX and upper air data collected in Waycross, Georgia.

The data for these stations were processed into a format that can be input to the AERMOD model using the meteorological preprocessor program AERMET. The data were processed using the Lakes Environmental graphical interface using the latest version of AERMET (04300). The hourly surface data were obtained from the Solar and Meteorological Observation Network (SAMSON) CD. Upper air sounding data were obtained in the required NCDC TD-6201 format from the Lakes website (www.webmet.com).

A unique feature of AERMOD is its incorporation of land use parameters for the processing of boundary layer parameters used for the dispersion. Based on the most recent regulatory guidance, the land use parameters should be representative of the data measurement site (i.e., JAX). Land use data, representing the average surface roughness, albedo, and Bowen ratio that exist within a 3-km radius of JAX were extracted from 1-degree land use files from the US Geographical Survey (USGS) using the AERSURFACE program. AERSURFACE currently extracts land use data in 12 wind direction sectors covering 360 degrees. The land use values for each wind direction sector were input into Stage 3 of the

AERMET preprocessor program to create the surface and profile meteorological files that AERMOD requires.

2.4 BACKGROUND CONCENTRATIONS

Background concentrations are necessary to determine total ambient air quality impacts to demonstrate compliance with the NAAQS. "Background concentrations" are defined as concentrations due to sources other than those specifically included in the modeling analysis. For example, background concentration would account for other small point sources not included in the modeling, fugitive emission sources, and natural background sources (*e.g.*, mobile sources).

Existing ambient air quality data were reviewed in the selection of background concentrations. Data collected included monitor locations, their proximity to the Palatka Mill, data quality, and how recent the data was collected. Table C-1 presents the values for background concentrations in micrograms per cubic meter ($\mu g/m^3$). These values reflect the most current years of available data by each representative monitor.

2.5 BUILDING DOWNWASH

In accordance with current EPA policy, the effect of building downwash effects on predicted air quality concentration levels was evaluated. Building dimensions for all key GP Palatka buildings were entered into the EPA-developed Building Profile Input Program (BPIP, Version 95086) to obtain direction-specific building heights, lengths, and widths for all GP Palatka Mill point sources. The BPIP model was used in its PRIME mode to generate the appropriate PRIME downwash input dimensions for the AERMOD model. The direction-specific building dimensions are input for H_b and l_b for 36 radial directions, with each direction representing a 10-degree sector. The H_b is the building height and l_b is the lesser of the building height or projected width. In addition, the AERMOD model inputs three additional building parameters that further describe the building/wake configuration:

- Projected length of the building along the flow direction,
- Along-flow distance from the stack to the center of the upwind face of the projected building, and
- Cross-flow distance from the stack to the center of the upwind face of the projected building.

The building dimensions used in the modeling for the buildings and structures associated with the GP Palatka Mill are presented in Table C-2, and are portrayed in Figure C-2.

2.6 SIGNIFICANT IMPACT ANALYSIS

2.6.1. *Purpose and Methodology*

The significant impact analysis is the first phase of the Source Impact Analysis and determines two results: 1) the maximum impacts due to the proposed project emissions and 2) the location of predicted impacts that are greater than significant impact levels (SILs). The area of these impacts defines the impact area of the project and the significant impact distance (SID). For the purposes of this report, the significant impact analysis includes all emission increases associated with the No. 4 Recovery Boiler project, emission increases associated with other GP projects being planned within the same general time frame, as well as all other contemporaneous project emission increases or decreases.

A significant impact analysis was performed to determine whether the proposed project's emissions increase results in maximum predicted impacts greater than the PSD modeling SILs or the EPA monitoring deminimis concentrations. Current EPA and FDEP policies stipulate that the highest annual and highest short-term predicted impacts are to be compared to these impact levels. The SILs and deminimis concentrations are presented in Table C-3 for the pollutants for which the proposed projects trigger PSD review.

2.6.2. *Model Inventory*

For the significant impact analysis, the emission inventory includes all sources that will experience an increase or decrease in emissions due to the proposed GP and contemporaneous projects. The emission increase represents the difference between the potential emissions and the actual emissions during the baseline period. The baseline must reflect conditions prior to any modifications or physical changes. For this analysis, the average of 2003 and 2004 operations was selected to represent the baseline. A summary of the maximum short-term (i.e., lb/hr) emission increases and decreases due to all proposed GP projects and contemporaneous emissions changes is presented in Table C-4. The annual (i.e., TPY) emission increases and decreases due to the projects and contemporaneous changes are presented in Table C-5. Supporting documentation is included in a separate attachment to this PSD application.

2.6.3. *Project Source Modeling Parameters*

Stack location and parameter data for the proposed GP sources and the contemporaneous sources are included in Table C-6. The point source data include stack location, stack height, diameter, exit temperature, and velocity. The area source data include the source location, release height and initial sigma-z. The volume source data include release height, side length, initial sigma-y and initial sigma-y.

PM emissions from truck traffic resulting from the transport of petcoke within the Palatka Mill site are included in the modeling analysis. The traffic was simulated as a series of volume sources. The side length for each of the petcoke truck traffic volume sources represents the distance between the separated volumes, which varies along the route (see Section 2.8 also).

2.6.4. *Receptor Locations*

The modeling analysis used Universal Transverse Mercator (UTM) coordinates from zone 17, North American Datum 1927 (NAD27). Nested Cartesian receptor grids were used in addition to discrete Cartesian receptors along the Mill fenceline. The significant impact analysis used the following receptor spacing:

- 50-m intervals along the fenceline
- 100-m intervals beyond the fenceline to 2 km from the Mill
- 250-m intervals from 2 to 4 km from the Mill

The receptor grid used for the significant impact analysis is depicted in Figure C-3. Receptor elevations and hill scale heights for all receptors were obtained from 7.5 minute USGS Digital Elevation Model (DEM) data using the AERMOD terrain preprocessor program AERMAP, Version 03107.

To determine the location of the maximum impact from the significant impact analysis, concentration plot files were written into and analyzed in a spreadsheet. The location of all receptors and the maximum concentrations at each receptor were plotted over a base map with Golden Software's Surfer 8.0 software. The receptors where predicted concentrations exceeded the SIL were identified. Based on this analysis, it was determined that the maximum predicted PM_{10} and NO_2 concentrations exceeded the SIL and that all receptors exceeding a particular SIL were located within 2 km of the modeling origin (i.e., the No. 4 Lime Kiln stack). Since this area of the receptor grid has a resolution of 100 m or less, additional air modeling refinements were not required. It was also determined that maximum predicted CO concentrations occurred within 2 km of the modeling origin and did not exceed the SIL.

2.7 NAAQS MODELING ANALYSIS

2.7.1. *Purpose and Methodology*

As discussed in the results section (Section 2.10), preliminary modeling of the proposed project's emissions exceeded the SIL for PM_{10} and NO_2. Therefore, PSD review requires that a full air quality analysis be performed to demonstrate compliance with the NAAQS for these pollutants. The NAAQS impact analysis predicts the maximum ambient air concentration due to 1) all GP Palatka Mill sources emitting at maximum potential emission rates, 2) off-site sources at maximum permitted rates, and 3) other PM_{10} and NO_2 emissions not explicitly included in the modeling analysis. The sum of these concentrations must be less than the NAAQS. The applicable NAAQS for this project are presented in Table C-7.

2.7.2. *Inventory - GP*

For the NAAQS impact analysis, the model inventory includes all emission sources from the entire Mill at their potential emission rates. The inventory does not include any offset or negative emission sources. The analysis also included PM_{10} emissions from Mill roads. The emission rate for each model road source is assumed constant along a particular truck route. There are five existing truck routes and one proposed petcoke truck route. All Mill roads are paved.

Tables C-8 and C-9 summarize the maximum potential PM_{10} and NO_X emission rates for the NAAQS analysis, respectively. Table C-10 summarizes the modeling parameters for the GP Palatka Mill future point sources and Figure C-4 presents the arrangement of these sources.

2.7.3. *Fugitive Source Modeling Parameters*

GP also calculated modeling parameters for fugitive sources that are modeled as either an AREAPOLY or VOLUME sources. The parameters for the areapoly sources are release height, number of corners, and initial vertical source dimension. The parameters for the volume sources are release height and initial lateral and vertical source dimensions. GP calculated values for the parameters in accordance with the ISCST3 manual and general EPA guidance. For the area source, the release height is the height of the expected release. For a volume source, the release height is at the center of the physical source. The modeling parameters for the future Mill fugitive sources are presented in Table C-11, and Figures C-4 and C-5 presents the arrangement of these sources.

2.7.4. *Inventory – Competing Sources*

A full analysis must include the emissions of competing sources located within the modeling screening area. The modeling screening area is unique for each pollutant, and is the area within a circle centered on the project with a radius equal to the SID for that pollutant plus 50 km, but not to exceed 100 km. The screening areas for PM_{10} and NO_2 are 50.8 and 51.6 km, respectively, based on significant impact distances of 800 m and 1,600 m, respectively. In addition to the sources within the screening area, larger sources that are located beyond the screening area are also considered.

The North Carolina Screening Technique was used to evaluate all sources within the screening area. The technique compares the annual emissions (in TPY) to a specific threshold. If the emissions for a facility are less than the threshold, then that facility is assumed to not have a significant interaction with the Palatka Mill. The threshold is equal to the quantity of 20 x (D-S), where D is the distance between the competing source and the Mill, and S is the SID. If the facility-wide permitted emission rate was above the threshold, that facility was included in the analysis.

Table C-12 presents the screening analysis for competing PM_{10} sources. Table C-13 presents the individual stack parameters for sources at the facilities that are to be included in the modeling analysis.

Among the competing sources to be modeled are Florida Rock and GP's Chip-n-saw Mill (Sawmill), both located within 3 km of the GP Mill. For Florida Rock, the potential emission rate in the FDEP's inventory database, 17 pounds per hour, was revised to 0.2 lb/hr, based on current information provided for the baghouse from Florida Rock. For GP's Sawmill, updated potential emission rates and source parameters were obtained from GP and this information has been included in Tables C-12 and C-13.

GP also determined source-specific building information for each GP Sawmill stack. A summary of the building dimensions at the Sawmill are provided in Table A-1 in Appendix A. Florida Rock and the GP Sawmill were included in the modeling analyses because they are PSD sources nearby the GP Palatka Mill.

To reduce the number of model sources, GP first combined sources with identical stack parameters. Second, GP combined stacks at an individual facility using US EPA's method for merging sources (US EPA, 1992). For each stack, the parameter M was computed as:

$$M = (h_s)(V)(T_s)/(Q)$$

where: M = merged stack parameter which accounts for the relative influence of stack height, plume rise, and emission rate on concentrations

h_s = stack height (m)

V = $(\pi/4)\, d_s^2 v_s$ = stack gas volumetric flow rate (m^3/s)

d_s = inside stack diameter (m)

v_s = stack gas exit velocity (m/s)

T_s = stack gas exit temperature (K)

Q = pollutant emission rate (g/s)

The stack with the lowest value of M is used as the representative stack. Then, the sum of the emissions from all applicable sources is modeled with the representative stack.

Table C-14 presents the screening analysis for NO_x competing sources. Table C-15 presents the individual .stack parameters for sources at these facilities that were included in the air modeling analysis.

2.7.5. *Receptors*

For the NAAQS analyses, receptors grids were developed to extended out to a distance just beyond the respective SID. For PM_{10} and NO_2, receptor grid distances of 1 and 2 km were used for each respective modeling analysis. Receptors were spaced at 50 m or less intervals along the fenceline and at 100 m intervals beyond the fenceline. Fenceline receptors that lie well beyond the respective pollutant SID were also excluded from the modeling analyses.

2.8 PSD CLASS II INCREMENT ANALYSIS

2.8.1. *Purpose and Methodology*

As discussed in Section 2.10, the proposed project's emissions exceed the SIL for PM_{10} and NO_2. Therefore, PSD review requires that an air modeling analysis be performed to demonstrate compliance with the allowable PSD Class II increments for these pollutants. The increment analysis predicts the maximum ambient air concentration due to all Mill sources and off-site sources within the screening areas that affect consume increment. The sum of concentrations from the Mill and off-site sources must be less than the allowable PSD Class II increments, as listed in Table C-16.

2.8.2. *Inventory - GP*

For this project, the Increment analysis included all the future paper mill sources that were used in the NAAQS analysis and also all source emissions that occurred at the time of the PSD baseline date. The PSD baseline emissions are set to negative in the model and are subtracted from the future emissions to determine the amount of PSD increment that is consumed.

Because the Mill is a major source, all emission increases after the major source baseline due to a change in the method of operation consume PSD increment. Other types of emission increases, such as increase in utilization, only affect (*i.e.*, consume or expand) PSD increment after the minor source baseline date is set. Table C-17 summarizes the baseline dates. Therefore, the calculations to determine which GP emissions consume increment will vary by pollutant.

2.8.3. *Particulate Matter*

The 1974 PSD baseline emissions for the GP Palatka Mill are presented in Table C-18. The locations and stack parameters for the PSD baseline sources are presented in Table C-19.

2.8.4. *Nitrogen Dioxide*

The 1988 PSD baseline emissions for the GP Palatka Mill are presented in Table C-20. The locations and stack parameters for the PSD baseline sources are presented in Table C-21.

2.8.5. *Inventory – Competing Sources*

A full analysis must include the emissions of competing sources. In contrast to the NAAQS analysis, the PSD increment analysis only includes emissions from competing sources that affect PSD increment. A listing of PSD increment-affecting sources was obtained from prior modeling report and from discussions with the FDEP. Table C-22 presents a summary of the competing facilities in the vicinity of the Palatka Mill that affect PSD increment. Table C-23 presents the modeling parameters for the PSD-affecting sources that were included in the modeling analysis.

2.8.6. *Receptors*

For the PM_{10} and NO_2 PSD increment analyses, GP used the same receptor grids that were used for the PM_{10} and NO_2 NAAQS analyses, respectively.

2.9 SOURCE IMPACT ANALYSIS RESULTS

2.9.1. *Significant Impact Analysis*

Particulate Matter

The maximum predicted concentrations for each year for the significant impact analysis are presented in Table C-24. The maximum 24-hour PM_{10} impact due to the proposed GP projects and contemporaneous emission changes is 7.4 μg/m^3, which is above the SIL of 5 μg/m^3, but is below the monitoring de minimis concentration of 10 μg/m^3. The maximum annual impact is 2.2 μg/m^3, which exceeds the annual SIL of 1 μg/m^3. Therefore, detailed NAAQS and PSD Class II increment analyses are required for PM_{10}. Figure C-6 shows the receptor locations where the proposed project's impacts exceed the SIL. The SID for PM_{10} is 800 m.

Nitrogen Dioxide

The maximum predicted concentrations for each year for the NO_2 significant impact analysis are shown in Table C-25. The maximum impact due to the proposed GP projects and contemporaneous changes is 4.3 μg/m^3, which is above the SIL of 1 μg/m^3, but is below the monitoring de minimis concentration of 14 μg/m^3. Figure C-7 shows the receptor locations where the proposed project's impacts exceed the SIL. Because the project's maximum concentration is above the SIL, detailed NAAQS and PSD Class II increment analyses are required for NO_2. The SID for NO_2 is 1.75 km.

Carbon Monoxide

The maximum predicted concentrations for each year for the CO significant impact analysis are presented in Table C-26. The maximum 1-hour CO impact due to the proposed GP projects and contemporaneous changes is 93 μg/m^3, which is below the SIL of 2,000 μg/m^3. The maximum 8-hour impact is 82 μg/m^3, which is below the SIL of 500 μg/m^3 and the monitoring de minimis concentration of 575 μg/m^3. Therefore, the project's impacts are not significant for CO and detailed modeling analyses are not required for CO.

Summary

The significant impact analyses determined that the project's emission increase would result in maximum impacts that are above the PM_{10} and NO_2 SIL. Table C-27 summarizes the significant impact distance for each pollutant.

2.9.2. *NAAQS Analysis*

Particulate Matter

By modeling the potential GP Mill and competing source emissions, it was determined that the maximum predicted PM_{10} impacts were 30.1 and 9.0 μg/m^3, respectively, for the 24-hour and annual averaging times. The maximum impact locations were in an area that did not require additional refined receptor grids. Table C-28 summarizes the PM_{10} NAAQS modeling results.

Background concentrations of 57 and 27 μg/m^3 were added to the modeling results for the 24-hour and annual averaging periods, respectively. As summarized in Table C-29, the 24-hour and annual average total concentrations are 87.1 and 36.0 μg/m^3, respectively, which are below the respective NAAQS of 150 and 50 μg/m^3.

Nitrogen Dioxide

By modeling the total potential Mill emissions and competing source emissions, GP determined that the maximum predicted annual NO_2 impact is 14.1 μg/m^3. The maximum impact location is in an area that did not require additional refined receptor grids. Table C-30 summarizes the NO_2 NAAQS modeling results.

GP added a background concentration of 27.5 μg/m^3 to the modeling result. As summarized in Table C-31, when adding the background concentration, the annual concentration is 41.6 μg/m^3. This impact is below the NAAQS of 100 μg/m^3. Therefore, the Mill's emissions are in compliance with the NO_2. NAAQS.

2.9.3. *PSD Class II Increment Analysis*

Particulate Matter

By modeling the potential GP Mill and competing source emissions, it was determined that the maximum predicted PM_{10} PSD Class II increment consumption was 6.1 μg/m^3 and less than 0.0 μg/m^3, respectively, for the 24-hour and annual averaging times. The maximum impact locations were in an area that did not require additional refined receptor grids. Table C-32 summarizes the PM_{10} PSD increment modeling results. The maximum predicted 24-hour and annual increments are below allowable PSD Class II increments of 30 and 17 μg/m^3, respectively. Therefore, the Mill's PM_{10} emissions are in compliance with the allowable PSD Class II increments.

Nitrogen Dioxide

By modeling the increment-affecting emissions from the GP Mill and competing sources, it was determined that the predicted maximum annual average NO_2 PSD increment consumption is 7.0 μg/m^3. The maximum impact location is in an area that did not require additional refined receptor grids. Table C-33 summarizes the NO_2 model results. The maximum predicted impact is less than the allowable PSD Class II increment of 25 μg/m^3. Therefore, the Mill's NO_X emissions are in compliance of the allowable NO_2 PSD Class II increment.

3.0 GOOD ENGINEERING PRACTICE STACK HEIGHT ANALYSIS

PSD review rules require that controls required for emission sources using the Best Available Control Technology cannot be affected by a stack height that exceeds Good Engineering Practice (GEP) or any other dispersion technique. In other words, emissions rates specified in a source impact analysis must demonstrate compliance with stack heights at or below GEP, even if the physical height of the stack is greater than GEP. On July 8, 1985, EPA defined GEP stack height in the final stack height regulations (see 40 CFR 51.100(hh)). GEP stack height is defined as:

> The greater of:
>
> (1) 65 meters, measured from the ground-level elevation at the base of the stack:
>
> (2)(i) For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52, Hg=2.5H, provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation.
>
> Hg = good engineering practice stack height, measured from the ground-level elevation at the base of the stack
> H = height of nearby structure(s) measured from the ground-level elevation at the base of the stack.
>
> (ii) For all other stacks, Hg = H + 1.5L,
> L = lesser dimension, height or projected width, of nearby structure(s) provided that the EPA, State or local control agency may require the use of a field study or fluid model to verify GEP stack height for the source
>
> (3) The height demonstrated by a fluid model or a field study approved by the EPA, State or local control agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash, wakes, or eddy effects created by the source itself, nearby structures or nearby terrain features. "Nearby" is defined as a distance up to five times the lesser of the height or projected width dimensions of a structure or terrain feature but not greater than 0.8 kilometer (km).

Because all point sources associated with the proposed GP projects and contemporaneous emission changes are either not affected by building structures or have stacks below the GEP stack height, the project stacks are in accordance with GEP regulations.

4.0 AMBIENT AIR QUALITY ANALYSIS

Rule 40 CFR 52.21(m) describes the analyses of ambient air quality data required by PSD regulations. These requirements include pre-application and post-application analyses. Both of these requirements are exempted by 40 CFR 52.21(i)(8) if the source impact analysis demonstrates that the emissions increase from the modification would cause air quality impacts less than the de minimis monitoring concentrations in all areas. As the source impact analysis (Section 2.0) for GP Palatka concluded that all maximum impacts from the proposed GP projects and contemporaneous changes will be below the de minimis monitoring concentrations, air monitoring requirements are not required.

GP used existing ambient air monitoring data and the results of the source impact analysis together to assess the total air quality in the area that the project emissions could affect. GP Palatka does not operate any ambient air quality monitors, but the FDEP has operated a PM_{10} monitoring station in Palatka (Site ID 12-107-1008) for many years. To determine if existing data is appropriate, EPA guidance recommends three criteria: monitor location, data quality, and currentness of the data. GP reviewed these factors and selected the highest mean annual concentration reported for the past three years as being representative of the maximum annual background air quality concentration for the proposed projects. Additionally, GP selected the 6th-highest 24-hour concentration measured in the last 5 complete years (which excluded 2002) as being representative of the maximum 24-hour background concentration for the proposed projects. Table C-1 summarizes the background selections used for the air modeling analysis.

The post-application analysis determines post-construction ambient monitoring needs, such as quantifying the effect of the Mill-wide emissions on air quality. EPA guidance recommends that post-construction monitoring is appropriate when:

1) the NAAQS is threatened, or
2) the modeling databases contain significant uncertainties.

Because these conditions do not exist for this project, GP is proposing to use the existing air monitoring station data to satisfy any post-application requirement.

5.0 ADDITIONAL IMPACT ANALYSIS – CLASS II AREAS

5.1 IMPACTS UPON SOILS AND VEGETATION

5.1.1. *Soils*

Air contaminants can affect soils through fumigation by gaseous forms, accumulation of compounds transformed from the gaseous state, or by the direct deposition of PM or PM to which certain contaminants are absorbed. According to the Putnam County Soil Survey (1990), the soils in the vicinity of the GP Palatka Mill are dominated by Terra Ceia muck, with Cassia fine sand and Pamona fine sand also present.

The Terra Ceia muck, Cassia fine sand, and Pomona fine sand series are described in the Putnam County Soil Survey as follows:

Terra Ceia muck, frequently flooded – This soil is nearly level and very poorly drained, found on broad to narrow plains along the St. Johns River and its tributaries. Typically the upper part of this organic soil is dark reddish brown muck approximately 28 inches thick, while the lower portion to a depth of approximately 80 inches is black muck. This soil has a high water table at the surface except during extended dry periods. The available water capacity is very high, permeability is rapid, and natural fertility is moderate. Typical vegetation includes wetlands forested with sweetgum, red maple, cypress, bay, and cabbage palm. The soil reaction for Terra Ceia muck is classified as slightly acid within the top 28 inches, and mildly alkaline between 28 and 80 inches below the surface.

Pomona fine sand – This soil is nearly level and poorly drained, found in broad flatwoods areas. Typically this soil has a surface layer of black fine sand approximately 6 inches thick underlain by a subsurface layer of gray and light gray fine sand to a depth of 20 inches. In most years this soil has a high water table at a depth of less than 12 inches for 1 to 3 months. The available water capacity is very low, permeability is rapid, and natural fertility is low. Typical vegetation is pine flatwoods. The soil reaction for Pomona fine sand is classified as extremely acid within the top 6 inches, very strongly acidic between 6 to 10 inches, and strongly acidic between 10 and 20 inches below the surface.

Cassia fine sand – This soil is nearly level and somewhat poorly drained, found on small knolls within flatwoods and in low positions on uplands. Typically, this soil has a surface layer of gray fine sand approximately 4 inches thick, and a subsurface layer of light gray fine sand to a depth of 28 inches. In most years, this soil has a water table at a depth of 15 to 40 inches for about 6 months. The available water capacity is very low, permeability is rapid, and natural fertility is low. Natural vegetation includes pine flatwoods and oak. Cassia fine sand is classified as extremely acid within the top 4 inches, very strongly acidic between 4 to 9 inches, and strongly acidic between 9 and 24 inches below the surface.

The dominant soil in the vicinity of the GP facility, Terra Ceia muck, is a highly organic wetland soil and has an extremely high buffering capacity based on the cation exchange capacity, base saturation, and bulk density. Therefore, this soil would be relatively insensitive to atmospheric inputs. The maximum predicted CO concentrations in the vicinity of the site as a result of the proposed project are below the significant impact levels. The maximum predicted NO_2 and PM_{10} concentrations in the vicinity of the site are below the AAQS. Since the AAQS are designed to protect the public welfare, including effects on soils and vegetation, no detrimental effects on soils should occur in the vicinity of the GP Palatka Mill due to the proposed project.

5.1.2. *Vegetation*

In general, the effects of air pollutants on vegetation occur from SO_2, NO_2, O_3, and PM. The effects of air pollutants are dependent both on the concentration of the contaminant and the duration of the exposure. The term "injury," as opposed to damage, is commonly used to describe all plant responses to air contaminants and will be used in the context of this analysis. Air contaminants are thought to interact primarily with plant foliage that is considered to be the major pathway of exposure. For purposes of this analysis, it was assumed that 100 percent of each air contaminant of concern is accessible to the plants.

Injury to vegetation from exposure to various levels or air contaminants can be termed acute, physiological, or chronic. Acute injury occurs as a result of a short-term exposure to a high contaminant concentration and is typically manifested by visible injury symptoms ranging from chlorosis (discoloration) to necrosis (dead areas). Physiological or latent injury occurs as the result of a long-term exposure to contaminant concentrations below that which results in acute injury symptoms. Chronic injury results from repeated exposure to low concentrations over extended periods of time, often without any visible symptoms, but with some effect on the overall growth and productivity of the plant. In this assessment, 100 percent of the particular air pollutant in the ambient air was assumed to interact with the vegetation. This is a conservative approach. The following paragraphs address the effects of NO_2, PM, ozone, and sulfuric acid mist (SAM) concentrations due to the proposed project, since these pollutants are subject to PSD review.

Nitrogen Dioxide

A review of the literature indicates great variability in NO_2 dose-response relationship in vegetation. Acute NO_2 injury symptoms are manifested as water-soaked lesions, which first appear on the upper surface, followed by rapid tissue collapse. Low-concentration, long-term exposures as frequently encountered in polluted atmospheres often do not induce the lesions associated with acute exposures but may still result in some growth suppression. Citrus trees exposed to 470 μg/m^3 of NO_2 for 290 days showed injury (Thompson *et al.*, 1970). Sphagnum exposed for 18 months at an average concentration of 11.7 μg/m^3 showed reduced growth (Press *et al.*, 1986)

The maximum increase in ground-level annual average NO_2 concentration predicted to occur in the vicinity of the GP Palatka Mill due to the proposed projects is 4 μg/m^3 (see Table C-25). This maximum predicted concentration is well below the reported effects levels.

Carbon Monoxide

Concentrations of CO even in polluted atmospheres are not detrimental to vegetation (EPA, 1976). CO has not been found to produce detrimental effects on plants at concentrations below 100 ppm (114,500 μg/m^3) for exposures from 1 to 3 weeks (EPA, 1976). The predicted maximum concentrations due to the proposed projects, shown in Table C-26, are well below levels reported to cause detrimental effects.

Particulate Matter

Although information pertaining to the effects of particulate matter on plants is scarce, some threshold concentrations are available. Mandoli and Dubey (1998) exposed ten species of native Indian plants to levels of particulate matter ranging from 210 to 366 μg/m^3 for an 8-hour averaging period. Damage in the form of a higher leaf area/dry weight ratio was observed at varying degrees for most plants tested. Concentrations of particulate matter lower than 163 μg/m^3 did not appear to be injurious to the tested plants. The maximum predicted 24-hour and annual average PM_{10} concentrations due to the proposed projects of 7.4 μg/m^3, 24-hour average, and 2.2 μg/m^3, annual average (see Table C-24), are well below the injury thresholds reported in the literature.

VOC Emissions and Impacts on Ozone

It is difficult to predict what effect the proposed project's emissions of VOC will have on ambient O_3 concentrations from either a local or regional scale. VOC and NO_x emissions are precursors to the formation of O_3. O_3 is formed down-wind from emission sources when VOC and NO_x emissions from the facility react in the presence of sunlight.

O_3 can cause various damage to broad-leaved plants including: tissue collapse, interveinal necrosis and markings on the upper surface of leaves known as stippling (pigmented yellow, light tan, red brown, dark brown, red, or purple), flecking (silver or bleached straw white), mottling, chlorosis or bronzing, and bleaching. O_3 can also stunt plant growth and bud formation. On certain plants such as citrus, grape, and tobacco, it is common for leaves to wither and drop early. A literature review suggests that exposure for 4 hours at levels of 0.04 to 11.0 ppm of O_3 will result in plant injury for sensitive plants. The extent of the injury depends on the plant species and environmental conditions prior to and during exposure.

Given that the O_3 measurements in the region comply with the NAAQS and the increase in VOC emissions for the project represents less than a 1-percent change in regional VOC emissions (389 TPY), no adverse effects on vegetation due to the project's VOC emissions are expected.

Sulfuric Acid Mist

Acidic precipitation or acid rain is coupled to SO_2 emissions, which is mainly formed during the burning of fossil fuels. SO_2 is oxidized in the atmosphere and dissolves in rain forming SAM, which falls as acidic precipitation (Ravera, 1989). Although concentration data are not available, SAM has been reported to yield necrotic spotting on the upper surfaces of leaves (Middleton *et al.*, 1950).

No significant adverse effects on vegetation are expected from the project's emissions because SO_2 emissions, which lead directly to the formation of SAM concentrations, are below the PSD significant emission rate, and the increase in direct SAM emissions due to the proposed projects is only 25.5 TPY.

Summary

In summary, GP expects that the project increase in emissions will not adversely impact the soils or vegetation in areas adjacent to the Palatka Mill.

5.2 IMPACTS DUE TO ADDITIONAL GROWTH

5.2.1. *Introduction*

Rule 62-212.400(3)(h)(5), F.A.C., states that an application must include information relating to the air quality impacts of, and the nature and extent of all general, residential, commercial, industrial and other growth which has occurred since August 7, 1977, in the area the facility or modification would affect. This growth analysis considers air quality impacts due to emissions resulting from the industrial, commercial, and residential growth associated with the proposed expansion at the GP Palatka Mill. This information is consistent with the EPA Guidance related to this requirement in the *Draft New Source Review Workshop Manual* (EPA, 1990).

In general, there has been minimal growth in the GP Palatka Mill area since 1977. Putnam County is surrounded by Marion County to the south and west, Alachua County to the west, Clay County to the north, St. John's County to the north and east, Flagler County to the east, and Volusia County to the south. Putnam County encompasses an 827-square mile area including 733-square miles of land area.

The proposed projects are for the purpose of improving energy efficiency and combustion efficiency, reducing fuel oil consumption, and implementing needed repairs. Additional growth as a direct result of the proposed modification is not expected.

Construction of the projects will occur over a several year period, requiring variable number of workers during that time. It is anticipated that many of these construction personnel will commute to the site.

The projects will not require any additional operational workers once the projects are completed.

There are also expected to be no air quality impacts due to associated commercial and industrial growth given the location of the existing GP Palatka Mill. The existing commercial and industrial infrastructure should be adequate to provide any support services that the project might require and would not increase with the operation of the project.

The following discussion presents general trends in residential, commercial, industrial, and other growth that has occurred since August 7, 1977, in Putnam County. As such, the analysis presents information available from a variety of sources (*i.e.*, Florida Statistical Abstract, FDEP, etc.) that characterize Putnam County as a whole.

5.2.2. *Residential Growth*

Population and Household Trends

As an indicator of residential growth, the trend in the population and number of household units in Putnam County since 1977 are shown in Figure C-8. The county experienced a 47-percent increase in population for the years 1977 through 2000. During this period, there was an increase in population of about 22,600. Similarly, the number of households in the county increased by about 12,000, or 73 percent, since 1977.

Growth Associated with the Operation of the Project

Because there will be no additional workers needed to operate the project, there will be no residential growth due to the project.

5.2.3. Commercial Growth

Retail Trade and Wholesale Trade

As an indicator of commercial growth in Putnam County, the trends in the number of commercial facilities and employees involved in retail and wholesale trade are presented in Figure C-9. The retail trade sector comprises establishments engaged in retailing merchandise. The retailing process is the final step in the distribution of merchandise. Retailers are, therefore, organized to sell merchandise in small quantities to the general public. The wholesale trade sector comprises establishments engaged in wholesaling merchandise. This sector includes merchant wholesalers who buy and own the goods they sell; manufacturers' sales branches and offices that sell products manufactured domestically by their own company; and agents and brokers who collect a commission or fee for arranging the sale of merchandise owned by others.

Since 1977, retail trade has increased by about 14 establishments and 2,000 employees or 6 and 118 percent, respectively. For the same period, wholesale trade has increased by 28 establishments and 346 employees, or 82 and 126 percent, respectively.

Labor Force

The trend in the labor force in Putnam County since 1977 is shown in Figure C-10. The greatest number of persons employed in Putnam County has been in the manufacturing, government, and retail trade sectors. Between 1977 and 1999, approximately 5,000 persons were added to the available work force, for an increase of 34 percent.

Tourism

Another indicator of commercial growth in Putnam County is the tourism industry. As an indicator of tourism growth in the county, the trend in the number of hotels and motels and the number of units at the hotels and motels are presented in Figure C-11.

This industry comprises establishments primarily engaged in marketing and promoting communities and facilities to businesses and leisure travelers through a range of activities, such as assisting organizations in locating meeting and convention sites; providing travel information on area attractions, lodging accommodations, restaurants; providing maps; and organizing group tours of local historical, recreational, and cultural attractions.

Between 1978 and 2000, there was a decrease of 12 percent in the number of hotels and motels, and an increase of 14 percent in the number of units at those establishments in the county.

Transportation

As an indicator of transportation growth, the trend in the number of vehicle miles traveled (VMT) by motor vehicles on major roadways in Putnam County is presented in Figure C-12. The county's main roadways are U.S. Route 17 and SR 100.

Between 1977 and 2001, there was an increase of about 1,560,000 VMT, or 113 percent, on major roadways in the county.

Growth Associated with the Operation of the Project

The existing commercial and transportation infrastructure should be adequate to provide any support services that might be required during construction and operation of the project. The workforce needed to operate the proposed project represents a small fraction of the labor force present in the immediate and surrounding areas.

5.2.4. *Industrial Growth*

Manufacturing and Agricultural Industries

As an indicator of industrial growth, the trend in the number of employees in the manufacturing industry in Putnam County since 1977 is shown in Figure C-13. As shown, the manufacturing industry experienced a slight decrease in employees from 1977 through 2000.

As another indicator of industrial growth, the trend in the number of employees reported in the agricultural industry in Putnam County since 1977 is also shown in Figure C-13. As shown, the agricultural industry experienced an increase of about 400 employees from 1977 through 2000.

Utilities

Existing power plants in Putnam County include the following:

- Florida Power & Light's Putnam Plant;
- Seminole Electric Cooperative, Inc.'s Seminole Power Plant; and
- Georgia-Pacific Corporation's Palatka Operations.

Together, these power plants have an electrical nameplate generating capacity of over 1,800 megawatts (MW).

As an indicator of electrical utility growth, the electrical nameplate generating capacity in Putnam County since 1977 is shown in Figure C-14. As shown, the electrical nameplate generating capacity has increased by 1,585 MW, or 521 percent since 1977.

Growth Associated with the Operation of the Project

Since the PSD baseline date of August 7, 1977, there has been only one major facility built within a 35-km radius of the GP Palatka Mill site. This was the Seminole Electric Power Plant. There are a limited number of facilities located throughout the 35-km radius area surrounding the site. Based on the locations of nearby air emission sources, there has not been a concentration of industrial and commercial growth in the vicinity of the GP Palatka Mill site.

5.2.5. *Air Quality Discussion*

Air Emissions and Spatial Distribution of Major Facilities

The locations of major air pollutant facilities in Putnam County are presented in Tables C-12 and C-14. Based on actual emissions reported for 1999 (latest year of available data) by EPA on its AIRSdata website, total emissions from stationary sources in the county are as follows:

SO_2:	43,000 TPY
PM_{10}:	1,700 TPY
NO_x:	28,900 TPY

CO: 4,640 TPY
VOC: 800 TPY

Air Emissions from Mobile Sources

The trends in the air emissions of CO, VOC, and NO_x from mobile sources in Putnam County are presented in Figure C-15. Between 1977 and 2002, there were significant decreases in CO emissions, while there was a slight increase in NO_x and a slight decrease in VOC emissions during that same time period. The decrease in CO and VOC emissions were about 41 and 5 tons per day, respectively, which represent decreases from 1977 emissions of 48 and 42 percent, respectively. The increase in NO_x emissions was less than one half of a ton per day, which represents an increase of about 5 percent since 1977.

Air Monitoring Data

Since 1977, Putnam County has been classified as attainment for all criteria pollutants. Air quality monitoring data have been collected in Putnam County, primarily in the central portion of the county in and around the city of Palatka. For this evaluation, the air quality monitoring data collected at the monitoring station nearest to the GP Palatka Mill were used to assess air quality trends since 1977. Air quality monitoring data were based on the following monitoring stations:

- SO_2 and PM_{10} concentrations – Palatka,
- NO_2 concentrations – Palatka and Jacksonville,
- CO concentrations – Jacksonville, and
- O_3 concentrations – Gainesville and Jacksonville.

Data collected from these stations are considered to be generally representative of air quality in Putnam County. Because the monitoring stations in Jacksonville (NO_2, CO, and O_3) are located in more urbanized areas than the GP Palatka Mill, the reported concentrations for those stations are likely to be higher than that experienced at the site.

The air monitoring data indicate that the maximum air quality concentrations currently measured in the region comply with and are well below the applicable AAQS. These monitoring stations are located in areas where the highest concentrations of a measured pollutant are expected due to the combined effect of emissions from stationary and mobile sources, as well as the effects of meteorology. Therefore, the ambient concentrations in areas not monitored should have pollutant concentrations less than the monitored concentrations from these sites.

In addition, since 1988, PM in the form of PM_{10} has been collected at the air monitoring stations due to the promulgation of the PM_{10} AAQS. Prior to 1989, the AAQS for PM was in the form of total suspended particulates (TSP) concentrations, and this form was measured at the stations.

SO_2 Concentrations

The trends in the 3-hour, 24-hour, and annual average SO_2 concentrations measured in Putnam County since 1977 are presented in Figures C-16 through C-18, respectively. As shown in these figures, measured SO_2 concentrations have been and continue to be well below the AAQS.

PM_{10}/TSP Concentrations

The trends in the 24-hour and annual average PM_{10} and TSP concentrations since 1977 are presented in Figures C-19 and C-20, respectively. TSP concentrations are presented through 1988 since the AAQS was based on TSP concentrations through that year. In 1988, the TSP AAQS was revoked and the PM standard was revised to PM_{10}.

As shown in these figures, measured TSP concentrations were generally below the TSP AAQS. Since 1988 when PM_{10} concentrations have been measured, the PM_{10} concentrations have been and continue to be below the AAQS.

NO_2 Concentrations

The trends in the annual average NO_2 concentrations measured at the nearest monitors to the GP Palatka Mill are presented in Figure C-21. As shown in this figure, measured NO_2 concentrations have been well below the AAQS.

CO Concentrations

The trends in the 1-hour and 8-hour average CO concentrations measured since 1977 in Jacksonville are presented in Figures C-22 and C-23, respectively. As shown in these figures, measured CO concentrations have been well below the AAQS for the past several years.

Ozone Concentrations

The trends in the 1-hour average O_3 concentrations since 1977 are presented in Figure C-24. The trends in the 8-hour average O_3 concentrations since 1995 are presented in Figure C-25. As shown in these figures, even in the more urbanized areas of Jacksonville and Gainesville, the measured O_3 concentrations have primarily been below the 1-hour average AAQS and the new 8-hour average AAQS.

Air Quality Associated with the Operation of the Project

The air quality data measured in the region of the GP Palatka Mill indicate that the maximum air quality concentrations are well below and comply with the AAQS. Also, based on the trends presented of these maximum concentrations, the air quality has generally improved in the region since the baseline date of August 7, 1977. Because the maximum concentrations for the proposed modifications at the GP Mill are predicted to be below the significant impact levels except for PM_{10} and NO_x, air quality concentrations in the region are expected to remain below and comply with the AAQS when the project becomes operational. For PM_{10} and NO_x, the modeling analysis demonstrates compliance with AAQS. For ozone, VOC emissions are estimated to increase by 389 TPY due to the proposed projects. This represents about a 15 percent increase in county-wide VOC emissions (current emissions of 800 TPY point sources and 1,800 TPY mobile sources, or 2,600 TPY total). However, this increase due to the proposed projects is based on a comparison of past actual to future potential emissions, and the increase in future actual emissions is expected to be much lower.

5.3 IMPACTS ON VISIBILITY

The proposed projects only affect and modify existing sources, such as the No. 4 Lime Kiln, the No. 4 Recovery Boiler, the No. 4 Smelt Dissolving Tank, and the No. 4 Combination Boiler. The application does not request an increase in permitted emissions, except for the No. 4 Lime Kiln. The maximum permit limits for several emissions units are being reduced (for TRS and SO_2 emissions). The existing sources are in compliance with opacity regulations and should remain in compliance after the modification. As a result, no change in opacity, GP does not expect any adverse impacts upon visibility.

6.0 ADDITIONAL IMPACT ANALYSIS – CLASS I AREAS

6.1 INTRODUCTION

Generally, if the facility undergoing the modification is within 200 kilometers of a PSD Class I area, then a significant impact analysis is also performed to evaluate the impact due to the project alone at the PSD Class I areas. The three PSD Class I areas that are located within 200 km of the Mill are:

- Okefenokee National Wilderness Area (NWA), 108 km north of the Mill;
- Wolf Island NWA, 186 km north of the Mill; and
- Chassahowitzka NWA, 137 km southwest of the Mill.

The maximum predicted impacts due to the proposed GP projects and contemporaneous emission changes at the Okefenokee, Wolf Island and Chassahowitzka NWAs are compared to EPA's proposed significant impact levels for PSD Class I areas. These recommended significant impact levels have never been promulgated as rules, but are the currently accepted criteria for determining whether a proposed project will incur a significant impact on a PSD Class I area.

If the project-only impacts at the PSD Class I areas are above the proposed EPA PSD Class I significant impact levels, then an analysis is performed to demonstrate compliance with allowable PSD Class I impacts at the PSD Class I areas. The proposed project's maximum emission increases are also evaluated at the PSD Class I areas to support the air quality related values (AQRV) analysis, which includes an evaluation of regional haze degradation, sulfur and nitrogen deposition, and impacts upon soils, vegetation and wildlife.

For predicting maximum impacts at the Okefenokee and Chassahowitzka NWA PSD Class I areas, the California Puff (CALPUFF) modeling system was used. CALPUFF, Version 5.711a (EPA, 2004), is a Lagrangian puff model that is recommended by the FDEP, in coordination with the Federal Land Manager (FLM) for the NWA, for predicting pollutant impacts at PSD Class I areas that are beyond 50 km from a project site. The following sections present a description of the CALPUFF model methodology.

6.2 GENERAL AIR MODELING APPROACH

The general modeling approach was based on using the long-range transport model, California Puff model (CALPUFF, Version 5.711a). The methods and assumptions used in the CALPUFF model were based on the latest recommendations for a refined analysis as presented in the IWAQM Phase 2 Summary Report and the FLAG document.

The following sections present the methods and assumptions used to assess the impacts of the proposed project. The analysis is consistent with a "refined analysis" since it was performed using the detailed weather data from multiple surface and upper air stations as well as the MM4/MM5 prognostic with fields.

6.2.1. *Model Selection and Settings*

The California Puff (CALPUFF, version 5.711a) air modeling system was used to model to assess the proposed project's impacts at the PSD Class I area for comparison to the PSD Class I significant impact levels. CALPUFF is a non-steady state Lagrangian Gaussian puff long-range transport model that includes algorithms for building downwash effects as well as chemical transformations (important for visibility controlling pollutants), and wet/dry deposition.

The CALPUFF meteorological and geophysical data preprocessor (CALMET, Version 5.53a), a preprocessor to CALPUFF, is a diagnostic meteorological model that produces a three-dimensional field of wind and temperature and a two-dimensional field of other meteorological parameters. CALMET was designed to process raw meteorological, terrain and land-use databases to be used in the air modeling analysis.

The CALPUFF modeling system uses a number of FORTRAN preprocessor programs that extract data from large databases and converts the data into formats suitable for input to CALMET. The processed data produced from CALMET was input to CALPUFF to assess the pollutant specific impact. Both CALMET and CALPUFF were used in a manner that is recommended by the IWAQM Phase 2 and FLAG reports.

6.2.2. *CALPUFF Model Approaches and Settings*

The IWAQM has recommended approaches for performing a Phase 2 refined modeling analyses that are presented in Table C-34. These approaches involve use of meteorological data, selection of receptors and dispersion conditions, and processing of model output. The specific settings used in the CALPUFF model are presented in Table C-35.

6.2.3. *Emission Inventory and Building Wake Effects*

The CALPUFF model included the facility's emission, stack, and operating data as well as building dimensions to account for the effects of building-induced downwash on the emission sources. Dimensions for all significant building structures were processed with the Building Profile Input Program modified to process additional direction-specific building information, and were included in the CALPUFF model input. The modeling presents a listing of the facility's emissions and structures included in the analysis.

6.2.4. *Receptor Locations*

All Class I receptor grids were obtained from the National Park Service. The grid for the Okeefenokee NWA was reduced to 180 receptors, including all boundary receptors and interior receptors with less resolution than the original set. The Chassahowitzka grid was reduced to 58 receptors located on the boundary of the area. Therefore, pollutant concentrations were predicted with an array of 180 discrete receptors located at the Okefenokee NWA, 30 discrete receptors located at the Wolf Island NWA and 58 discrete receptors located at Chassahowitzka NWA.

6.2.5. *Meteorological Data*

A wind field domain was developed that including all PSD Class I areas that were evaluated in this analysis. A detailed description of the domain is provided in the following section.

6.2.6. *Modeling Domain*

A rectangular modeling domain extending 448 km in the east-west (x) direction and 684 km in the north-south (y) direction was used for the refined modeling analysis. The southwest corner of the domain is the origin and is located at 26.25 degrees north latitude and 85.0 degrees west longitude (east and north UTM coordinates of 77 and 2966.0 km, respectively, zone 17 equivalent). This location is in the Gulf of Mexico approximately 250 km west of Naples, Florida. For the processing of meteorological and geophysical data, the domain contains 112 grid cells in the x-direction and 171 grid cells in the y-direction. The domain grid resolution is 4 km. The air modeling analysis was developed in the UTM coordinate system, Zone 17.

6.2.7. *Mesoscale Model – Generations 4 and 5 (MM4 and MM5) Data*

Pennsylvania State University in conjunction with the NCAR Assessment Laboratory developed the MM4 and MM5 data set, a prognostic wind field or "guess" field, for the United States. The hourly meteorological variables used to create this data set (wind, temperature, dew point depression, and geopotential height for eight standard levels and up to 15 significant levels) are extensive and are available for 1990, 1992, and 1996. The analysis used the MM4 and MM5 data to initialize the CALMET wind field. The MM4 and MM5 data available for 1990 and 1992, respectively, have a horizontal spacing of 80 km and are used to simulate atmospheric variables within the modeling domain. The MM5 data are also available for 1996 and have a horizontal spacing of 36 km.

The MM4 and MM5 data used in the CALMET, although advanced, lacks the fine detail of specific temporal and spatial meteorological variables and geophysical data. These variables were processed into the appropriate format and introduced into the CALMET model through the additional data files obtained from the following sources.

6.2.8. *Surface Data Stations and Processing*

The surface station data processed for the CALPUFF analyses consisted of data from up to sixteen NWS stations or Federal Aviation Administration (FAA) Flight Service stations for Charleston in South Carolina; Columbus, Macon, Savannah, Augusta, Athens, and Atlanta in Georgia; and Tampa, Jacksonville, Daytona Beach, Tallahassee, Vero Beach, Fort Myers, Orlando, Pensacola and Gainesville in Florida. A summary of the surface station information and locations are presented in Table C-36. The surface station parameters include wind speed, wind direction, cloud ceiling height, opaque cloud cover, dry bulb temperature, relative humidity, station pressure, and a precipitation code that is based on current weather conditions. The surface station data were processed into a SURF.DAT file format for CALMET input.

Because the modeling domain extends over water, up to 10 sea surface stations were incorporated in the analysis. Data were obtained from C-Man stations and NOAA buoys. These data were processed into an over-water surface station format (i.e., SEA*.DAT) for input to CALMET. The over-water station data include wind direction, wind speed and air temperature.

6.2.9. *Upper Air Data Stations and Processing*

Upper air data from the following NWS stations, based on the availability of the upper air data, were used in the modeling analysis:

- Waycross, Georgia (1990, 1992);
- Athens, Georgia (1990, 1992);
- Charleston, South Carolina (1990, 1992, 1996);
- Cape Canaveral (1996)
- Miami (1996)
- Apalachicola, Florida (1990);

- Ruskin, Florida (1990, 1992, 1996);
- Tallahassee, Florida (1992, 1996);
- West Palm Beach (1990, 1992)
- Jacksonville, Florida (1996); and
- Peachtree City, Georgia (1996).

Table C-36 presents the data and locations for the upper air stations.

6.2.10. *Precipitation Data Stations and Processing*

Precipitation data were processed from a network of hourly precipitation data files collected from primary and secondary NWS precipitation-recording stations located within the latitude and longitudinal limits of the modeling domain. Data for 82 stations in Alabama, Georgia and Florida were obtained in NCDC TD-3240 variable format and converted into a fixed-length format. The utility programs PXTRACT and PMERGE were then used to process the data into the format for the PRECIP.DAT file that is used by CALMET

6.2.11. *Geophysical Data Processing*

Terrain elevations for each grid cell of the modeling domain were obtained from 1-degree Digital Elevation Model (DEM) files obtained from the U.S. Geographical Survey (USGS) Internet website. The DEM data was extracted for the modeling domain grid using the utility program TERREL. Land-use data were also extracted from 1-degree USGS files and processed using utility programs CTGCOMP and CTGPROC. Both the terrain and land use files were combined into a GEO.DAT file for input to CALMET with the MAKEGEO utility program.

6.3 DEPOSITION AND VISBILITY METHODOLOGY AND MODEL RESULTS

The following sections summarize the processing methods for deposition and visibility impacts, and the impact results.

6.3.1. *Deposition Methodology*

As part of the AQRV analyses, total nitrogen (N) rates were predicted for the proposed project at each PSD Class I area evaluated. The deposition analysis criterion is based on the annual averaging period. The total N deposition is estimated in units of kilogram per hectare per year (kg/ha/yr). The CALPUFF model is used to predict wet and dry deposition fluxes of various oxides of these elements.

For N deposition, the species include:

- Particulate ammonium nitrate (from species NO_3), wet and dry deposition;
- Nitric acid (species HNO_3), wet and dry deposition;
- NO_x dry deposition; and
- Ammonium sulfate (species SO_4), wet and dry deposition.

The CALPUFF model produces results in units of micrograms per square meter per second ($\mu g/m^2/s$). The modeled deposition rates are then converted to N deposition in kilograms per hectare, respectively, by using a multiplier equal to the ratio of the molecular weights of the substances (refer to the IWAQM Phase 2 report, Section 3.3).

The deposition analysis threshold (DAT) for N of 0.01 kg/ha/yr was provided by the USFWS (January 2002). A DAT is the additional amount of N deposition within a Class I area, below which estimated impacts from a proposed new or modified source are considered insignificant. The maximum N deposition predicted for the proposed GP project is, therefore, compared to the DAT or significant impact level.

6.3.2. *Visibility Methodology*

Based on the FLAG document, current regional haze guidelines characterize a change in visibility by the change in the light-extinction coefficient (b_{ext}). The b_{ext} is the attenuation of light per unit distance due to the scattering and absorption by gases and particles in the atmosphere. A change in the extinction coefficient produces a perceived visual change. An index that simply quantifies the percent change in visibility due to the operation of a source is calculated as:

$$\Delta\% = (b_{exts} / b_{extb}) \times 100$$

where: b_{exts} is the extinction coefficient calculated for the source, and
b_{extb} is the background extinction coefficient.

The purpose of the visibility analysis is to calculate the extinction at each receptor for each day (24-hour period) of the year due to the proposed project. The criteria to determine if the project's impacts are potentially significant are based on a change in extinction of 5 percent or greater for any day of the year.

The analysis of visibility impairment for this study was performed with the CALPUFF model and the CALPUFF post-processing program CALPOST. The analysis was conducted in accordance with the most recent guidance from the FLAG report (December 2000). The CALPUFF postprocessor model CALPOST is used to calculate the combined visibility effects from the different pollutants that are emitted from the proposed project. Daily background extinction coefficients are calculated on an hour-by-hour basis using hourly relative humidity data from CALMET and hygroscopic and non-hygroscopic extinction components specified in the FLAG document. For the Okefenokee NWA, the hygroscopic and non-hygroscopic components are 0.9 and 8.5 inverse megameter (Mm^{-1}). CALPOST then calculates the percent extinction change for each day of the year.

Impacts for the proposed projects and contemporaneous changes only were compared to both the proposed EPA PSD Class I significance levels for PM_{10} and NO_2, the regional haze degradation criteria of 5 percent, and the N deposition criteria of 0.01 kilograms per hectare per year (kg/ha/yr).

6.3.3. *Deposition and Visibility Impact Results*

The maximum PM_{10} and NO_2 concentrations predicted for the proposed GP projects and contemporaneous projects at each evaluated PSD Class I area, as compared with the EPA's proposed PSD Class I significance levels, are shown in Table C-37. The maximum PM_{10} and NO_2 concentrations were predicted to be below the significant impact levels at each PSD Class I area. Therefore, a full PSD Class I increment analysis was not required for these pollutants.

The maximum visibility impairment predicted for the proposed project at each evaluated PSD Class I area is shown in Table C-38. The air modeling results indicate that a total of 11 days in 3 years had visibility impairment above the recommended FLM criteria of 5 percent at the three PSD Class I areas of the Okefenokee NWA, the Wolf Island NWA and Chassahowitzka NWA.

Based on the air modeling results, the 11 days over the visibility criteria were further analyzed to determine if visibility may have been naturally impaired on any of the days. The results of this analysis are presented in Table C-39. Haze, fog, and rain showers are some of the naturally occurring phenomena that can reduce visibility. Present weather codes from Jacksonville International Airport (JAX) surface observations were used to determine if natural visibility impairment phenomena existed during days predicted to exceed the criteria at Okefenokee and Wolf Island NWAs. Present weather codes from Tampa International Airport (TPA) surface observations were used to determine if natural visibility impairment phenomena existed during the days predicted to exceed the criteria Chassahowitzka NWA. The weather conditions for each hour on those days is presented Appendix B, Tables APPB-1 to APPB-5.

The results of the existing weather indicated that at least 5 hours of fog, haze or light rain occurred on all but 3 of the 11 days, with 2 additional days experiencing 2 or 3 hours of reduced visibility. Only 1 day had no hours of visibility impairment. Based on these results, and the fact that the GP Palatka Mill is an existing operation, no new emission sources are being created due to the proposed projects (other than very minor PM sources), and allowable emissions are increasing on only one emissions unit (the No. 4 Lime Kiln) as a result of the proposed projects, GP believes that the actual visibility impairment in the Class I areas will be much less than the 5.0 percent criteria.

The maximum nitrogen deposition predicted for the proposed project only at each evaluated PSD Class I area is presented in Table C-40. The predicted impacts are less than the criteria of 0.01 kg/ha/yr.

6.4 IMPACTS ON SOILS, VEGETATION AND WILDLIFE – OKEFENOKEE AND WOLF ISLAND

6.4.1. *Introduction*

The facility is subject to the PSD new source review requirements for NO_x, PM, PM_{10}, CO, VOC, and SAM. The Class I area analysis addresses these pollutants. The analysis addresses the potential impacts on vegetation, soils, and wildlife of the Okefenokee NWA Class I area due to the proposed project. In addition, potential impacts upon visibility resulting from the proposed project are assessed. The Okefenokee NWA Class I area is located approximately 108 km north of the GP Palatka Mill. Although the Wolf Island NWA Class I area is located approximately 186 km north of the GP Palatka Mill, only the Okefenokee NWA Class I area was evaluated since it is much closer to the Mill than Wolf Island, and both have similar AQRVs.

The analysis demonstrates that the increase in impacts due to the proposed project is extremely low. Regardless of the existing conditions in the vicinity of the Class I area, the proposed project will not cause any significant adverse effects due to the predicted low impacts upon that area.

6.4.2. *Soils, Vegetation, and AQRV Analysis Methodology*

This analysis uses the maximum air quality impacts predicted to occur in the Class I area due to the proposed increase in emissions. These impacts are presented in Section 2.10, and summarized in Table C-37.

The analysis involved predicting worst-case maximum short- and long-term concentrations of pollutants in the Class I area and comparing the maximum predicted concentrations to lowest observed effect levels for AQRVs or analogous organisms. In conducting the assessment, several assumptions were made as to how pollutants interact with the different matrices, *i.e.*, vegetation, soils, wildlife, and aquatic environment.

A screening approach was used to evaluate potential effects by comparison of the maximum predicted ambient concentrations with effect threshold limits for the pollutants of concern, for both vegetation and wildlife, as reported in the scientific literature. A literature search was conducted which specifically addressed the effects of air contaminants on plant species reported to occur in the vicinity of the plant and the Class I area. It is recognized that effects threshold information is not available for all species found in the Okefenokee NWA, although studies have been performed on other similar species that may be used as models.

6.4.3. *Identification of AQRVs and Methodology*

An AQRV analysis was conducted to assess the potential risk to AQRVs of the Okefenokee NWA due to the proposed GP project. The U.S. Department of the Interior in 1978 administratively defined AQRVs to be:

> *All those values possessed by an area except those that are not affected by changes in air quality and include all those assets of an area whose vitality, significance, or integrity is dependent in some way upon the air environment. These values include visibility and those scenic, cultural, biological, and recreational resources of an area that are affected by air quality.*
>
> *Important attributes of an area are those values or assets that make an area significant as a national monument, preserve, or primitive area. They are the assets that are to be preserved if the area is to achieve the purposes for which it was set aside (Federal Register 1978).*

Except for visibility, AQRVs were not specifically defined. However, odor, soil, flora, fauna, cultural resources, geological features, water, and climate generally have been identified by land managers as AQRVs. Since specific AQRVs have not been identified for the Okefenokee NWA, this AQRV analysis evaluates the effects of air quality on general soil and vegetation types and wildlife found in the Class I area.

Vegetation type AQRVs and their representative species types have been defined as:

- Freshwater Marsh - sawgrass, pickerelweed, and sand cordgrass
- Marsh Islands - cabbage palm and eastern red cedar
- Estuarine Habitat - black needlerush, salt marsh cordgrass, and wax myrtle
- Hardwood Swamp - red maple, red bay, sweet bay, and cabbage palm
- Upland Forests - live oak, scrub oak, longleaf pine, slash pine, wax myrtle, and saw palmetto

Wildlife AQRVs have been identified as endangered species, waterfowl, wading birds, shorebirds, reptiles, and mammals.

The maximum pollutant concentrations predicted for the project in the Okefenokee NWA are presented in Table C-37. These results were compared with effect threshold limits for both vegetation and wildlife as reported in the scientific literature. While the literature search focused on such species as cabbage palm, eastern red cedar, lichens, and species of the hardwood swamplands and mangrove forest, no specific citations that addressed these species were found. Threshold information is not available for all species found in the Class I area, although studies have been performed on a few of the common species and on other similar species that can be used as indicators of effects.

6.4.4. *Impacts to Soils*

For soils, the potential and hypothesized effects of atmospheric deposition include:

- Increased soil acidification,
- Alteration in cation exchange,
- Loss of base cations, and
- Mobilization of trace metals.

The potential sensitivity of specific soils to atmospheric inputs is related to two factors. First, the physical ability of a soil to conduct water vertically through the soil profile is important in influencing the interaction with deposition. Second, the ability of the soil to resist chemical changes, as measured in terms of pH and soil cation exchange capacity (CEC), is important in determining how a soil responds to atmospheric inputs.

The soils of the Okefenokee NWA are generally classified as histosols. Histosols (peat soils) are organic and have extremely high buffering capacities based on their CEC, base saturation, and bulk density. Therefore, they would be relatively insensitive to atmospheric inputs.

The relatively low sensitivity of the soils to atmospheric inputs coupled with the extremely low ground-level pollutant concentrations due to the project for the Okefenokee NWA precludes any significant impact on soils.

6.4.5. *Impacts to Vegetation*

In general, the effects of air pollutants on vegetation occur primarily from SO_2, NO_2, O_3, and PM_{10}. Effects from minor air contaminants such as fluoride, chlorine, hydrogen chloride, ethylene, ammonia, hydrogen sulfide, CO, and pesticides have also been reported in the literature. The effects of air pollutants are dependent both on the concentration of the contaminant and the duration of the exposure. The term "injury," as opposed to damage, is commonly used to describe all plant responses to air contaminants and will be used in the context of this analysis. Air contaminants are thought to interact primarily with plant foliage, which is considered to be the major pathway of exposure.

Injury to vegetation from exposure to various levels or air contaminants can be termed acute, physiological, or chronic. Acute injury occurs as a result of a short-term exposure to a high contaminant concentration and is typically manifested by visible injury symptoms ranging from chlorosis (discoloration) to necrosis (dead areas). Physiological or latent injury occurs as the result of a long-term exposure to contaminant concentrations below that which results in acute injury symptoms. Chronic injury results from repeated exposure to low concentrations over extended periods of time, often without any visible symptoms, but with some effect on the overall growth and productivity of the plant. In this assessment, 100 percent of the particular air pollutant in the ambient air was assumed to interact with the vegetation. This is a conservative approach.

The response of vegetation and wildlife to atmospheric pollutants is influenced by the concentration of the pollutant, duration of exposure, and frequency of exposures. The pattern of pollutant exposure expected from the facility is that of a few episodes of relatively high ground-level concentration which occur during certain meteorological conditions interspersed with long periods of extremely low ground-level concentrations. If there are any effects of stack emissions on plants or animals, they will likely arise from the short-term, higher doses. A dose is the product of the concentration of the pollutant and duration of the exposure.

Nitrogen Dioxide

NO_2 can injure plant tissue with symptoms usually appearing as irregular white to brown collapsed lesions between the leaf veins and near the margins. Conversely, non-injurious levels of NO_2 can be absorbed by plants, enzymatically transformed into ammonia, and incorporated into plant constituents such as amino acids (Matsumaru *et al.*, 1979).

Plant damage can occur through either acute (short-term, high concentration) or chronic (long-term, relatively low concentration) exposure. For plants that have been determined to be more sensitive to NO_2 exposure than others, acute (1-, 4-, and 8-hour) exposure caused 5 percent predicted foliar injury at concentrations ranging from 3,800 to 15,000 $\mu g/m^3$ (Heck and Tingey, 1979). Chronic exposure of selected plants (some considered NO_2-sensitive) to NO_2 concentrations of 2,000 to 4,000 $\mu g/m^3$ for 213 to 1,900 hours caused reductions in yield of up to 37 percent and some chlorosis (Zahn, 1975).

The maximum 8-hour average NO_2 concentration due to the increase in emissions resulting from the proposed projects in the Okefenokee Class I area is predicted to be 0.28 $\mu g/m^3$ (Table C-37). This concentration is less than 0.006 percent of the levels that cause foliage injury in acute exposure scenarios. By comparison of published toxicity values for NO_2 exposure to long-term (annual averaging time) modeled concentrations, the possibility of plant damage in the Class I areas can be examined for chronic exposure situations. For a chronic exposure, the maximum annual average NO_2 concentration due to the proposed projects in the Okefenokee NWA Class I area is 0.0052 $\mu g/m^3$. This concentration is less than 0.0003 percent of the levels that cause foliage injury in chronic exposure scenarios.

Particulate Matter (PM_{10})

Although information pertaining to the effects of PM on plants is scarce, some threshold concentrations are available. Mandoli and Dubey (1998) exposed ten species of native Indian plants to levels of PM ranging from 210 to 366 $\mu g/m^3$ for an 8-hour averaging period. Damage in the form of a higher leaf area/dry weight ratio was observed at varying degrees for most plants tested. Concentrations of PM lower than 163 $\mu g/m^3$ did not appear to be injurious to the tested plants.

By comparison of these published toxicity values for PM exposure (*i.e.*, concentrations for an 8-hour averaging time), the possibility of plant damage in the Okefenokee NWA can be determined. The maximum predicted 8-hour PM_{10} concentration due to the increase in emissions resulting from the proposed project at the Class I area is 0.071 $\mu g/m^3$ (Table C-37). These concentrations are only 0.02 to 0.04 percent of the lower threshold value that reportedly affects plant foliage. As a result, no effects to vegetative AQRVs are expected from the project's emissions.

Carbon Monoxide

As with PM_{10}, information pertaining to the effects of CO on plants is scarce. The main effect of high concentrations of CO is the inhibition of cytochrome *c* oxidase, the terminal oxidase in the mitochondrial electron transfer chain. Inhibition of cytochrome *c* oxidase depletes the supply of adenosine triphosphate (ATP), the principal donor of free energy required for cell functions. However, this inhibition only occurs at extremely high concentrations of CO. Pollok *et al.* (1989) reported that exposure to $CO:O_2$ ratio of 25 (equivalent to an ambient CO concentration of 6.85×10^6 $\mu g/m^3$) resulted in stomatal closure in the leaves of the sunflower (*Helianthus annuus*). Naik *et al.* (1992) reported cytochrome *c* oxidase inhibition in corn, sorghum, millet, and Guinea grass at $CO:O_2$ ratios of 2.5 (equivalent to an ambient CO concentration of 6.85×10^5 $\mu g/m^3$). These plants were considered the species most sensitive to CO-induced inhibition of cytochrome *c* oxidase.

By comparison of published effect values for CO exposure, the possibility of plant damage in the Class I area can be determined. The maximum 1-hour (most conservative) estimated CO concentration due to the increase in emissions resulting from the proposed projects in the Okefenokee NWA Class I area is 2.8 $\mu g/m^3$. This concentration is less than 0.00004 percent of the value that caused inhibition in laboratory studies. The amount of damage sustained at this level (if any) for 1 hour would have negligible effects over an entire growing season. The predicted maximum annual CO concentration of 0.044 $\mu g/m^3$ reflects a more realistic (yet conservative) CO level for the Class I area. This concentration is less than 0.000007 percent of the value that caused cytochrome *c* oxidase inhibition.

Sulfuric Acid Mist

Acidic precipitation or acid rain is coupled to SO_2 emissions mainly formed during the burning of fossil fuels. This pollutant is oxidized in the atmosphere and dissolves in rain forming SAM, which falls as acidic precipitation (Ravera, 1989). Although concentration data are not available, SAM has been reported to yield necrotic spotting on the upper surfaces of leaves (Middleton *et al.*, 1950).

No significant adverse effects on vegetation are expected from the project's emissions because SO_2 concentrations, which lead directly to the formation of SAM concentrations, are predicted to be well below levels which have been documented as negatively affecting vegetation. During the last decade, much attention has been focused on acid rain. Acidic deposition is an ecosystem-level problem that affects vegetation because of some alterations of soil conditions such as increased leaching of essential base cations or elevated concentrations of aluminum in the soil water (Goldstein *et al.*, 1985). Although effects of acid rain in eastern North America have been well published and publicized, detrimental effects of acid rain on Florida vegetation are lacking documentation.

VOC Emissions and Impacts on Ozone

It is difficult to predict what effect the proposed increase in emissions of VOC will have on ambient O_3 concentrations on a regional scale. VOC and NO_x emissions are precursors to the formation of O_3. O_3 is not directly emitted from fuel combustion, but is formed down-wind from emission sources when VOC and NO_x emissions react in the presence of sunlight. Natural (without man-made sources) ambient concentrations of O_3 are normally in the range of 20 to 39 $\mu g/m^3$ (0.01 to 0.02 ppm) (Heath, 1975).

The nearest monitors to the GP Palatka Mill that measure O_3 concentrations are located in Gainesville (AIRS No. 12-001-0025 and 12-001-3011). These stations measure concentrations according to EPA procedures. Based on the O_3 monitoring concentrations measured over the last several years in Gainesville (see Table C-1), the region is in attainment of the existing 1-hour O_3 AAQS as well as the new 8-hour O_3 AAQS.

O_3 can cause various damage to broad-leaved plants including: tissue collapse, interveinal necrosis and markings on the upper surface leaves know as stippling (pigmented yellow, light tan, red brown, dark brown, red, or purple), flecking (silver or bleached straw white), mottling, chlorosis or bronzing, and bleaching. O_3 can also stunt plant growth and bud formation. On certain plants such as citrus, grape, and tobacco, it is common for leaves to wither and drop early.

As described in Section 5.2.5, the VOC emissions due to the proposed GP projects represents less than a 15-percent increase in regional VOC emissions, based on future potential emissions. However, future actual emissions are expected to be lower. Therefore, the effects of O_3, as a result of VOC emissions from the project, are expected to be insignificant.

Summary

In summary, the phytotoxic effects from the project's emissions are minimal. It is important to note that the elements were conservatively modeled with the assumption that 100 percent was available for plant uptake. This is rarely the case in a natural ecosystem.

6.4.6. *Impacts to Wildlife*

The major air quality risk to wildlife in the United States is from continuous exposure to pollutants above the National AAQS. This occurs in non-attainment areas, *e.g.*, Los Angeles Basin. Risks to wildlife also may occur for wildlife living in the vicinity of an emission source that experiences frequent upsets or episodic conditions resulting from malfunctioning equipment, unique meteorological conditions, or startup operations (Newman and Schreiber, 1988). Under these conditions, chronic effects (*e.g.*, particulate contamination) and acute effects (*e.g.*, injury to health) have been observed (Newman, 1981).

A wide range of physiological and ecological effects to fauna has been reported for gaseous and particulate pollutants (Newman, 1981; Newman and Schreiber, 1988). The most severe of these effects have been observed at concentrations above the secondary AAQS. Physiological and behavioral effects have been observed in experimental animals at or below these standards.

For impacts on wildlife, the lowest threshold values of NO_2, PM_{10}, and SO_2 that are reported to cause physiological changes are shown in Table C-41. These values are up to orders of magnitude larger than maximum concentrations predicted due to the GP projects in the Okefenokee NWA Class I area. No effects on wildlife AQRVs from NO_2, CO, and particulates are expected. The proposed project's contribution to cumulative impacts is expected to be negligible.

Research with primates shows that O_3 penetrates deeper into non-ciliated peripheral pathways and can cause lesions in the respiratory bronchioles and alveolar ducts as concentrations increase from 0.2 to 0.8 ppm (Paterson, 1997). These bronchioles are the most common site for severe damage. In rats, the Type I cells in the proximal alveoli (where gas exchange occurs) were the primary site of action at concentrations between 0.5 and 0.9 ppm (Paterson, 1997). Work with rats and rabbits suggest that the mucus layer that lines the large airways does not protect completely against the effects of O_3, and desquamated cells were found from acute exposures at 0.25, 0.5, and 1.0 ppm. In animal research, O_3 has been found to increase the susceptibility to bacterial pneumonia (Paterson, 1997). During the last decade, there has also been growing concern with the possibility that repeated or long-term exposure to elevated O_3 concentrations may be causing or contributing to irreversible chronic lung injury.

The project's contribution to ground level O_3 is expected to be very low and dispersed over a large area. Coupled with the historical ambient data, mobility of wildlife, the potential for exposure of wildlife to the facility's impacts that lead to high concentration is extremely unlikely.

6.5 IMPACTS ON SOILS, VEGETATION AND WILDLIFE – CHASSAHOWITZKA

6.5.1. *Introduction*

The GP Palatka Mill is subject to the PSD new source review requirements for NO_x, PM, PM_{10}, CO, VOC, and SAM. The analysis presented in this section addresses the potential impacts on vegetation, soils, and wildlife of the Chassahowitzka NWA Class I area due to the proposed GP Palatka Mill projects. The Chassahowitzka NWA is located approximately 137 km southwest of the GP Palatka Mill.

The analysis demonstrates that the increase in impacts due to the proposed project is extremely low. Regardless of the existing conditions in the vicinity of the Class I area, the proposed project will not cause any significant adverse effects due to the predicted low impacts upon these areas.

6.5.2. *Soil, Vegetation, and AQRV Analysis Methodology*

This analysis uses the maximum air quality impacts predicted to occur in the Chassahowitzka NWA Class I area due to the increase in the proposed project's emissions. These impacts are summarized in Section 2.10 and Table C-37.

The analysis involved predicting worst-case maximum short- and long-term concentrations of pollutants in the Class I area and comparing the maximum predicted concentrations to lowest observed effect levels for AQRVs or analogous organisms. In conducting the assessment, several assumptions were made as to how pollutants interact with the different matrices, *i.e.*, vegetation, soils, wildlife, and aquatic environment.

A screening approach was used to evaluate potential effects by comparison of the maximum predicted ambient concentrations with effect threshold limits for the pollutant of concern, for vegetation and wildlife, as reported in the scientific literature. A literature search was conducted which specifically addressed the effects of air contaminants on plant species reported to occur in the Class I area. It was recognized that effects threshold information is not available for all species found in the Chassahowitzka NWA, although studies have been performed on a few of the common species and on other similar species, which can be used as models.

6.5.3. *Identification of AQRVs and Methodology*

An AQRV analysis was conducted to assess the potential risk to AQRVs of the Chassahowitzka NWA due to the proposed emissions from the GP project. The U.S. Department of the Interior in 1978 administratively defined AQRVs to be:

> *All those values possessed by an area except those that are not affected by changes in air quality and include all those assets of an area whose vitality, significance, or integrity is dependent in some way upon the air environment. These values include visibility and those scenic, cultural, biological, and recreational resources of an area that are affected by air quality.*
>
> *Important attributes of an area are those values or assets that make an area significant as a national monument, preserve, or primitive area. They are the assets that are to be preserved if the area is to achieve the purposes for which it was set aside (Federal Register, 1978).*

Except for visibility, AQRVs were not specifically defined. However, odor, soil, flora, fauna, cultural resources, geological features, water, and climate generally have been identified by land managers as AQRVs. Since specific AQRVs have not been identified for the Chassahowitzka NWA, this AQRV analysis evaluates the effects of air quality on general soil and vegetation types and wildlife found in the Chassahowitzka NWA.

Vegetation type AQRVs and their representative species types have been defined by the USFWS as:

- Marshlands - black needlerush, saw grass, salt grass, and salt marsh cordgrass
- Marsh Islands - cabbage palm and eastern red cedar
- Estuarine Habitat - black needlerush, salt marsh cordgrass, and wax myrtle
- Hardwood Swamp - red maple, red bay, sweet bay, and cabbage palm
- Upland Forests - live oak, scrub oak, longleaf pine, slash pine, wax myrtle, and saw palmetto
- Mangrove Swamp - red, white, and black mangrove

Wildlife AQRVs have been identified as endangered species, waterfowl, marsh and waterbirds, shorebirds, reptiles, and mammals.

The maximum pollutant concentrations predicted for the proposed GP projects in the Chassahowitzka NWA are presented in Table C-37. These results were compared with effect threshold limits for both vegetation and wildlife as reported in the scientific literature. A literature search was conducted that specifically addressed the effects of air contaminants on plant species reported to occur in the Chassahowitzka NWA. While the literature search focused on such species as cabbage palm, eastern red cedar, lichens, and species of the hardwood swamplands and mangrove forest, no specific citations that addressed these species were found. It is recognized that effect threshold information is not available for all species found in the Chassahowitzka NWA, although studies have been performed on a few of the common species and on other similar species that can be used as indicators of effects.

6.5.4. *Impacts to Soils*

For soils, the potential and hypothesized effects of atmospheric deposition include:

- Increased soil acidification,
- Alteration in cation exchange,
- Loss of base cations, and
- Mobilization of trace metals.

The potential sensitivity of specific soils to atmospheric inputs is related to two factors. First, the physical ability of a soil to conduct water vertically through the soil profile is important in influencing the interaction with deposition. Second, the ability of the soil to resist chemical changes, as measured in terms of pH and soil cation exchange capacity (CEC), is important in determining how a soil responds to atmospheric inputs.

The soils of the Chassahowitzka NWA are generally classified as histosols. According to the U.S. Department of Agriculture (USDA) Soil Surveys of Citrus and Hernando Counties, nine soil complexes are found in the Chassahowitzka NWA. These include Aripeka fine sand, Aripeka-Okeelanta-Lauderhill, Hallendale-Rock outcrop, Homosassa mucky fine sandy loam, Lacooche, Okeelanta mucks, Okeelanta-Lauderdale-Terra Ceia mucks, Rock outcrop-Homosassa-Lacoochee, and Weekiwachee-Durbin mucks (Porter, 1996). The majority of the soil complexes found in the Chassahowitzka NWA are inundated by tidal waters, contain a relatively high organic matter content, and have high buffering capacities based on their CEC, base saturation, and bulk density. The regular flooding of these soils by the Gulf of Mexico regulates the pH and any change in acidity in the soil would be buffered by this activity. Therefore, they would be relatively insensitive to atmospheric inputs. However, Terra Ceia, Okeelanta, and Lauderdale freshwater mucks are present along the eastern border of the Chassahowitzka NWA, and may be more sensitive to atmospheric sulfur deposition (Porter, 1996). Although not tidally influenced, these freshwater mucks are highly organic and, therefore, have a relatively high intrinsic buffering capacity.

The relatively low sensitivity of the soils to atmospheric inputs coupled with the extremely low ground-level pollutant concentrations due to the project at the Chassahowitzka NWA precludes any significant impact on soils.

6.5.5. *Impacts to Vegetation*

In general, the effects of air pollutants on vegetation occur primarily from SO_2, NO_2, O_3, and PM. Effects from minor air contaminants, such as fluoride (F), chlorine, hydrogen chloride, ethylene, ammonia, hydrogen sulfide, CO, and pesticides, have also been reported in the literature. The effects of air pollutants are dependent both on the concentration of the contaminant and the duration of the exposure. The term "injury," as opposed to damage, is commonly used to describe all plant responses to air contaminants and will be used in the context of this analysis. Air contaminants are thought to interact primarily with plant foliage, which is considered to be the major pathway of exposure. For purposes of this analysis, it was assumed that 100 percent of each air contaminant of concern is accessible to the plants.

Injury to vegetation from exposure to various levels or air contaminants can be termed acute, physiological, or chronic. Acute injury occurs as a result of a short-term exposure to a high contaminant concentration and is typically manifested by visible injury symptoms ranging from chlorosis (discoloration) to necrosis (dead areas). Physiological or latent injury occurs as the result of a long-term exposure to contaminant concentrations below that which results in acute injury symptoms. Chronic injury results from repeated exposure to low concentrations over extended periods of time, often without any visible symptoms, but with some effect on the overall growth and productivity of the plant. In this assessment, 100 percent of the particular air pollutant in the ambient air was assumed to interact with the vegetation. This is a conservative approach.

The concentrations of the pollutants, duration of exposure and frequency of exposures influence the response of vegetation and wildlife to atmospheric pollutants. The pattern of pollutant exposure expected from the facility is that of a few episodes of relatively high ground-level concentrations, which occur during certain meteorological conditions interspersed with long periods of extremely low ground-level concentrations. If there are any effects of stack emissions on plants and animals they will be from the short-term, higher doses. A dose is the product of the concentration of the pollutant and duration of the exposure.

Nitrogen Dioxide

NO_2 can injure plant tissue with symptoms usually appearing as irregular white to brown collapsed lesions between the leaf veins and near the margins. Conversely, non-injurious levels of NO_2 can be absorbed by plants, enzymatically transformed into ammonia, and incorporated into plant constituents such as amino acids (Matsumaru *et al.*, 1979).

Plant damage can occur through either acute (short-term, high concentration) or chronic (long-term, relatively low concentration) exposure. For plants that have been determined to be more sensitive to NO_2 exposure than others, acute (1, 4, 8 hours) exposure caused 5 percent predicted foliar injury at concentrations ranging from 3,800 to 15,000 $\mu g/m^3$ (Heck and Tingey, 1979). Chronic exposure of selected plants (some considered NO_2-sensitive) to NO_2 concentrations of 2,000 to 4,000 $\mu g/m^3$ for 213 to 1,900 hours caused reductions in yield of up to 37 percent and some chlorosis (Zahn, 1975).

The maximum 8-hour average NO_2 concentration due to the increase in emissions from the GP project is predicted to be 0.19 $\mu g/m^3$ in the Chassahowitzka NWA (Table C-37). This concentration is less than 0.007 percent of the levels that cause foliar injury in acute exposure scenarios. By comparison of published toxicity values for NO_2 exposure to long-term (annual averaging time) modeled concentrations, the possibility of plant damage in the Chassahowitzka NWA Class I area can be examined for chronic exposure situations. For a chronic exposure, the maximum annual average NO_2 concentration due to the project in the Chassahowitzka NWA Class I area is 0.0027 $\mu g/m^3$. This value is less than 0.0004 percent of the levels that caused minimal yield loss and chlorosis in plant tissue. Average and maximum background 24-hour average concentrations of NO_2 reported in the Chassahowitzka NWA are 0.006 and 0.104 $\mu g/m^3$, respectively.

Although it has been shown that simultaneous exposure to SO_2 and NO_2 results in synergistic plant injury (Ashenden and Williams, 1980), the magnitude of this response is generally only 3 to 4 times greater than either gas alone and usually occurs at unnaturally high levels of each gas. Therefore, the concentrations within the Chassahowitzka NWA are still far below the levels that potentially cause plant injury for either acute or chronic exposure.

Particulate Matter (PM_{10})

Although information pertaining to the effects of PM on plants is scarce, some threshold concentrations are available. Mandoli and Dubey (1998) exposed ten species of native Indian plants to levels of PM ranging from 210 to 366 $\mu g/m^3$ for an 8-hour averaging period. Damage in the form of a higher leaf area/dry weight ratio was observed at varying degrees for most plants tested. Concentrations of PM lower than 163 $\mu g/m^3$ did not appear to be injurious to the tested plants.

By comparison of these published toxicity values for PM exposure (*i.e.*, concentrations for an 8-hour averaging time), the possibility of plant damage in the Chassahowitzka NWA can be determined. The maximum predicted 8-hour PM_{10} concentration due to the increase in emissions resulting from the proposed project at the Chassahowitzka NWA Class I area is 0.045 $\mu g/m^3$ (Table C-37). This concentration is only 0.02 to 0.04 percent of the lower threshold value that reportedly affects plant foliage. As a result, no effects to vegetative AQRVs are expected from the project's emissions.

Carbon Monoxide

As with PM_{10}, information pertaining to the effects of CO on plants is scarce. The main effect of high concentrations of CO is the inhibition of cytochrome *c* oxidase, the terminal oxidase in the mitochondrial electron transfer chain. Inhibition of cytochrome *c* oxidase depletes the supply of ATP, the principal donor of free energy required for cell functions. However, this inhibition only occurs at extremely high concentrations of CO. Pollok *et al.* (1989) reported that exposure to CO:O_2 ratio of 25 (equivalent to an ambient CO concentration of 6.85 x 10^6 µg/m^3) resulted in stomatal closure in the leaves of the sunflower (*Helianthus annuus*). Naik *et al.* (1992) reported cytochrome *c* oxidase inhibition in corn, sorghum, millet, and Guinea grass at CO:O_2 ratios of 2.5 (equivalent to an ambient CO concentration of 6.85 x 10^5 µg/m^3). These plants were considered the species most sensitive to CO-induced inhibition of cytochrome *c* oxidase.

By comparison of published effect values for CO exposure, the possibility of plant damage in the Class I area can be determined. The maximum 1-hour (most conservative) estimated CO concentration due to the increase in emissions resulting from the proposed project in the Chassahowitzka NWA Class I area is 2.5 µg/m^3 (see Table C-37). This concentration is less than 0.00005 percent of the value that caused inhibition in laboratory studies. The amount of damage sustained at this level (if any) for 1 hour would have negligible effects over an entire growing season. The predicted maximum annual CO concentration of 0.03 µg/m^3 reflects a more realistic (yet conservative) CO level for the Class I area. This concentration is less than 0.000007 percent of the value that caused cytochrome *c* oxidase inhibition.

Sulfuric Acid Mist

Acidic precipitation or acid rain is coupled to SO_2 emissions mainly formed during the burning of fossil fuels. This pollutant is oxidized in the atmosphere and dissolves in rain forming SAM, which falls as acidic precipitation (Ravera, 1989). Although concentration data are not available, SAM has been reported to yield necrotic spotting on the upper surfaces of leaves (Middleton *et al.*, 1950).

No significant adverse effects on vegetation are expected from the project's emissions because SO_2 concentrations, which lead directly to the formation of SAM concentrations, are predicted to be well below levels that have been documented as negatively affecting vegetation. During the last decade, much attention has been focused on acid rain. Acidic deposition is an ecosystem-level problem that affects vegetation because of some alterations of soil conditions such as increased leaching of essential base cations or elevated concentrations of aluminum in the soil water (Goldstein *et al.*, 1985). Although effects of acid rain in eastern North America have been well published and publicized, detrimental effects of acid rain on Florida vegetation are lacking documentation.

VOC Emissions and Impacts on Ozone

It is difficult to predict what effect the proposed increase in emissions of VOC will have on ambient O_3 concentrations on a regional scale. VOC and NO_x emissions are precursors to the formation of O_3. O_3 is not directly emitted from fuel combustion, but is formed down-wind from emission sources when VOC and NO_x emissions react in the presence of sunlight. Natural (without man-made sources) ambient concentrations of O_3 are normally in the range of 20 to 39 $\mu g/m^3$ (0.01 to 0.02 ppm) (Heath, 1975).

The nearest monitors to the GP Palatka Mill that measure O_3 concentrations are located in Gainesville (AIRS No. 12-001-0025 and 12-001-3011). These stations measure concentrations according to EPA procedures. Based on the O_3 monitoring concentrations measured over the last several years in Gainesville (see Table C-1), the region is in attainment of the existing 1-hour O_3 AAQS as well as the new 8-hour O_3 AAQS.

O_3 can cause various damage to broad-leaved plants including: tissue collapse, interveinal necrosis and markings on the upper surface leaves know as stippling (pigmented yellow, light tan, red brown, dark brown, red, or purple), flecking (silver or bleached straw white), mottling, chlorosis or bronzing, and bleaching. O_3 can also stunt plant growth and bud formation. On certain plants such as citrus, grape, and tobacco, it is common for leaves to wither and drop early.

As described in subsection 5.2.5, the VOC emissions due to the proposed GP project represent less than a 15-percent increase in regional VOC emissions, based on future potential emissions. However, future actual emissions are expected to be lower. Therefore, the effects of O_3, as a result of VOC emissions from the projects, are expected to be insignificant.

Summary

In summary, the phytotoxic effects from the project's emissions are minimal. It is important to note that the emissions were conservatively modeled with the assumption that 100 percent was available for plant uptake. This is rarely the case in a natural ecosystem.

6.5.6. *Impacts to Wildlife*

The major air quality risk to wildlife in the United States is from continuous exposure to pollutants above the NAAQS. This occurs in non-attainment areas, *e.g.*, Los Angeles Basin. Risks to wildlife also may occur for wildlife living in the vicinity of an emission source that experiences frequent upsets or episodic conditions resulting from malfunctioning equipment, unique meteorological conditions, or startup operations (Newman and Schreiber, 1988). Under these conditions, chronic effects (*e.g.*, particulate contamination) and acute effects (*e.g.*, injury to health) have been observed (Newman, 1981).

A wide range of physiological and ecological effects to fauna has been reported for gaseous and particulate pollutants (Newman, 1981; Newman and Schreiber, 1988). The most severe of these effects have been observed at concentrations above the secondary AAQS. Physiological and behavioral effects have been observed in experimental animals at or below these standards.

For impacts on wildlife, the lowest threshold values of SO_2, NO_2, and particulates that are reported to cause physiological changes are shown in C-41. These values are orders of magnitude larger than maximum concentrations predicted for the GP project at the Chassahowitzka NWA Class I area. No effects on wildlife AQRVs from NO_2, CO and particulates are expected. The proposed project's contribution to cumulative impacts is expected to be negligible.

Research with primates shows that O_3 penetrates deeper into non-ciliated peripheral pathways and can cause lesions in the respiratory bronchioles and alveolar ducts as concentrations increase from 0.2 to 0.8 ppm (Paterson, 1997). These bronchioles are the most common site for severe damage. In rats, the Type I cells in the proximal alveoli (where gas exchange occurs) were the primary site of action at concentrations between 0.5 and 0.9 ppm (Paterson, 1997). Work with rats and rabbits suggest that the mucus layer that lines the large airways does not protect completely against the effects of O_3, and desquamated cells were found from acute exposures at 0.25, 0.5, and 1.0 ppm. In animal research, O_3 has been found to increase the susceptibility to bacterial pneumonia (Paterson, 1997). During the last decade, there has also been growing concern with the possibility that repeated or long-term exposure to elevated O_3 concentrations may be causing or contributing to irreversible chronic lung injury.

The project's contribution to ground level O_3 is expected to be very low and dispersed over a large area. Coupled with the historical ambient data, mobility of wildlife, the potential for exposure of wildlife to the facility's impacts that lead to high concentration is extremely unlikely.

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TABLE C-1
SUMMARY OF BACKGROUND CONCENTRATIONS FOR NO_x, PM_{10} AND OZONE

Pollutant	Monitor Description	Averaging Period	Background Concentration ($\mu g/m^3$)
Ozone	12-001-3011 Alachua County, 200 Savannah – 2003	1-hour	175 [a]
		8-hour	145 [b]
NO_x	12-031-0032 Duval County, 2900 Bennett St – (2002 to 2004)	Annual	27.5
PM_{10}	12-107-1008 Putnam County, Palatka – (1999-2001, 2003-2004)	24-hour	57[c]
		Annual	27[d]

Notes

[a] High-Second-Highest

[b] 3-year average

[c] high, 6th-highest in 5 years

[d] highest, 2002-2004

Source: Florida Department of Environmental Protection. Quick Look Reports. 1999-2004.

TABLE C-2
STRUCTURE DIMENSIONS USED IN THE MODELING ANALYSIS

Structure	Height		Length		Width	
	(ft)	(m)	(ft)	(m)	(ft)	(m)
RB4 Precipitator	85	25.9	123	37.5	58	17.6
RB4 Boiler Building	193.7	59.0	104	31.7	90	27.4
Power Plant Building	107.6	32.8	101	30.8	92	28.0
Pulp Dryer No. 3	84.5	25.8	275	83.7	157	47.9
Pulp Dryer No. 5	70.5	21.5	328	99.9	99	30.3
Pulp Dryer No. 4	73	22.3	265	80.7	125	38.2
Roll Storage Building	52	15.8	464	141.4	346	105.5
Tissue Converting & Finishing (White)	84	25.6	298	90.8	207	63.1
Towel & Napkin Warehouse (Green)	33.5	10.2	434	132.3	424	129.2
Towel & Napkin Converting & Finishing (Yellow)	48	14.6	377	114.9	422	128.6
Towel & Napkin Warehouse (Blue)	40	12.2	464	141.4	641	195.4
Towel & Napkin Warehouse (Gray)	28	8.5	434	132.3	481	146.6
Converting Operations	48	14.6	47	14.3	65	19.8
Building 63	40	12.2	134	40.8	148	45.1
Warehouse Complex 1	62.67	19.1	1,394	424.9	377	114.8
Warehouse Complex 2	46.8	14.3	924	281.5	425	129.5
Nos. 1 and 2 Machines Storage	71.16	21.7	225	68.6	407	124.2
Kraft Converting and Storage	60.75	18.5	310	94.4	524	159.9
Kraft Warehouse and Multi-Wall	56.7	17.3	290	88.4	521	158.7
Digester	62.2	19.0	264	80.4	33	10.1
No. 3 RB Building [a]	100	30.5	61	18.6	34	10.4
No. 2 RB Building [a]	100	30.5	58	17.7	73	22.3

[a] 1974 Baseline Only

TABLE C-3
SIGNIFICANT IMPACT LEVELS AND DE MINIMIS MONITORING CONCENTRATIONS FOR MODELED POLLUTANTS

Pollutant	Averaging Time	Significant Impact Levels ($\mu g/m^3$)	De Minimis Monitoring Concentration ($\mu g/m^3$)
PM_{10}	24-hour	5	10
	Annual	1	--
NO_x	Annual	1	14
CO	1-hour	2,000	--
	8-hour	500	575

Table C-5
Annual Emissions Used in Significant Impact Analysis, Lime Kiln Petcoke Project, GP Palatka

Source Description	Annual Emissions											
	SO_2		NO_x		CO		PM_{10}		TRS		SAM	
	TPY	g/s	TPY	g/s	TPY	g/s	TPY	g/s	TPY	g/s	TPY	g/s
Future Potential Emissions												
Lime Kiln Petcoke Project												
No. 4 Lime Kiln	151.1	4.35	427.0	12.28	71.5	2.06	130.2	3.75	16.3	0.47	6.7	0.19
Petcoke Storage Silo	--	--	--	--	--	--	0.60	0.017	--	--	--	--
Petcoke Truck Traffic	--	--	--	--	--	--	0.24	0.007	--	--	--	--
Other Affected Sources												
No. 4 Combination Boiler - 2.1% S [a]	902.2	25.95	545.1	15.68	1,212.6	34.88	104.7	3.01	--	--	39.7	1.14
Bark Handling System (March 2005)	--	--	--	--	--	--	13.9	0.40	--	--	--	--
No. 4 Recovery Boiler @ 12 ppmvd SO_2 annual	153.9	4.43	738.1	21.23	2,245.6	64.60	248.3	7.14	34.2	0.98	15.9	0.46
No. 4 Smelt Dissolving Tank	33.7	0.97	69.6	2.00	11.4	0.33	49.7	1.43	14.9	0.43	--	--
Black Liquor/Green Liquor Tanks	--	--	--	--	--	--	--	--	3.7	0.11	--	--
Caustic Area	--	--	--	--	--	--	2.6	0.075	5.7	0.16	--	--
Total- Future Potential	**1,240.9**	35.70	**1,779.8**	51.20	**3,541.1**	101.87	**550.2**	15.83	**74.8**	2.15	**62.3**	1.79
Past Actual Emissions[b]												
No. 4 Lime Kiln	8.6	0.25	126.9	3.65	6.2	0.18	38.3	1.10	2.3	0.066	0.4	0.012
No. 4 Combination Boiler	791.9	22.78	422.6	12.16	812.1	23.36	80.7	2.32	0.0	0.000	34.8	1.00
Bark Handling System	--	--	--	--	--	--	10.6	0.30	--	--	--	--
No. 4 Recovery Boiler	11.8	0.34	425.4	12.24	1,110.2	31.94	103.8	2.99	5.8	0.17	1.85	0.053
No. 4 Smelt Dissolving Tank	27.6	0.79	57.1	1.64	9.5	0.27	35.6	1.02	6.2	0.18	--	--
Black Liquor/Green Liquor Tanks	--	--	--	--	--	--	--	--	3.0	0.09	--	--
Caustic Area	--	--	--	--	--	--	1.7	0.049	3.7	0.11	--	--
Total- Past Actual	**839.9**	24.16	**1,032.0**	29.69	**1,938.0**	55.75	**270.7**	7.79	**21.1**	0.61	**37.1**	1.07
CONTEMPORANEOUS EMISSION CHANGES												
New Bleach Plant (6/99) (Permit Nos. 1070005-006, 010 and 019-AC)- startup Feb. 2001												
--Increase Due to New No. 3 Bleach Plant	--	--	--	--	[a]	[a]	--	--	9.00		--	--
--Decrease from Nos. 1 and 2 Bleach Plants	--	--	--	--	[a]	[a]	--	--	-1.20		--	--
MACT I Compliance Project (9/00) (Permit nos. 1070005-007-AC and -017-AC) - startup 2002												
--Increase Due to New Thermal Oxidizer	109.7	3.16	[b]	[b]	8.8	0.25	30.7	0.88	0.89	0.03	7.7	0.22
--Increase Due to Modified No. 4 Comb. Boiler	548.7	15.78	[b]	[b]	--	--	--	--	0.47	0.01	21.9	0.63
--Increase Due to BSW System w/Condensate Treatment	--	--	--	--	--	--	--	--	58.7	1.69	--	--
--Decrease Due to Existing Thermal Oxidizer	-749.8	-21.57	[b]	[b]	-0.30	-0.0086	-20.6	-0.59	-0.30	-0.0086	-26.9	-0.77
--Decrease Due to Existing BSW System w/o Condensate Treatment	--	--	--	--	--	--	--	--	-62.9	-1.81	--	--
New Package Boiler (9/02) (Permit No. 1070005-018-AC) - startup Oct. 2002												
--Increase Due to New Package Boiler (EU 044)	0.1	0.0029	39.4	1.13	16.5	0.47	1.5	0.043	--	--	--	--
--Decrease from old No. 6 Package Boiler	-0.07	-0.0020	-9.2	-0.26	-2.1	-0.060	-0.15	-0.0043	--	--	--	--
Brown Stock Washer and Oxygen Delignification System (7/04) (Permit No. 1070005-024-AC) - not yet started												
--Increase Due to No. 5 Power Boiler	[b]	[b]	--	--	0.3	0.0086	--	--	17.1	0.49	9.5	0.27
--Increase Due to Pulp Storage Tanks	--	--	--	--	--	--	--	--	9.6	0.28	--	--
--Decrease from existing BSW System, BL Filter, etc.	--	--	--	--	--	--	--	--	-77.1	-2.22	--	--
No. 4 Power Boiler Shutdown (Sep. 2003)	**-270.6**	-7.78	-33.65	-0.97	-3.60	-0.10	-15.74	-0.45	--	--	-11.91	-0.34
Total Contemporaneous Emission Changes	**-362.0**	-10.41	**-3.4**	-0.10	19.6	0.56	**-4.3**	-0.12	**-45.7**	-1.32	**0.3**	0.0084

[a] Modeled in previous PSD permitting.

[b] Modeled in previous PCP permit issued for Palatka Mill.

Table C-4

Short-Term Emissions Used in Significant Impact Analysis, Lime Kiln Petcoke Project, GP Palatka

Source Description	Hourly Emissions									
	SO_2		NO_x		CO		PM_{10}		SAM	
	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s	lb/hr	g/s
Future Potential Emissions										
Lime Kiln Petcoke Project										
No. 4 Lime Kiln	34.5	4.35	97.5	12.28	16.3	2.06	29.7	3.75	1.5	0.19
Petcoke Storage Silo	--	--	--	--	--	--	0.14	0.018	--	--
Petcoke Truck Traffic	--	--	--	--	--	--	0.16	0.020	--	--
Other Affected Sources										
No. 4 Combination Boiler - 2.1% S	961.2	121.11	167.4	21.09	307.6	38.76	26.6	3.35	42.3	5.33
Bark Handling System (March 2005)	--	--	--	--	--	--	3.2	0.40	--	--
No. 4 Recovery Boiler @ 12 ppmvd SO2 annual	109.9	13.84	168.5	21.23	1,025.4	129.20	56.7	7.14	3.6	0.46
No. 4 Smelt Dissolving Tank	7.7	0.97	15.9	2.00	2.6	0.33	11.3	1.43	--	--
Black Liquor/Green Liquor Tanks	--	--	--	--	--	--	--	--	--	--
Caustic Area	--	--	--	--	--	--	0.59	0.075	--	--
Total- Future Potential	**1,113.2**	140.27	**449.3**	56.61	**1,351.9**	170.34	**128.4**	16.18	**47.5**	5.98
Past Actual Emissions										
No. 4 Lime Kiln	4.3	0.54	33.7	4.25	1.8	0.23	11.9	1.50	0.21	0.026
No. 4 Combination Boiler	831.8	104.81	114.9	14.48	255.5	32.19	24.2	3.05	36.6	4.61
Bark Handling System	--	--	--	--	--	--	2.42	0.30	--	--
No. 4 Recovery Boiler	4.3	0.54	115.0	14.49	318.0	40.07	39.5	4.98	0.6	0.08
No. 4 Smelt Dissolving Tank	6.8	0.86	14.0	1.76	2.3	0.29	9.2	1.16	--	--
Black Liquor/Green Liquor Tanks	--	--	--	--	--	--	--	--	--	--
Caustic Area	--	--	--	--	--	--	0.39	0.049	--	--
Total- Past Actual	**847.2**	106.75	**277.6**	34.98	**577.6**	72.78	**87.6**	11.04	**37.4**	4.71
CONTEMPORANEOUS EMISSION CHANGES										
New Bleach Plant (6/99) (Permit Nos. 1070005-006, 010 and 019 AC)- startup Feb. 2001										
--Increase Due to New No. 3 Bleach Plant	--	--	--	--	[a]	[a]	--	--	--	--
--Decrease from Nos. 1 and 2 Bleach Plants	--	--	--	--	[a]	[a]	--	--	--	--
MACT I Compliance Project (9/00) (Permit nos. 1070005-007-AC and -017-AC) - startup 2002										
--Increase Due to New Thermal Oxidizer	--	--	[b]	[b]	2.0	0.25	7.0	0.88	--	--
--Increase Due to Modified No. 4 Comb. Boiler	626.4	78.93	[b]	[b]	--	--	--	--	25.1	3.16
--Increase Due to BSW System w/Condensate Treatment	--	--	--	--	--	--	--	--	--	--
--Decrease Due to Existing Thermal Oxidizer	-171.2	-21.57	[b]	[b]	-0.068	-0.009	-4.70	-0.59	-6.1	-0.77
--Decrease Due to Existing BSW System w/o Condensate Treatment	--	--	--	--	--	--	--	--	--	--
New Package Boiler (9/02) (Permit No. 1070005-018-AC) - startup Oct. 2002										
--Increase Due to New Package Boiler (EU 044)	0.15	0.02	48.90	6.16	20.5	2.58	1.9	0.239	--	--
--Decrease from old No. 6 Package Boiler	-0.062	-0.008	-10.43	-1.31	-2.50	-0.315	-0.10	-0.0030	--	--
Brown Stock Washer and Oxygen Delignification System (7/04) (Permit No. 1070005-024-AC) - not yet started										
--Increase Due to No. 5 Power Boiler	[b]	[b]	--	--	0.068	0.0086	--	--	3.30	0.095
--Increase Due to Pulp Storage Tanks	--	--	--	--	--	--	--	--	--	--
--Decrease from existing BSW System, BL Filter, etc.	--	--	--	--	--	--	--	--	--	--
No. 4 Power Boiler Shutdown (Sep. 2003)	-287.3	-36.20	-39.10	-4.93	-4.16	-0.52	-16.91	-2.13	-12.78	-1.61
Total Contemporaneous Emission Changes	**168.0**	21.17	**-0.6**	-0.08	**15.8**	2.00	**-12.8**	-1.61	**9.5**	1.19

[a] Modeled in previous PSD permitting.

[b] Modeled in previous PCP permit issued for Palatka Mill.

TABLE C-6
SOURCE LOCATIONS AND SOURCE PARAMETER DATA USED FOR THE SIGNIFICANT IMPACT ANALYSIS - GP PALATKA MILL

				Stack Parameters							
		UTM NAD27		**Physical**				**Operating**			
Source	**Model**	**East**	**North**	**Height**		**Diameter**		**Temperature**		**Velocity**	
Description	**ID**	**(m)**	**(m)**	**(ft)**	**(m)**	**(ft)**	**(m)**	**(°F)**	**(K)**	**(fps)**	**(m/s)**
No. 4 Lime Kiln	LK4	434106.73	3283246.93	131	39.9	4.4	1.35	164	346.5	70.6	21.51
No. 4 Combination Boiler	CB4	433982.43	3283450.46	237	72.2	8	2.44	466	514	92.3	28.14
No. 4 Recovery Boiler	RB4	433882.28	3283437.93	230	70.1	12	3.66	425	491	65.9	20.08
No. 4 Smelt Dissolving Tanks	SDT4	433934.67	3283477.55	206	62.8	5	1.52	180	355	34.0	10.35
New Themal Oxidizer	TOX	433981.56	3283380.12	250	76.2	3.6	1.10	160	344.3	13.4	4.09
Old TRS Incinerator	TRSB	434083.59	3283347.55	250	76.2	3.1	0.94	533	551.5	105.1	32.03
No. 7 Power Boiler	PB7	433986.18	3283465.92	60	18.3	7.0	2.13	750	672.0	43.5	13.25
No. 6 Power Boiler	PB6B	433992.76	3283466.42	60	18.3	6.0	1.83	660	622.0	57.2	17.43
Petcoke Storage Silo	PETCSTOR	434053.17	3283316.3	115	34.9	1.0	0.30	115	319.3	0.0	0.01
No. 4 Power Boiler	PB4B	433998.01	3283481.49	200	61.0	4	1.22	395	475	71.6	21.83

		UTM NAD27		Area Source Parameters			
Source	Model	East	North	Release Height		Initial Sigma-z	
Description	ID	(m)	(m)	(ft)	(m)	(ft)	(m)
Bark Pile Fugitives	BARKF	433967.81	3283305.26	30	9.1	14.0	4.25

		UTM NAD27		Volume Source Parameters							
Source	Model	East	North	Release Height		Length of Side		Initial Sigma-y		Initial Sigma-z	
Description	ID	(m)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)
Caustic Area	CAUSTIC	434059.87	3283312.76	20	6.1	16.4	5.00	3.8	1.16	4.7	1.42
Petcoke Truck Traffic	PETTKxxx	varies	varies	7.5	2.3	varies	varies	varies	varies	7.0	2.13

TABLE C-7
STATE AND NATIONAL AMBIENT AIR QUALITY STANDARDS FOR MODELED POLLUTANTS

Pollutant	Averaging Time	NAAQS/AAQS ($\mu g/m^3$)	Form of Standard
PM_{10}	24-hour	150	High-sixth-highest for 5 years
	Annual	50	Annual Mean
NO_2	Annual	100	Annual Mean

TABLE C-8
SUMMARY OF MAXIMUM POTENTIAL EMISSIONS FOR PM_{10} - GP PALATKA MILL

			Emission Rates	
Emission Pt ID	**Model ID**	**Source Description**	**(lb/hr)**	**(g/s)**
015	PB5	# 5 Power Boiler	56.89	7.17
016	CB4	# 4 Combination Boiler	26.60	3.35
018	RB4	# 4 Recovery Boiler	56.7	7.14
019	SDT4	# 4 Smelt Dissolving Tanks	11.3	1.42
044	PB7	# 7 Package Boiler	1.90	0.24
017	LK4	# 4 Lime Kiln	29.7	3.75
037	TOX	Thermal Oxidizer	7.00	0.88
	CAUSTIC	Caustic Area	0.59	0.075
	PETCSTOR	Petcoke Storage Silo	0.14	0.018
039	BCYCL	Bark Handling Cyclone	3.2	0.40
039	BARKF	Chip Mill Fugitives	1.2	0.15
No. 5 Tissue Machine Sources				
043	TM5_3	[3] Stock Prep Area Exhaust Fan (FM1)	0.30	0.037
043	TM5_4	[4] Roof Exhaust Fan 776	0.30	0.037
043	TM5_9	[9] Former Area Exhaust Fan 2042	0.30	0.037
043	TM5_5	[5] AirCap Roof Exhaust Fan 2041(FM2)	0.08	0.010
043	TM5_10	[10] Roof Exhaust Fan 902	0.24	0.030
043	TM5_11	[11] Fan 778	0.35	0.045
043	TM5_12	[12] Roof Exhaust Fan 905	0.24	0.030
043	TM5_16	[16] Burner Area Exhaust Fan	0.35	0.045
043	TM5_7	[7] Winder Area Roof Exhaust Fan 2039	0.88	0.111
043	TM5_6	[6] Reel Roof Exhaust Fan 2040 (WND)	0.88	0.111
043	TM5_15	[15] Existing Wet & Dry Yankee Hood (YKD)-burner	1.20	0.151
043	TM5_14	[14] Afterdryer Hood Exhaust (MND)	0.33	0.042
045	CONV1	Converting Operations	0.5667	0.0714
045	CONV2	Converting Operations	0.5667	0.0714
045	CONV3	Converting Operations	0.5667	0.0714
045	TRIM1	Converting Operations	3.6	0.4536
045	TRIM2	Converting Operations	3.6	0.4536
045	TRIM3	Converting Operations	3.8	0.4788
	TM4	No. 4 Tissue Machine Combined Source	0.55	0.0693
	TM3	No. 3 Tissue Machine Combined Source	0.55	0.0693
Roads				
	GATE1***	Traffic Through Gate 1 (1.31 lb/day - 64 sources)	0.05458	0.00688
	GATE2***	Traffic Through Gate 2 (2.83 lb/day - 29 sources)	0.11792	0.01486
	GATE3***	Traffic Through Gate 3 (0.55 lb/day - 41 sources)	0.02292	0.00289
	GATE4***	Traffic Through Gate 4 (23.56 lb/day - 102 sources)	0.98167	0.12369
	GATE5***	Traffic Through Gate 5 (0.55 lb/day - 51 sources)	0.02292	0.00289
	PETTKxxx	New for Petcoke Project	0.16	0.020
Total All Sources:			215.87	27.20

TABLE C-9
SUMMARY OF MAXIMUM POTENTIAL EMISSIONS FOR NOx - GP PALATKA MILL

Emission Pt ID	Model ID	Source Description	Emission Rates (TPY)	Emission Rates (g/s)
015	PB5	# 5 Power Boiler	781.00	22.47
016	CB4	# 4 Combination Boiler	582.90	16.77
018	RB4	# 4 Recovery Boiler	738.1	21.23
019	SDT4	# 4 Smelt Dissolving Tanks	69.6	2.00
044	PB7	# 7 Package Boiler	39.40	1.13
017	LK4	# 4 Lime Kiln	427.0	12.28
043	TM5_15	[15] Existing Wet & Dry Yankee Hood (YKD)-burner	23.65	0.68
	TM4	No. 4 Tissue Machine Combined Source	10.80	0.31
	TM3	No. 3 Tissue Machine Combined Source	10.80	0.31
037	TOX	Thermal Oxidizer	151.36	4.35
Total All Sources:			2834.61	81.54

TABLE C-10
LOCATIONS AND STACK PARAMETERS FOR POINT SOURCES FOR NAAQS IMPACT ANALYSIS - GP PALATKA MILL

		Stack Parameters									
		Source Location UTM		Stack Height		Stack Exit Temp		Stack Velocity		Stack Diameter	
Model ID	Description	East (m)	North (m)	(ft)	(m)	F	K	(fps)	(m/s)	(ft)	(m)
PB5	# 5 Power Boiler	433977.26	3283447.19	237	72.2	413	485	85.9	26.19	8	2.44
CB4	# 4 Combination Boiler	433982.43	3283450.46	237	72.2	466	514	92.3	28.14	8	2.44
RB4	# 4 Recovery Boiler	433882.28	3283437.93	230	70.1	425	491	65.9	20.08	12	3.66
SDT4	# 4 Smelt Dissolving Tanks	433934.67	3283477.55	206	62.8	180	355	34.0	10.35	5	1.52
PB7	# 7 Package Boiler	433986.18	3283465.92	60	18.3	750	672	43.5	13.25	7	2.13
LK4	# 4 Lime Kiln	434106.73	3283246.93	131	39.9	164	346.5	70.6	21.51	4.42	1.35
TOX	Thermal Oxidizer	433981.56	3283380.12	250	76.2	160	344	18.0	5.49	3.6	1.10
PETCSTOR	Petcoke Storage Silo	434053.17	3283316.3	115	34.9	115	319.3	0.0	0.01	1.0	0.30
BCYCL	Bark Handling Cyclone	433966.62	3283485.19	117.6	35.85	77	298	23.6	7.20	3	0.91
TM5_3	TM-5 Stock Prep Area Exhaust Fan (FM1)	434234.62	3283507.73	94	28.65	115	319	39.2	11.94	5.7	1.74
TM5_4	TM-5 Roof Exhaust Fan 776	434245.04	3283495.24	94	28.65	115	319	39.2	11.94	5.7	1.74
TM5_9	TM-5 Former Area Exhaust Fan 2042	434245.04	3283486.71	94	28.65	120	322	39.2	11.94	5.7	1.74
TM5_5	TM-5 AirCap Roof Exhaust Fan 2041(FM2)	434256.99	3283477.82	94	28.65	115	319	39.2	11.94	5.7	1.74
TM5_10	TM-5 Roof Exhaust Fan 902	434255.09	3283473.87	94	28.65	115	319	38.4	11.71	4.7	1.43
TM5_11	TM-5 Fan 778	434258.43	3283468.66	94	28.65	115	319	39.2	11.94	5.7	1.74
TM5_12	TM-5 Roof Exhaust Fan 905	434261.04	3283465.13	94	28.65	115	319	38.4	11.71	4.7	1.43
TM5_16	TM-5 Burner Area Exhaust Fan	434251.74	3283469.22	84	25.60	115	319	39.2	11.94	5.7	1.74
TM5_7	TM-5 Winder Area Roof Exhaust Fan 2039	434280.95	3283445.22	94	28.65	115	319	38.4	11.71	4.7	1.43
TM5_6	TM-5 Reel Roof Exhaust Fan 2040 (WND)	434270.53	3283459.73	94	28.65	115	319	47.1	14.35	5.2	1.58
TM5_15	TM-5 Existing Wet & Dry Yankee Hood (YKD)-burn	434264.95	3283462.34	94	28.65	450	505	64.5	19.66	5	1.52
TM5_14	TM-5 Afterdryer Hood Exhaust (MND)	434266.06	3283458.25	94	28.65	180	355	56.7	17.29	3.8	1.16
CONV1	Converting Operations	434383.27	3283544.38	55.3	16.86	90	305	147.2	44.87	3.1	0.94
CONV2	Converting Operations	434389.22	3283548.48	55.3	16.86	90	305	147.2	44.87	3.1	0.94
CONV3	Converting Operations	434395.36	3283552.94	55.3	16.86	90	305	147.2	44.87	3.1	0.94
TRIM1	Converting Operations	434286.17	3283423.52	55	16.76	90	305	81.2	24.75	2.8	0.85
TRIM2	Converting Operations	434288.13	3283427.44	55	16.76	90	305	81.2	24.75	2.8	0.85
TRIM3	Converting Operations	434282.89	3283423.52	58.3	17.77	90	305	0.03	0.01	2.8	0.85
TM4	No. 4 Tissue Machine Combined Source	434302.09	3283502.61	94	28.65	450	505	64.5	19.66	5	1.52
TM3	No. 3 Tissue Machine Combined Source	434220.66	3283432.68	94	28.65	450	505	64.5	19.66	5	1.52

TABLE C-11
SUMMARY OF MODEL PARAMETERS FOR FUGITIVE SOURCES - GP PALATKA MILL

Model ID	Source Description	Source Location UTM (m)		Release Ht (m)	Computed Initial Dispersion Coefficients (a)	
		East	North		Horizontal	Vertical
BARKF[a]	Chip Mill Fugitives	433967.81	3283305.26	9.14	NA	4.25
CAUSTIC[b]	Caustic Area	434059.87	3283312.76	6.1	1.163	1.42
PETTKxxx[c]	New Petcoke Trucks	Varies	Varies	2.29	varies	2.13
GATE#xxx[c]	All Paved Roads	Varies	Varies	2.29	varies	2.13

[a] Areapoly Source

[b] Volume Source

[c] Line Source Represented by Separated Volume Sources

TABLE C-12
NORTH CAROLINA TECHNIQUE SCREENING ANALYSIS FOR COMPETING SOURCES OF PARTICULATE MATTER

AIRS Number	Owner	Facility	Distance to GP (km)	Threshold (tpy)	Include in PM_{10} NAAQS? Emissions (tpy)	Include in PM_{10} NAAQS? Emission > Threshold?
1070022	Florida Rock Industries, Inc. Putnam	Florida Rock -Comfort Rd	2.3	30.5	0.88	YES[a]
1070030	Georgia-Pacific Corporation	Georgia-Pacific Corp. Palatka Chipnsaw	2.7	37.8	64.3	YES
1070031	Cdr Systems Corporation	Cdr Systems Corporation	2.9	42.8	0.00	NO
1070028	Tarmac Florida, Inc. Palatka	Tarmac Florida, Inc. Palatka	3.0	43.4	0.00	NO
1070043	Price Brothers Company	Palatka Plant	4.0	64.0	39.90	NO
1070025	Seminole Electric Cooperative, Inc.	Seminole Power Plant	7.5	134.6	1884.80	YES
1070039	Lafarge North America, Inc.	Lafarge North America, Inc.	7.7	138.4	221.65	YES
1070014	Florida Power & Light (Ppn)	Putnam Power Plant	10.9	201.1	40.56	NO
1070029	Southern Crematory, Inc.	Watts Funeral Home	12.9	242.8	0.70	NO
0190007	Iluka Resources Inc.	Green Cove Springs	20.9	401.2	209.24	NO
1070038	Johnson-Overturf Funeral Home, Inc.	Johnson-Overturf Funeral Homes Inc	21.6	415.3	1.30	NO
1070041	Masters Funeral Home, P.A.	Palatka Facility	21.7	417.9	1.43	NO
1070007	Florida Rock Industries, Inc. Keuka Plt	Florida Rock Industries, Inc. Keuka Plt	24.5	473.9	21.46	NO
1070001	Feldspar Corp/Edgar Plastic Kaolin Div	Feldspar Corp/Edgar Plastic Kaolin Div	27.7	538.9	38.96	NO
0190027	Florida Rock Industries, Inc. Clay	Florida Rock Industries, Inc. Clay	31.7	618.2	0.00	NO
7775007	Hanson Pipe & Products, Inc.	Hanson Pipe & Products, Inc.	32.2	628.1	0.00	NO
0190031	Vac-Con	Vac-Con	32.7	638.3	0.01	NO
1070040	Delray Stake And Shavings, Inc.	Crescent City Mill	32.8	639.2	53.29	NO
0190068	Mobro Marine, Inc	Green Cove Springs	33.3	650.5	49.90	NO
0190019	Tamko Roofing Products, Inc.	Tamko Roofing Products, Inc.	33.4	652.4	63.06	NO
0190069	Redd Team Manufacturing, Inc.	Keystone Heights	33.4	652.9	24.00	NO
0190056	New Ngc, Inc.	Unifix Usa - National Gypsum Co. - Clay	33.5	654.1	0.02	NO
1090450	Tarmac America, Llc	St. Augustine Ii	33.6	655.1	0.00	NO
0190021	Pyramid Mouldings	Pyramid Mouldings	34.3	670.1	8.92	NO
0190070	Coastal Marine, Inc.	Coastal Marine Inc	34.4	672.2	7.80	NO
1090446	Hicks Trucking & Land Clearing	Hicks Trucking & Land Clearing	34.5	674.5	16.38	NO
7770007	Anderson Columbia, Inc. #9	#9 Ashpalt Plant	34.6	676.3	10.11	NO
1070015	Georgia-Pacific Corp. Plywood Plant	Georgia-Pacific Corp. Plywood Plant	35.7	698.3	232.45	NO
7775083	Pave-Tec, Inc.	Pave-Tec, Inc.	36.7	718.3	7.50	NO
1090037	V.J. Usina Contracting, Inc.	V.J.Usina Contracting, Inc.	37.8	739.6	41.60	NO
1090036	Lakeview Dirt Company, Inc.	Lakeview Dirt Company, Inc.	38.9	761.7	0.00	NO
1090019	Tarmac America, Inc. St. Augustine	Tarmac America, Inc. St. Augustine	38.9	762.4	0.00	NO
1090035	Masters Land Clearing, Inc.	Masters Land Clearing, Inc.	39.0	764.0	0.00	NO
1090444	St. Augustine Memorial Park & Crematory	St. Augustine Memorial Park & Crematory	39.2	767.3	0.75	NO
1090447	Halna, Inc.	Hydro Aluminum Of North America - St. Au	39.4	771.0	19.11	NO
1090018	Florida Rock Industries, Inc. St. Johns	Florida Rock Industries, Inc. St. Johns	39.9	782.0	29.65	NO
7775056	Apac-Southeast, Inc. - First Coast Div.	Apac-Southeast, Inc. -Plant No. 4	40.2	788.9	48.97	NO
0190032	Florida Army National Guard - Camp Blndg	Florida Army National Guard - Camp Blndg	40.7	798.5	7.49	NO
1090011	W.J. Development Corporation	St. Augustine Marine	41.8	819.6	0.00	NO
0190011	E.I. Dupont De Nemours & Co - Trailridge	E.I. Dupont De Nemours & Co - Trailridge	42.1	826.5	153.52	NO
1090015	Florida School For The Deaf & The Blind	Florida School For The Deaf & The Blind	43.7	858.9	3.17	NO
7775261	Florida Rock Industries, Inc.	Portable Redi-Mix	43.8	859.1	0.00	NO
0350002	Tarmac America, Inc. Bunnell	Tarmac America, Inc. Bunnell	44.4	871.0	0.00	NO
0830070	Florida Gas Transmission Company	Fgtc Station 17, Marion County	45.1	886.7	5.62	NO
7770037	Apac-Southeast, Inc. - First Coast Div.	Apac-Southeast Inc., First Coast Div.	45.3	889.3	24.25	NO
0190059	W.W.Carter Contracting	W.W.Carter Contractmasters Road Property	45.7	898.4	4.80	NO
0350004	Rinker Materials Corporation - Bunnell	Rinker Materials Corporation - Bunnell	45.8	900.1	0.00	NO
1090040	Rinker Materials Corporation	Rinker Materials #1 Plant	46.1	906.2	0.00	NO
7775001	American Concrete Products L.C.	American Concrete Products L.C.	47.1	926.1	2.12	NO
0070016	Owen Joist Corporation	Smi Joist Of Florida	49.8	979.0	1.46	NO
0070011	Florida Rock Industries, Inc. Bradford	Florida Rock Industries, Inc. Bradford	50.5	994.9	109.85	NO
0070004	Griffin Industries Of Florida	Griffin Industries Of Florida	50.7	998.8	116.43	NO
0190026	Tarmac Florida, Inc. Orange Park	Tarmac Florida, Inc. Orange Park	50.9	1002.2	0.00	NO
0830094	Bedrock Resources	Bedrock Resources/Citra Mine	51.3	1009.3	2.50	NO
0310225	Southern Culvert Division/Wheeler Cnsl.	Southern Culvert Division/Wheeler Cnsl.	53.0	1043.6	0.01	NO
7775240	Apac-Southeast, Inc. First Coast Divisi	Gainesville Asphalt Plant	53.5	1053.6	3.94	NO
0070001	E.I. Dupont De Nemours & Co Inc Highland	E.I. Dupont De Nemours & Co Inc Highland	54.6	1075.2	145.42	NO
0310462	First Coast Technology & Repair	First Coast Technology & Repair	54.6	1076.0	0.00	NO
7775041	Apac- Southeast, Inc.	Apac-Southeast, Inc.	55.0	1084.5	60.80	NO
1270096	Falcon Industries, Inc.	Falcon Industries, Inc.	55.0	1084.8	0.41	NO
0310208	Standard Precast, Inc.	Standard Precast, Inc.	55.4	1092.7	0.07	NO
0310250	Tarmac America, Inc.	Tarmac America, Inc.	55.5	1093.4	0.37	NO
0830045	Standard Sand & Silica Co	Standard Sand & Silica Co	56.3	1109.7	47.70	NO
0830062	Tru Balance Wheel Weights, Inc.	Tru Balance Wheel Weights, Inc.	56.3	1109.9	0.00	NO
0310277	Rinker Materials Corp.	Rinker Materials Corp.	57.1	1125.0	20.10	NO
0310043	Duval Asphalt Products	Phillips Highway Plant	57.1	1126.6	8.12	NO

TABLE C-12
NORTH CAROLINA TECHNIQUE SCREENING ANALYSIS FOR COMPETING SOURCES OF PARTICULATE MATTER

AIRS Number	Owner	Facility	Distance to GP (km)	Threshold (tpy)	Include in PM_{10} NAAQS? Emissions (tpy)	Emission > Threshold?
0310223	Cemex, Inc.	Cemex, Inc.(Florida Mining Blvd.)	57.6	1135.6	0.91	NO
0310293	Jaxson Brown, Inc.	Sunbeam Road Landfill	58.3	1150.7	0.00	NO
0310026	Atlantic Coast Asphalt, Inc.	Shad Asphalt Plant	58.4	1151.4	23.84	NO
0310171	Florida Rock Industries, Inc.	Capitol Concrete Plant # 3	58.7	1157.5	2.33	NO
0830051	Seilers Concrete	Seilers Concrete	59.0	1163.7	0.05	NO
0310341	Chancey Metal Products, Inc.	Chancey Metal Products, Inc.	59.0	1164.8	0.93	NO
0310215	United States Navy	Nas-Jacksonville	59.4	1172.0	104.01	NO
0010117	Garden Of Love Pet Memorial Park	Micanopy Facility	59.5	1174.8	1.14	NO
7775181	Anderson Materials Company Inc.	Concrete Plant No. 7	60.2	1188.0	15.00	NO
0190005	Gilman Building Products Co.	Gilman Building Products Co.	62.3	1230.3	13.72	NO
0830017	Mfm Industries Inc	Lowell Processing Plant	62.5	1233.3	87.60	NO
0830016	Franklin Industrial Minerals	Franklin Industrial/Lowell	63.0	1243.7	323.40	NO
1250007	Pride Enterprises	Pride - Union Metal	65.4	1292.0	0.00	NO
0830091	Dixie Lime & Stone	Cummer Limestone Mine	65.6	1295.3	10.50	NO
0830145	United States Plastic Lumber	Uspl	65.9	1302.2	0.00	NO
0830069	Delta Laboratories	Delta Laboratories/Ocala	66.8	1320.0	5.70	NO
0830059	Steven Counts, Inc. Fka Harlis Ellington	Steven Counts, Inc. Plant #1	67.0	1323.9	6.05	NO
0830064	Gmp Industries Inc	Aaa Ready Mix	67.0	1324.7	0.14	NO
0310503	Trend Offset Printing Services, Inc.	Trend Offset Printing Services, Inc.	67.5	1334.2	0.18	NO
0830093	Southeastern Mfg	Semco	67.7	1339.0	0.00	NO
0830134	Mickey Body Company	Mickey Body Company/Ocala	68.0	1344.7	0.42	NO
0830039	The Brewer Company	The Brewer Company	68.1	1345.3	147.70	NO
1270161	Prestige Gunite Inc	Prestige Gunite Of Ormond Beach	68.4	1351.2	0.00	NO
1270165	Set Materials Inc	Set Materials Inc	68.4	1351.6	0.88	NO
7770088	Steven Counts, Inc.	Clifton Mine	68.4	1352.2	12.80	NO
0830135	Anderson Columbia Company	Anderson Columbia Co Plant # 8	68.5	1353.8	8.09	NO
1270031	Halifax Paving, Inc.	Halifax Paving/Ormond Beach	68.5	1355.0	74.24	NO
1250008	New River Solid Waste Association	New River Regional Landfill	68.6	1356.1	4.60	NO
0830140	Ocala Lumber Sales Company	Ocala Lumber Sales	69.0	1364.9	0.00	NO
1270102	Florida Production Engineering, Inc.	Florida Production Engineering, Inc.	69.3	1370.2	2.60	NO
0830056	Hiers Funeral Home	Hiers Funeral Home/Ocala	69.7	1378.6	0.00	NO
0830131	Branch Properties Inc	Seminole Stores	69.8	1380.9	19.50	NO
1270090	Imperial Foam & Insulation Mfg. Co.	Imperial Foam & Insulation Mfg	69.9	1382.0	0.00	NO
0830010	Royal Oak Enterprises	Royal Oak Enterprises	70.0	1383.6	101.88	NO
0830007	Dayco Products Inc	Mark Iv Dayco	70.2	1388.0	105.06	NO
0830155	Florida Cremation Society	Florida Cremation Society	70.2	1388.2	2.00	NO
0830001	Counts Construction Company, Inc.	Counts Construction Company, Inc.	70.8	1400.7	0.36	NO
0830026	Cemex, Inc. Fka Southdown	Southdown/Ocala Plant	70.9	1402.2	4.47	NO
0830101	Skyline Corportation	Skyline/Hornette # 535	71.0	1404.9	0.34	NO
0830004	Stewart Enterprises Inc	Roberts Funeral Home	71.1	1405.8	2.00	NO
0830103	Lippert Components Inc	Lippert Components	71.5	1414.9	0.00	NO
0830128	Damar Manufacturing Inc	Damar Manufacturing	71.8	1419.2	1.00	NO
0830102	Skyline Corporation	Skyline/Cameron Homes # 538	71.9	1421.3	13.60	NO
0830100	Skyline Corporation	Skyline/Oak Springs # 531	71.9	1422.4	18.90	NO
0830027	Rinker Materials Corp	Rinker/Ocala	72.1	1426.1	2.29	NO
0830052	Closetmaid Fka Clairson Intl	Closetmaid	72.5	1433.8	21.15	NO
0830043	Golden Flake Snack Foods	Golden Flake Snack Foods	72.7	1437.8	25.72	NO
0830137	Merillat Corp	Merillat/Ocala	73.7	1457.8	1.20	NO
0830132	Florida Rock Industries	Florida Rock/Ocala	74.1	1466.7	0.00	NO
1270016	Rinker Materials Corp	Rinker/Ormond Beach	74.5	1473.2	88.08	NO
0830066	Emergency One, Inc.	Emergency One, Inc. - Body Plant	74.6	1476.5	0.00	NO
0830084	Flair Manufacturing	Flair Manufacturing	76.5	1514.2	0.10	NO
1270074	Crane Cams Inc	Crane Cams	77.7	1537.8	0.00	NO
0830082	Emergency One, Inc.	Emergency One, Inc. - Svo Facility	78.1	1545.1	0.00	NO
0830068	Evans Septic Tank & Ready Mix, Inc.	Evans Septic Tank & Ready Mix	79.0	1564.6	0.00	NO

Notes:

[a] Included in analysis because of proximity to Project

GP Palatka Paper Mill is located at UTM zone 17 coordinates (km):	East	434.0
	North	3283.4

Significant Impact Distance = 0.8 km

TABLE C-13
PM_{10} NAAQS ANALYSIS MODELING PARAMETERES FOR COMPETING SOURCES

Facility Description	Model ID	PM_{10} Emission	Release Height		Stack Diameter		Exit Temperature		Exit Velocity		Volume Source Dimensions (m)	
Stack Description	ID Name	Rate (g/s)	(ft)	(m)	(ft)	(m)	(F)	(K)	(fps)	(m/s)	Sig y	Sig z
1070022 Florida Rock -Comfort Rd												
Concrete Batch Plant (Ready Mix) W/Baghouse	FLROCK	0.025[a]	13	3.96	2	0.55	77	298.2	63	19.20	--	--
1070030 Georgia-Pacific Corp. Palatka Chipnsaw												
Planer Mill Cyclone	CNS04	0.750	80	24.38	7	2.04	68	293.2	18	5.49	--	--
Planer Mill Trim Hog Cyclone	CNS05	0.112	30	9.14	3	0.82	68	293.2	43	13.11	--	--
Chip Bin Cyclone	CNS08	0.066	63	19.2	1	0.40	68	293.2	101	30.66	--	--
Fuel Silo Cyclone	CNS03	0.517	80	24.38	2	0.67	80	299.8	12	3.66	--	--
Kiln 2 Source Vent 1	KILN2_1	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 2 Source Vent 2	KILN2_2	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 2 Source Vent 3	KILN2_3	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 2 Source Vent 4	KILN2_4	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 2 Source Vent 5	KILN2_5	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 2 Source Vent 6	KILN2_6	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 1 Source Vent 1	KILN1_1	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 1 Source Vent 2	KILN1_2	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 1 Source Vent 3	KILN1_3	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 1 Source Vent 4	KILN1_4	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 1 Source Vent 5	KILN1_5	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Kiln 1 Source Vent 6	KILN1_6	0.0105	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
Cutoff Saws	F0103	0.0016	10	3.05	--	--	--	--	--	--	1.585	1.418
Debarker	F02	0.26	10	3.05	--	--	--	--	--	--	1.418	1.418
Mulch Hog + screen	F0405	2.0E-04	15	4.57	--	--	--	--	--	--	1.418	2.127
Mulch & Fuel Bin	F06	3.4E-05	14	4.27	--	--	--	--	--	--	1.736	1.985
Screen	F14	3.2E-03	8	2.44	--	--	--	--	--	--	1.228	1.134
Drum Screen	F15	3.2E-03	20	6.10	--	--	--	--	--	--	0.709	2.835
Chip Bin+Truck Spreader Loading	F1617	3.0E-03	14	4.27	--	--	--	--	--	--	1.736	1.985
Planer Shavings Bin	F22	1.8E-03	14	4.27	--	--	--	--	--	--	1.736	1.985
	F24	4.0E-04	14	4.27	--	--	--	--	--	--	1.736	1.985
1070025 Seminole Electic - Seminole Power Plant												
Steam Electric Generators No. 1 and 2	SEMELECT	54.220	675	205.74	36	10.97	128	326.5	26	7.92	--	--
1070039 Lafarge North America, Inc.												
FGD Surge Bin (55-ton Bin)		0.007	50	15.24	1	0.15	68	293.2	42	12.92	--	--
Imp Mill Feed Silo A		0.007	60	18.29	1	0.15	130	327.6	42	12.92	--	--
Stucco Silo A		0.010	--	--		--	--	--	--	--	--	--
STARCH SILO		0.020	52	15.85	1	0.15	68	293.2	53	16.03	--	--
Norba Grinder and Hammermill System		0.065	50	15.24	1	0.30	68	293.2	64	19.42	--	--
Wallboard Dryer (4 Natural Gas Burners)		0.001	46	14.02	7	2.19	165	347.0	71	21.49	--	--
Ball Mills		0.024	--	--	--	--	--	--	--	--	--	--
Landplaster Bin		0.518	--	--	--	--	--	--	--	--	--	--
Additives System and Pin Mixer		0.259	--	--	--	--	--	--	--	--	--	--
IMP Mill Feed Silo B		0.007	--	--	--	--	--	--	--	--	--	--
Stucco Silo B		0.007	--	--	--	--	120	322.0	--	--	--	--
Cage Mill Flash Dryer System		1.404	--	--	--	--	--	--	--	--	--	--
Composite Stack 1	LNA1	2.327	50	15.24	1	0.15	68	293.2	42	12.92	--	--
Cage mill dryer system		1.404	130	39.62	5	1.55	190	360.9	54	16.43	--	--
Imp Mill Flash Calciner System A		0.281	130	39.62	4	1.22	325	435.9	23	7.10	--	--
Air Cooling System A		1.037	130	39.62	4	1.22	150	338.7	42	12.92	--	--
Imp Mill Flash Calciner System B		0.281	130	39.62	4	1.10	320	433.2	--	--	--	--
Air Cooling System B		1.037	130	39.62	4	1.22	155	341.5	--	--	--	--
Composite Stack 2	LNA2	4.039	130	39.62	4	1.22	325	435.9	23	7.10	--	--

[a] Maximum Potential Emissions

TABLE C-14
NORTH CAROLINA TECHNIQUE SCREENING ANALYSIS FOR COMPETING SOURCES OF NO_x.

AIRS Number	Owner	Facility	Distance to GP (km)	Threshold (tpy)	Include in NO_x NAAQS? Emissions (tpy)	Emission > Threshold?
1070022	Florida Rock Industries, Inc. Putnam	Florida Rock -Comfort Rd	2.3	11.5	0	NO
1070030	Georgia-Pacific Corporation	Georgia-Pacific Corp. Palatka Chipnsaw	2.6	16.3	17	YES[a]
1070031	Cdr Systems Corporation	Cdr Systems Corporation	2.9	23.8	0	NO
1070028	Tarmac Florida, Inc. Palatka	Tarmac Florida, Inc. Palatka	3.0	24.4	0	NO
1070043	Price Brothers Company	Palatka Plant	4.0	45.0	0	NO
1070025	Seminole Electric Cooperative, Inc.	Seminole Power Plant	7.5	115.6	37696	YES
1070039	Lafarge North America, Inc.	Lafarge North America, Inc.	7.7	119.4	163	YES
1070014	Florida Power & Light (Ppn)	Putnam Power Plant	10.9	182.1	876	YES
1070029	Southern Crematory, Inc.	Watts Funeral Home	12.9	223.8	0	NO
0190007	Iluka Resources Inc.	Green Cove Springs	20.9	382.2	67	NO
1070038	Johnson-Overturf Funeral Home, Inc.	Johnson-Overturf Funeral Homes Inc	21.6	396.3	3	NO
1070041	Masters Funeral Home, P.A.	Palatka Facility	21.7	398.9	0	NO
1070007	Florida Rock Industries, Inc. Keuka Plt	Florida Rock Industries, Inc. Keuka Plt	24.5	454.9	0	NO
1070001	Feldspar Corp/Edgar Plastic Kaolin Div	Feldspar Corp/Edgar Plastic Kaolin Div	27.7	519.9	0	NO
0190027	Florida Rock Industries, Inc. Clay	Florida Rock Industries, Inc. Clay	31.7	599.2	0	NO
7775007	Hanson Pipe & Products, Inc.	Hanson Pipe & Products, Inc.	32.2	609.1	0	NO
0190031	Vac-Con	Vac-Con	32.7	619.3	0	NO
1070040	Delray Stake And Shavings, Inc.	Crescent City Mill	32.8	620.2	0	NO
0190068	Mobro Marine, Inc	Green Cove Springs	33.3	631.5	0	NO
0190019	Tamko Roofing Products, Inc.	Tamko Roofing Products, Inc.	33.4	633.4	0	NO
0190069	Redd Team Manufacturing, Inc.	Keystone Heights	33.4	633.9	0	NO
0190056	New Ngc, Inc.	Unifix Usa - National Gypsum Co. - Clay	33.5	635.1	0	NO
1090450	Tarmac America, Llc	St. Augustine Ii	33.6	636.1	0	NO
0190021	Pyramid Mouldings	Pyramid Mouldings	34.3	651.1	0	NO
0190070	Coastal Marine, Inc.	Coastal Marine Inc	34.4	653.2	0	NO
1090446	Hicks Trucking & Land Clearing	Hicks Trucking & Land Clearing	34.5	655.5	0	NO
7770007	Anderson Columbia, Inc. #9	#9 Ashpalt Plant	34.6	657.3	0	NO
1070015	Georgia-Pacific Corp. Plywood Plant	Georgia-Pacific Corp. Plywood Plant	35.7	679.3	0	NO
7775083	Pave-Tec, Inc.	Pave-Tec, Inc.	36.7	699.3	0	NO
1090037	V.J. Usina Contracting, Inc.	V.J.Usina Contracting, Inc.	37.8	720.6	0	NO
1090036	Lakeview Dirt Company, Inc.	Lakeview Dirt Company, Inc.	38.9	742.7	0	NO
1090019	Tarmac America, Inc. St. Augustine	Tarmac America, Inc. St. Augustine	38.9	743.4	0	NO
1090035	Masters Land Clearing, Inc.	Masters Land Clearing, Inc.	39.0	745.0	0	NO
1090444	St. Augustine Memorial Park & Crematory	St. Augustine Memorial Park & Crematory	39.2	748.3	0	NO
1090447	Halna, Inc.	Hydro Aluminum Of North America - St. Au	39.4	752.0	0	NO
1090018	Florida Rock Industries, Inc. St. Johns	Florida Rock Industries, Inc. St. Johns	39.9	763.0	0	NO
7775056	Apac-Southeast, Inc. - First Coast Div.	Apac-Southeast, Inc. -Plant No. 4	40.2	769.9	61	NO
0190032	Florida Army National Guard - Camp Blndg	Florida Army National Guard - Camp Blndg	40.7	779.5	0	NO
1090011	W.J. Development Corporation	St. Augustine Marine	41.8	800.6	0	NO
0190011	E.I. Dupont De Nemours & Co - Trailridge	E.I. Dupont De Nemours & Co - Trailridge	42.1	807.5	34	NO
1090015	Florida School For The Deaf & The Blind	Florida School For The Deaf & The Blind	43.7	839.9	0	NO
7775261	Florida Rock Industries, Inc.	Portable Redi-Mix	43.8	840.1	0	NO
0350002	Tarmac America, Inc. Bunnell	Tarmac America, Inc. Bunnell	44.4	852.0	0	NO
0830070	Florida Gas Transmission Company	Fgtc Station 17, Marion County	45.1	867.7	900	YES
7770037	Apac-Southeast, Inc. - First Coast Div.	Apac-Southeast Inc., First Coast Div.	45.3	870.3	14	NO
0190059	W.W.Carter Contracting	W.W.Carter Contractmasters Road Property	45.7	879.4	0	NO
0350004	Rinker Materials Corporation - Bunnell	Rinker Materials Corporation - Bunnell	45.8	881.1	0	NO
1090040	Rinker Materials Corporation	Rinker Materials #1 Plant	46.1	887.2	0	NO
7775001	American Concrete Products L.C.	American Concrete Products L.C.	47.1	907.1	0	NO
0070016	Owen Joist Corporation	Smi Joist Of Florida	49.8	960.0	0	NO
0070011	Florida Rock Industries, Inc. Bradford	Florida Rock Industries, Inc. Bradford	50.5	975.9	0	NO
0070004	Griffin Industries Of Florida	Griffin Industries Of Florida	50.7	979.8	48	NO
0190026	Tarmac Florida, Inc. Orange Park	Tarmac Florida, Inc. Orange Park	50.9	983.2	0	NO
0830094	Bedrock Resources	Bedrock Resources/Citra Mine	51.3	990.3	23	NO
0310225	Southern Culvert Division/Wheeler Cnsl.	Southern Culvert Division/Wheeler Cnsl.	53.0	1024.6	0	NO
7775240	Apac-Southeast, Inc. First Coast Divisi	Gainesville Asphalt Plant	53.5	1034.6	9	NO
0070001	E.I. Dupont De Nemours & Co Inc Highland	E.I. Dupont De Nemours & Co Inc Highland	54.6	1056.2	0	NO
0310462	First Coast Technology & Repair	First Coast Technology & Repair	54.6	1057.0	0	NO
7775041	Apac- Southeast, Inc.	Apac-Southeast, Inc.	55.0	1065.5	48	NO
1270096	Falcon Industries, Inc.	Falcon Industries, Inc.	55.0	1065.8	0	NO
0310208	Standard Precast, Inc.	Standard Precast, Inc.	55.4	1073.7	0	NO
0310250	Tarmac America, Inc.	Tarmac America, Inc.	55.5	1074.4	0	NO
0830045	Standard Sand & Silica Co	Standard Sand & Silica Co	56.3	1090.7	87	NO
0830062	Tru Balance Wheel Weights, Inc.	Tru Balance Wheel Weights, Inc.	56.3	1090.9	0	NO
0310277	Rinker Materials Corp.	Rinker Materials Corp.	57.1	1106.0	0	NO
0310043	Duval Asphalt Products	Phillips Highway Plant	57.1	1107.6	18	NO

TABLE C-14
NORTH CAROLINA TECHNIQUE SCREENING ANALYSIS FOR COMPETING SOURCES OF NO$_x$.

AIRS Number	Owner	Facility	Distance to GP (km)	Threshold (tpy)	Include in NO$_x$ NAAQS? Emissions (tpy)	Emission > Threshold?
0310223	Cemex, Inc.	Cemex, Inc.(Florida Mining Blvd.)	57.6	1116.6	0	NO
0310293	Jaxson Brown, Inc.	Sunbeam Road Landfill	58.3	1131.7	4	NO
0310026	Atlantic Coast Asphalt, Inc.	Shad Asphalt Plant	58.4	1132.4	45	NO
0310171	Florida Rock Industries, Inc.	Capitol Concrete Plant # 3	58.7	1138.5	0	NO
0830051	Seilers Concrete	Seilers Concrete	59.0	1144.7	0	NO
0310341	Chancey Metal Products, Inc.	Chancey Metal Products, Inc.	59.0	1145.8	0	NO
0310215	United States Navy	Nas-Jacksonville	59.4	1153.0	120	NO
0010117	Garden Of Love Pet Memorial Park	Micanopy Facility	59.5	1155.8	0	NO
7775181	Anderson Materials Company Inc.	Concrete Plant No. 7	60.2	1169.0	0	NO
0190005	Gilman Building Products Co.	Gilman Building Products Co.	62.3	1211.3	6	NO
0830017	Mfm Industries Inc	Lowell Processing Plant	62.5	1214.3	36	NO
0830016	Franklin Industrial Minerals	Franklin Industrial/Lowell	63.0	1224.7	110	NO
1250007	Pride Enterprises	Pride - Union Metal	65.4	1273.0	0	NO
0830091	Dixie Lime & Stone	Cummer Limestone Mine	65.6	1276.3	0	NO
0830145	United States Plastic Lumber	Uspl	65.9	1283.2	0	NO
0830069	Delta Laboratories	Delta Laboratories/Ocala	66.8	1301.0	0	NO
0830059	Steven Counts, Inc. Fka Harlis Ellington	Steven Counts, Inc. Plant #1	67.0	1304.9	4	NO
0830064	Gmp Industries Inc	Aaa Ready Mix	67.0	1305.7	0	NO
0310503	Trend Offset Printing Services, Inc.	Trend Offset Printing Services, Inc.	67.5	1315.2	6	NO
0830093	Southeastern Mfg	Semco	67.7	1320.0	4	NO
0830134	Mickey Body Company	Mickey Body Company/Ocala	68.0	1325.7	4	NO
0830039	The Brewer Company	The Brewer Company	68.1	1326.3	0	NO
1270161	Prestige Gunite Inc	Prestige Gunite Of Ormond Beach	68.4	1332.2	0	NO
1270165	Set Materials Inc	Set Materials Inc	68.4	1332.6	0	NO
7770088	Steven Counts, Inc.	Clifton Mine	68.4	1333.2	17	NO
0830135	Anderson Columbia Company	Anderson Columbia Co Plant # 8	68.5	1334.8	0	NO
1270031	Halifax Paving, Inc.	Halifax Paving/Ormond Beach	68.5	1336.0	78	NO
1250008	New River Solid Waste Association	New River Regional Landfill	68.6	1337.1	11	NO
0830140	Ocala Lumber Sales Company	Ocala Lumber Sales	69.0	1345.9	0	NO
1270102	Florida Production Engineering, Inc.	Florida Production Engineering, Inc.	69.3	1351.2	0	NO
0830056	Hiers Funeral Home	Hiers Funeral Home/Ocala	69.7	1359.6	0	NO
0830131	Branch Properties Inc	Seminole Stores	69.8	1361.9	0	NO
1270090	Imperial Foam & Insulation Mfg. Co.	Imperial Foam & Insulation Mfg	69.9	1363.0	1	NO
0830010	Royal Oak Enterprises	Royal Oak Enterprises	70.0	1364.6	90	NO
0830007	Dayco Products Inc	Mark Iv Dayco	70.2	1369.0	18	NO
0830155	Florida Cremation Society	Florida Cremation Society	70.2	1369.2	3	NO
0830001	Counts Construction Company, Inc.	Counts Construction Company, Inc.	70.8	1381.7	8	NO
0830026	Cemex, Inc. Fka Southdown	Southdown/Ocala Plant	70.9	1383.2	0	NO
0830101	Skyline Corportation	Skyline/Homette # 535	71.0	1385.9	0	NO
0830004	Stewart Enterprises Inc	Roberts Funeral Home	71.1	1386.8	3	NO
0830103	Lippert Components Inc	Lippert Components	71.5	1395.9	0	NO
0830128	Damar Manufacturing Inc	Damar Manufacturing	71.8	1400.2	0	NO
0830102	Skyline Corporation	Skyline/Cameron Homes # 538	71.9	1402.3	0	NO
0830100	Skyline Corporation	Skyline/Oak Springs # 531	71.9	1403.4	0	NO
0830027	Rinker Materials Corp	Rinker/Ocala	72.1	1407.1	0	NO
0830052	Closetmaid Fka Clairson Intl	Closetmaid	72.5	1414.8	17	NO
0830043	Golden Flake Snack Foods	Golden Flake Snack Foods	72.7	1418.8	5	NO
0830137	Merillat Corp	Merillat/Ocala	73.7	1438.8	0	NO
0830132	Florida Rock Industries	Florida Rock/Ocala	74.1	1447.7	0	NO
1270016	Rinker Materials Corp	Rinker/Ormond Beach	74.5	1454.2	0	NO
0830066	Emergency One, Inc.	Emergency One, Inc. - Body Plant	74.6	1457.5	15	NO
0830084	Flair Manufacturing	Flair Manufacturing	76.5	1495.2	0	NO
1270074	Crane Cams Inc	Crane Cams	77.7	1518.8	0	NO
0830082	Emergency One, Inc.	Emergency One, Inc. - Svo Facility	78.1	1526.1	0	NO
0830068	Evans Septic Tank & Ready Mix, Inc.	Evans Septic Tank & Ready Mix	79.0	1545.6	0	NO

Notes:

[a] Included in analysis because of proximity to Project

GP Palatka Paper Mill is located at UTM zone 17 coordinates (km): East 434.0
North 3283.4

Significant Impact Distance = 1.6 km

TABLE C-15
NO$_x$ NAAQS ANALYSIS MODELING PARAMETERS FOR COMPETING SOURCES

Facility Description		Model ID	NO$_x$ Emission	Release Height		Stack Diameter		Exit Temperature		Exit Velocity	
Stack Description		ID Name	Rate (g/s)	(ft)	(m)	(ft)	(m)	(F)	(K)	(fps)	(m/s)
1070030 Georgia-Pacific Corp. Palatka Chipnsaw											
	Kiln 2 Source Vent 1	KILN2_1	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 2 Source Vent 2	KILN2_2	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 2 Source Vent 3	KILN2_3	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 2 Source Vent 4	KILN2_4	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 2 Source Vent 5	KILN2_5	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 2 Source Vent 6	KILN2_6	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 1 Source Vent 1	KILN1_1	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 1 Source Vent 2	KILN1_2	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 1 Source Vent 3	KILN1_3	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 1 Source Vent 4	KILN1_4	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 1 Source Vent 5	KILN1_5	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
	Kiln 1 Source Vent 6	KILN1_6	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02
1070025 Seminole Power Plant											
	Steam Electric Generator No. 1	SEMELECT	1084.40	675	205.74	36	10.97	128	326.5	26	7.92
1070039 Lafarge North America, Inc.											
	Wallboard Dryer (4 Natural Gas Burners)		2.34	46	14.02	7	2.19	165	347.0	71	21.49
	Cage Mill Flash Dryer System		0.83	46	14.02	7	2.19	165	347.0	71	21.49
	Combined Stack 1	LNA1	3.17	46	14.02	7	2.19	165	347.0	71	21.49
	Cage mill dryer system		0.76	130	39.62	5	1.55	190	360.9	54	16.43
	Imp Mill Flash Calciner System A		0.38	130	39.62	4	1.22	325	435.9	23	7.10
	Imp Mill Flash Calciner System B		0.38	130	39.62	4	1.10	320	433.2	23	7.10
	Combined Stack 2	LNA2	1.51	130	39.62	4	1.10	325	435.9	23	7.10
1070014 FPL Putnam Power Plant											
	Ductburners for CC HRSG11, Phase II Acid Rain Unit		6.30	73	22.25	10	3.15	328	437.6	192	58.61
	Ductburners for CC HRSG12, Phase II Acid Rain Unit		6.30	73	22.25	10	3.15	328	437.6	200	61.08
	Ductburners for CC HRSG21, Phase II Acid Rain Unit		6.30	73	22.25	10	3.15	328	437.6	192	58.61
	Ductburners for CC HRSG22, Phase II Acid Rain Unit		6.30	73	22.25	10	3.15	328	437.6	200	61.08
	Combined Stack	FPLPUT	25.20	73	22.25	10	3.15	328	437.6	192	58.61
0830070 FGTC Station 17, Marion County											
	FGTC Engine 1701 - 2000 bhp RICE compressor engine		6.11	28	8.53	1	0.40	875	741.5	147	44.81
	FGTC Engine 1702 - 2000 bhp RICE compressor engine		6.11	28	8.53	1	0.40	875	741.5	147	44.81
	FGTC Engine 1703 - 2000 bhp RICE compressor engine		6.11	28	8.53	1	0.40	875	741.5	147	44.81
	FGTC Engine 1704 - 2000 bhp RICE compressor engine		4.45	28	8.53	1	0.40	875	741.5	147	44.81
	Combined Stack	FGTC1_4	22.78	28	8.53	1	0.40	875	741.5	147	44.81
	FGTC Engine 1705 - 2400 bhp RICE compressor engine	FGTC5	1.33	40	12.19	1	0.40	695	641.5	180	54.86
	FGTC Engine 1706 - 15,700 bhp gas turbine compressor engine	FGTC8	1.78	61	18.59	8	2.32	910	760.9	79	24.11

TABLE C-16
PSD CLASS II INCREMENTS FOR MODELED POLLUTANTS

Pollutant	Averaging Time	Allowable PSD Increment (μg/m^3)	Form of Standard
PM$_{10}$	24-hour	30	High-second-highest for each year
	Annual	17	Annual Mean
NO$_2$	Annual	25	Annual Mean

TABLE C-17
SUMMARY OF PSD CLASS II INCREMENT BASELINE DATES

Pollutant	Major Source Baseline Date	Minor Source Baseline Date
PM_{10}	January 6, 1975	December 27, 1977
NO_2	February 8, 1988	March 28, 1988

TABLE C-18
SUMMARY OF 1974 PM_{10} BASELINE EMISSIONS - GP PALATKA MILL

Model ID	Source Description	Emission Rates (lb/hr)	Emission Rates (g/s)
RB1B	# 1 Recovery Boiler	67.80	8.54
RB2B	# 2 Recovery Boiler	86.60	10.91
RB3B	# 3 Recovery Boiler	93.70	11.81
RB4B	# 4 Recovery Boiler	143.20	18.04
SDT1B	# 1 Smelt Dissolving Tanks	2.10	0.26
SDT2B	# 2 Smelt Dissolving Tanks	3.10	0.39
SDT3B	# 3 Smelt Dissolving Tanks	2.80	0.35
SDT4B	# 4 Smelt Dissolving Tanks	35.10	4.42
LK1B	# 1 Lime Kiln	154.80	19.50
LK2B	# 2 Lime Kiln	81.70	10.29
LK3B	# 3 Lime Kiln	80.00	10.08
LK4B	# 4 Lime Kiln	27.20	3.43
PB4B	# 4 Power Boiler	100.60	12.68
PB5B	# 5 Power Boiler	43.90	5.53
CB4B	# 4 Combination Boiler	612.10	77.12
TM3B	# 3 Tissue Machine Combined Source	1.74	0.219
TM5B	# 5 Tissue Machine Combined Source	1.69	0.213
Roads			
GATE1***	Traffic Through Gate 1 (1.86 lb/day - 64 sources)	0.07750	0.00977
GATE2***	Traffic Through Gate 2 (4.0 lb/day - 29 sources)	0.16667	0.02100
GATE3***	Traffic Through Gate 3 (0.78 lb/day - 41 sources)	0.03250	0.00410
GATE4***	Traffic Through Gate 4 (33.38 lb/day - 102 sources)	1.39083	0.17525
GATE5***	Traffic Through Gate 5 (0.78 lb/day - 51 sources)	0.03250	0.00410
Total Emissions		1539.83	194.02

Note: PM10 assumed 86 percent of total particulates for point source 1974 PSD Baseline emissions
PSD Baseline road emissions are 40.8 lb/day

TABLE C-19
LOCATIONS AND STACK PARAMETERS FOR 1974 PM$_{10}$ PSD BASELINE POINT SOURCES - GP PALATKA MILL

Model ID	Description	Stack Parameters									
		Source Location UTM		Stack Height		Stack Exit Temp		Stack Velocity		Stack Diameter	
		East (m)	North (m)	(ft)	(m)	F	K	(fps)	(m/s)	(ft)	(m)
RB1B	# 1 Recovery Boiler	434053.59	3283407.35	250	76.2	188	360	28.9	8.80	12.0	3.66
RB2B	# 2 Recovery Boiler	434053.59	3283407.35	250	76.2	210	372	28.9	8.80	12.0	3.66
RB3B	# 3 Recovery Boiler	434019.49	3283384.85	133	40.5	210	372	23.9	7.28	11.2	3.41
RB4B	# 4 Recovery Boiler	433882.28	3283437.93	230	70.1	394	474	55.3	16.86	12.0	3.66
SDT1B	# 1 Smelt Dissolving Tanks	434059.29	3283411.15	100	30.5	199	366	24.7	7.53	2.5	0.76
SDT2B	# 2 Smelt Dissolving Tanks	434059.29	3283411.15	100	30.5	215	375	31.2	9.51	3.0	0.91
SDT3B	# 3 Smelt Dissolving Tanks	434025.29	3283388.55	109	33.2	205	369	11.7	3.57	2.5	0.76
SDT4B	# 4 Smelt Dissolving Tanks	433934.67	3283477.55	206	62.8	163	346	27.1	8.26	5.0	1.52
LK1B	# 1 Lime Kiln	434121.89	3283301.05	50	15.2	262	401	17.2	5.24	4.2	1.28
LK2B	# 2 Lime Kiln	434117.39	3283298.85	52	15.8	154	341	35	10.67	5.6	1.71
LK3B	# 3 Lime Kiln	434119.29	3283270.45	52	15.8	156	342	27.8	8.47	5.6	1.71
LK4B	# 4 Lime Kiln	434106.73	3283246.93	149	45.4	172	351	54.0	16.46	4.3	1.31
PB4B	# 4 Power Boiler	433998.01	3283481.49	122	37.2	399	477	47.7	14.54	4.0	1.22
PB5B	# 5 Power Boiler	433977.26	3283447.19	232	70.7	476	520	52.4	15.97	9.0	2.74
CB4B	# 4 Combination Boiler	433982.43	3283450.46	237	72.2	399	477	34.5	10.52	10.0	3.05
TM3B	# 3 Tissue Machine Combined Source	434220.66	3283432.68	94	28.65	450	505	64.5	19.66	5.0	1.52
TM5B	# 5 Tissue Machine Combined Source	434264.95	3283462.34	94	28.65	450	505	64.5	19.66	5.0	1.52

TABLE C-20
SUMMARY OF 1988 PSD BASELINE NO_x EMISSIONS - GP PALATKA MILL

Model ID	Source Description	Emission Rates (lb/hr)	Emission Rates (g/s)
RB4B	# 4 Recovery Boiler	117.40	14.80
SDT4B	# 4 Smelt Dissolving Tanks	2.66	0.34
LK4B	# 4 Lime Kiln	47.44	5.98
PB4B	# 4 Power Boiler	21.77	2.74
PB5B	# 5 Power Boiler	108.02	13.62
CB4B	# 4 Combination Boiler	56.40	7.11
TM3B	# 3 Tissue Machine Combined Source	10.77	1.36
TM4B	# 4 Tissue Machine Combined Source	10.77	1.36
TM5B	# 5 Tissue Machine Combined Source	7.57	0.95
Total Emissions		382.80	48.27

TABLE C-21
LOCATIONS AND STACK PARAMETERS FOR 1988 BASELINE SOURCES - GP PALATKA MILL

		Stack Parameters									
		Source Location UTM		Stack Height		Stack Exit Temp		Stack Velocity		Stack Diameter	
Model ID	Description	East (m)	North (m)	(ft)	(m)	F	K	(fps)	(m/s)	(ft)	(m)
RB4B	# 4 Recovery Boiler	433882.28	3283437.93	230	70.1	400	478	63.7	19.42	12.0	3.66
SDT4B	# 4 Smelt Dissolving Tanks	433934.67	3283477.55	206	62.8	160	344	21.2	6.46	5.0	1.52
LK4B	# 4 Lime Kiln	434106.73	3283246.93	131	39.9	150	339	60.8	18.53	4.3	1.31
PB4B	# 4 Power Boiler	433998.01	3283481.49	122	37.2	395	475	71.6	21.82	4.0	1.22
PB5B	# 5 Power Boiler	433977.26	3283447.19	232	70.7	445	503	60.6	18.47	9.0	2.74
CB4B	# 4 Combination Boiler	433982.43	3283450.46	237	72.2	440	500	71.8	21.88	10.0	3.05
TM3B	# 3 Tissue Machine Combined Source	434220.66	3283432.68	94	28.65	450	505	64.5	19.66	5.0	1.52
TM5B	# 5 Tissue Machine Combined Source	434264.95	3283462.34	94	28.65	450	505	64.5	19.66	5.0	1.52
TM4B	No. 4 Tissue Machine Combined Source	434302.09	3283502.61	94	28.65	450	505	64.5	19.66	5.0	1.52

TABLE C-22
SUMMARY OF PSD-CONSUMING EMISSIONS FROM COMPETING SOURCES

AIRS Number	Owner	Facility	Emissions Affecting Increment (tpy)	
			PM_{10}	NO_x
1070022	Florida Rock Industries, Inc. Putnam	Florida Rock -Comfort Rd	0.9	-
1070030	Georgia-Pacific Corporation	Georgia-Pacific Corp. Palatka Chipnsaw	62.3	17.2
1070025	Seminole Electric Cooperative, Inc.	Seminole Power Plant	1884.8	37695.8
1070039	Lafarge North America, Inc.	Lafarge North America, Inc.	221.4	162.7

TABLE C-23
PSD INCREMENTS ANALYSES MODELING PARAMETERS FOR COMPETING SOURCES

Facility Description		Model ID	Emission Rate (g/s)		Release Height		Stack Diameter		Exit Temperature		Exit Velocity		Volume Source Dimensions (m)	
Stack Description		ID Name	PM_{10}	NO_x	(ft)	(m)	(ft)	(m)	(F)	(K)	(fps)	(m/s)	Sig y	Sig Z
1070022 Florida Rock -Comfort Rd														
	Concrete Batch Plant (Ready Mix) W/Baghouse	FLROCK	0.025	--	13	3.96	2	0.55	77	298.2	63	19.20	--	--
1070030 Georgia-Pacific Corp. Palatka Chipnsaw														
	Planer Mill Cyclone	CNS04	0.75	--	80	24.38	7	2.04	68	293.15	18	5.49	--	--
	Planer Mill Trim Hog Cyclone	CNS05	0.112	--	30	9.14	3	0.82	68	293.15	43	13.11	--	--
	Chip Bin Cyclone	CNS08	0.066	--	63	19.2	1	0.4	68	293.15	101	30.66	--	--
	Fuel Silo Cyclone	CNS03	0.517	--	80	24.38	2	0.67	80	299.82	12	3.66	--	--
	Kiln 2 Source Vent 1	KILN2_1	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 2 Source Vent 2	KILN2_2	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 2 Source Vent 3	KILN2_3	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 2 Source Vent 4	KILN2_4	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 2 Source Vent 5	KILN2_5	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 2 Source Vent 6	KILN2_6	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 1 Source Vent 1	KILN1_1	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 1 Source Vent 2	KILN1_2	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 1 Source Vent 3	KILN1_3	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 1 Source Vent 4	KILN1_4	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 1 Source Vent 5	KILN1_5	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Kiln 1 Source Vent 6	KILN1_6	0.0105	0.0412	31	9.45	3	0.80	210	372.0	6.6	2.02	--	--
	Cutoff Saws	F0103	0.0016	--	--	--	--	--	--	--	--	--	1.585	1.418
	Debarker	F02	0.26	--	--	--	--	--	--	--	--	--	1.418	1.418
	Mulch Hog + screen	F0405	2.0E-04	--	--	--	--	--	--	--	--	--	1.418	2.127
	Mulch & Fuel Bin	F06	3.4E-05	--	--	--	--	--	--	--	--	--	1.736	1.985
	Screen	F14	3.2E-03	--	--	--	--	--	--	--	--	--	1.228	1.134
	Drum Screen	F15	3.2E-03	--	--	--	--	--	--	--	--	--	0.709	2.835
	Chip Bin+Truck Spreader Loading	F1617	3.0E-03	--	--	--	--	--	--	--	--	--	1.736	1.985
	Planer Shavings Bin	F22	1.8E-03	--	--	--	--	--	--	--	--	--	1.736	1.985
	Planer Mill Fugitives	F24	4.0E-04	--	--	--	--	--	--	--	--	--	1.736	1.985
1070025 Seminole Electic - Seminole Power Plant														
	Steam Electric Generators No. 1 and 2	SEMELECT	54.220	1084.400	675	205.74	36	10.97	128	326.5	26	7.92	--	--
1070039 Lafarge North America, Inc.														
	Composite Stack 1	LNA1	2.330	3.170	50	15.24	1	0.15	68	293.2	42	12.92	--	--
	Composite Stack 2	LNA2	4.040	1.510	130	39.62	4	1.22	325	435.9	23	7.10	--	--

TABLE C-24
SIGNIFICANT IMPACT ANALYSIS RESULTS FOR PM_{10}

Averaging Period	Year	Maximum Predicted Impact (μg/m^3)	Receptor Location[a] East (m)	Receptor Location[a] North (m)	Period Ending (YYMMDDHH)	Significant Impact Level (μg/m^3)	Monitoring de Minimis Concentration (μg/m^3)
24-hour High 1st High	1986	6.6	434277	3282907	86110224	5	10
	1987	7.4	434514	3283109	87010224		
	1988	7.4	434380	3283009	88022124		
	1989	7.0	434300	3282949	89021024		
	1990	6.4	434380	3283009	90012224		
Annual	1986	1.99	434514	3283109	86123124	1	--
	1987	2.20	434514	3283109	87123124		
	1988	2.00	434487	3283089	88123124		
	1989	2.04	434514	3283109	89123124		
	1990	1.74	434514	3283109	90123124		

Note:

[a] UTM coordinates in Zone 17

YY =Year, MM=Month, DD=Day, HH=Hour

TABLE C-25
SIGNIFICANT IMPACT ANALYSIS RESULTS FOR NO_2

Averaging Period	Year	Maximum Predicted Impact ($\mu g/m^3$)	Receptor Location[a]		Significant Impact Level ($\mu g/m^3$)	Monitoring de Minimis Concentration ($\mu g/m^3$)
			East (m)	North (m)		
Annual	1986	3.31	434380	3283009	1	14
	1987	4.30	434420	3283039		
	1988	3.95	434380	3283009		
	1989	3.49	434354	3282989		
	1990	2.68	434354	3282989		

Note:

[a] **UTM coordinates in Zone 17**

TABLE C-26
SIGNIFICANT IMPACT ANALYSIS RESULTS FOR CO

Averaging Period	Year	Maximum Predicted Impact (µg/m^3)	Receptor Location[a]		Period Ending (YYMMDDHH)	Significant Impact Level (µg/m^3)	Monitoring de Minimis Concentration (µg/m^3)
			East (m)	North (m)			
1-hour High 1st High	1986	91.7	434487	3283089	86031408	2000	--
	1987	92.2	434460	3283069	87010116		
	1988	92.3	434460	3283069	88112809		
	1989	93.2	434487	3283089	89092119		
	1990	91.9	434460	3283069	90011220		
8-hour High 1st High	1986	58.6	434484	3282948	86012724	500	575
	1987	82.0	434487	3283089	87122908		
	1988	62.5	434487	3283089	88031908		
	1989	75.3	434487	3283089	89022408		
	1990	58.5	434484	3283048	90012608		

Note:

[a] UTM coordinates in Zone 17

YY =Year, MM=Month, DD=Day, HH=Hour

TABLE C-27
SUMMARY OF SIGNIFICANT IMPACT DISTANCE RESULTS

Pollutant	**Significant Impact Distance (km)**
NO_2	1.75
PM_{10}	0.8
CO	not significant

TABLE C-28
PM_{10} NAAQS SCREENING ANALYSIS RESULTS

Averaging Period	Year	Maximum Predicted Impact ($\mu g/m^3$)	Receptor Location[a]		Period Ending (YYMMDDHH)
			East (m)	North (m)	
Annual	1986	8.23	434513.69	3283108.5	--
	1987	9.03	434513.69	3283108.5	--
	1988	8.67	434513.69	3283108.5	--
	1989	8.80	434513.69	3283108.5	--
	1990	7.37	434513.69	3283108.5	--
24-Hour High 6th High	1988	30.06	434513.69	3283108.5	88042824

Note:

[a] UTM coordinates in Zone 17

YY =Year, MM=Month, DD=Day, HH=Hour

TABLE C-29
PM_{10} NAAQS TOTAL RESULTS

Averaging Period	Maximum Predicted Impact (mg/m^3)	Background Concentration (µg/m^3)	Total Concentration (µg/m^3)	NAAQS (µg/m^3)
Annual	9.03	27	36.0	50
24-Hour High 6th High	30.06	57	87.1	150

TABLE C-30
NO_2 NAAQS ANALYSIS RESULTS

Averaging Period	Year	Maximum Predicted Impact ($\mu g/m^3$)	Receptor Location[a]	
			East (m)	North (m)
Annual	1986	11.28	434487	3283089
	1987	14.12	434460	3283069
	1988	12.46	434420	3283039
	1989	11.68	434487	3283089
	1990	9.43	434540	3283129

Note:

[a] **UTM coordinates in Zone 17**

TABLE C-31
NO_2 NAAQS TOTAL RESULTS

Averaging Period	Maximum Predicted Impact (μg/m^3)	Background Concentration (μg/m^3)	Total Concentration (μg/m^3)	NAAQS (μg/m^3)
Annual	14.12	27.5	41.6	100

TABLE C-32
PM_{10} PSD CLASS II INCREMENT ANALYSIS RESULTS

Averaging Period	Year	Maximum Predicted Impact ($\mu g/m^3$)	Receptor Location (a)		Period Ending (YYMMDDHH)	Allowable Increment ($\mu g/m^3$)
			East (m)	North (m)		
Annual	1986	<0	0	0	--	17
	1987	<0	0	0	--	
	1988	<0	0	0	--	
	1989	<0	0	0	--	
	1990	<0	0	0	--	
24-Hour High 2nd High	1986	4.7	434540	3283129	86122024	30
	1987	4.4	434580	3283159	87052924	
	1988	6.1	434580	3283159	88120524	
	1989	5.1	434514	3283109	89112524	
	1990	3.1	434620	3283189	90011724	

Note:

[a] UTM coordinates in Zone 17

YY =Year, MM=Month, DD=Day, HH=Hour

TABLE C-33
NO_2 PSD CLASS II INCREMENT ANALYSIS RESULTS

Averaging Period	Year	Maximum Predicted Impact ($\mu g/m^3$)	Receptor Location (a)		Allowable Increment ($\mu g/m^3$)
			East (m)	North (m)	
Annual	1986	5.5	434487	3283089	25
	1987	7.0	434460	3283069	
	1988	5.9	434420	3283039	
	1989	5.6	434487	3283089	
	1990	4.7	434487	3283089	

Note:

[a] UTM coordinates in Zone 17

TABLE C-34
REFINED MODELING ANALYSES RECOMMENDATIONS[a]

Model Input/Output	Description
Meteorology	Use CALMET (minimum 6 to 10 layers in the vertical; top layer must extend above the maximum mixing depth expected); horizontal domain extends 50 to 80 km beyond outer receptors and sources being modeled; terrain elevation and land-use data is resolved for the situation.
Receptors	Within Class I area(s) of concern; obtain regulatory concurrence on coverage.
Dispersion	1. CALPUFF with default dispersion settings.
	2. Use MESOPUFF II chemistry with wet and dry deposition.
	3. Define background values for ozone and ammonia for area.
Processing	1. For PSD increments: use highest, second highest 3-hour and 24-hour average SO_2 concentrations; highest, second highest 24-hour average PM_{10} concentrations; and highest annual average SO_2, PM_{10}, and NO_x concentrations.
	2. For haze: process, on a 24-hour basis, compute the source extinction from the maximum increase in emissions of SO_2, NO_x, and PM_{10}; compute the daily relative humidity factor [f(RH)], provided from an external disk file; and compute the maximum percent change in extinction using the FLM supplied background extinction data in the FLAG document.
	3. For significant impact analysis: use highest annual and highest short-term averaging time concentrations for SO_2, PM_{10}, and NO_x.

[a] IWAQM Phase II report (December, 1998) and FLAG document (December, 2000).

TABLE C-35
CALPUFF MODEL SETTINGS

Parameter	Setting
Pollutant Species	SO_2, SO_4, NO_x, HNO_3, NO_3, PM_{10}.
Chemical Transformation	MESOPUFF II scheme including hourly ozone data.
Deposition	Include both dry and wet deposition, plume depletion.
Meteorological/Land Use Input	CALMET
Plume Rise	Transitional, Stack-tip downwash, Partial plume penetration.
Dispersion	Puff plume element, PG /MP coefficients, rural mode, ISC building downwash scheme.
Terrain Effects	Partial plume path adjustment.
Output	Create binary concentration file including output species for SO_4, NO_3, PM_{10}, SO_2, and NO_x; process for visibility change using Method 2 and FLAG background extinctions.
Model Processing	For haze: highest predicted 24-hour extinction change (%) for the year.
	For significant impact analysis: highest predicted annual and highest short-term averaging time concentrations for SO_2, NO_x, and PM_{10}.
Background Values	Ozone: 50 ppb; Ammonia: 1 ppb.

TABLE C-36
SURFACE AND UPPER AIR STATIONS USED IN THE NORTH CENTRAL FLORIDA SOUTH GEORGIA DOMAIN

Station Name	Station Symbol	WBAN Number	UTM Coordinates			Anemometer Height (m)
			Easting (km)	Northing (km)	UTM Zone	
Surface Stations						
Tampa, FL	TPA	12842	349.195	3094.289	17	10
Jacksonville, FL	JAX	13889	432.809	3374.192	17	10
Daytona Beach, FL	DAB	12834	495.118	3228.056	17	10
Tallahassee, FL	TLH	93805	176.408[a]	3365.835	16	10
Fort Myers. F L	FMY	12835	413.644	2940.405	17	10
Orlando, FL	MCO	12815	468.942	3146.889	17	10
Pensacola, FL	PNS	13899	-95.74	3386.714	16	10
Vero Beach, FL	VRB	12843	557.487	3058.363	17	10
Columbus, GA	CSG	93842	128.871[a]	3604.422	16	10
Charleston, SC	CHS	13880	590.422	3640.405	17	10
Macon, GA	MCN	3813	251.562	3620.929	17	10
Savannah, GA	SAV	3822	481.12	3554.985	17	10
Gainesville, FL	GNV	12816	377.39	3284.126	17	10
Augusta, GA	AGS	3820	410.024	3692.184	17	10
Athens, GA	AHN	13873	285.867	3758.824	17	10
Atlanta, GA	ATL	13874	181.588[a]	3728.434	16	10
Sea Surface Stations						
Venice, FL	VENF1	-	356.24	2995.05	17	--
Cape Canaveral, FL	41009	-	380.25	3152.87	17	--
Tampa West, FL	42036	-	156.41	3158.73	16	--
Cedar Key, FL	CDRF1	-	302.52	3225.2	17	--
Cape San Blas, FL	CSBF1	-	77.89	3290.18	16	--
Folly Island, SC	FBIS1	-	604.09	3616.38	17	--
Keaton Beach, FL	KTNF1	-	249.71	3301.66	17	--
Lake Worth, FL	LKWF1	-	596.57	2943.61	17	--
Savannah, GA	SVLS1	-	530.24	3534.94	17	--
St. Augustine, FL	SAUF1	-	474.89	3303.3	17	--
Upper Air Stations						
Ruskin, FL	TPA	12842	361.961	3064.616	17	NA
Waycross, GA	AYS	13861	366.674	3457.945	17	NA
Athens, GA	AHN	13873	285.866	3758.824	17	NA
Charleston, SC	CHS	13880	590.421	3640.405	17	NA
Cape Canaveral	XMR	12868	544.048	3150.459	17	NA
Miami -FIU	MFL	92803	562.181	2847.983	17	NA
Apalachicola, FL	AQQ	12832	109.807[a]	3295.816	16	NA
Tallahassee, FL	TLH	93805	176.4072	3365.835	16	NA
Jacksonville, FL	JAX	13889	432.808	3374.192	17	NA
Peachtree, GA	FFC	53819	155.6372	3696.207	16	NA

[a] Equivalent coordinate for Zone 17.

TABLE C-37
SUMMARY OF MAXIMUM POLLUTANT CONCENTRATIONS PREDICTED FOR THE PROPOSED GP AND CONTEMPORANEOUS PROJECTS

Pollutant	Averaging Time	Concentrations [a] ($\mu g/m^3$)									EPA Class I Significant Impact Levels ($\mu g/m^3$)
		Okefenokee NWA			Wolf Island NWA			Chassahowitzka NWA			
		1990	1992	1996	1990	1992	1996	1990	1992	1996	
PM_{10}	Annual	0.0015	0.0010	0.0015	0.0006	0.0007	0.0005	0.0011	0.0010	0.0010	0.2
	24-Hour	0.040	0.019	0.026	0.011	0.024	0.008	0.016	0.016	0.025	0.3
	8-Hour	0.071	0.044	0.068	0.022	0.036	0.015	0.033	0.039	0.045	
	3-Hour	0.105	0.092	0.101	0.034	0.042	0.028	0.045	0.068	0.083	
	1-Hour	0.129	0.158	0.146	0.048	0.046	0.037	0.051	0.072	0.086	
NO_2	Annual	0.0040	0.0032	0.0052	0.0014	0.0017	0.0012	0.0022	0.0027	0.0026	0.1
	24-Hour	0.0988	0.0876	0.1018	0.0482	0.0461	0.0280	0.058	0.062	0.0780	
	8-Hour	0.2157	0.1985	0.2806	0.1013	0.0952	0.0764	0.141	0.162	0.1870	
	3-Hour	0.3006	0.2741	0.4328	0.1930	0.1309	0.1538	0.169	0.200	0.3009	
	1-Hour	0.3611	0.3086	0.5264	0.2679	0.1507	0.1941	0.213	0.271	0.3434	
CO	Annual	0.0435	0.0386	0.0440	0.0222	0.0291	0.0201	0.0310	0.0291	0.0273	NA
	24-Hour	0.7900	0.9617	0.8745	0.3632	0.6683	0.3095	0.447	0.533	0.7401	
	8-Hour	1.3208	1.5363	1.9255	0.7698	0.8130	0.5922	0.932	0.940	1.2679	
	3-Hour	1.7940	2.3998	2.4185	1.1505	1.1530	1.0878	1.137	1.176	2.3329	
	1-Hour	2.1795	2.6888	2.8293	1.5244	1.2359	1.5178	1.358	1.700	2.4958	
SAM	Annual	0.0026	0.0023	0.0025	0.0016	0.0018	0.0014	0.0023	0.0020	0.0016	NA
	24-Hour	0.0536	0.0585	0.0509	0.0406	0.0390	0.0275	0.039	0.059	0.0433	
	8-Hour	0.1061	0.1126	0.0969	0.1052	0.0998	0.0560	0.078	0.150	0.0716	
	3-Hour	0.1908	0.1951	0.1430	0.1219	0.1172	0.0771	0.126	0.196	0.1081	
	1-Hour	0.2198	0.2758	0.1792	0.1257	0.1323	0.0908	0.138	0.222	0.1304	

NWA= National Wilderness Area

[a] Concentrations are the highest impacts predicted with the CALPUFF model and 1990, 1992, and 1996 CALMET Wind Fields.

NA = Not Applicable

TABLE C-38
MAXIMUM 24-HOUR AVERAGE VISIBILITY IMPAIRMENT PREDICTED FOR THE PROPOSED GP AND CONTEMPORANEOUS PROJECTS EMISSIONS AT THE OKEFENOKEE, WOLF ISLAND AND CHASSAHOWITZKA NWA PSD CLASS I AREAS

Area	**Visibility Impairment (%) [a]**			**Visibility Impairment Criteria (%)**
	1990	**1992**	**1996**	
Okefenokee NWA	5.89 (1)	5.92 (4)	8.21 (2)	5.0
Wolf Island NWA	3.22	5.41 (1)	3.08	5.0
Chassahowitzka NWA	4.01	7.92 (2)	8.49 (1)	5.0

[a] Concentrations are highest predicted using CALPUFF model and CALMET wind fields for N. FL-S. GA, 1990, 1992 and 1996. Background extinctions calculated using FLAG Document (December 2000) values and hourly relative humidity data.

NWA = National Wilderness Area

( ) = Number of Predicted Days > 5 %

TABLE C-39
WEATHER CONDITIONS FOR DAYS OVER 5.0 PERCENT VISIBILITY IMPAIRMENT

Class I Area	Number	Day (YYMMDD)	Predicted Impairment (percent)	Existing Weather Summary
Okefenokee NWA	1	900124	5.89	7 hours fog
	2	920217	5.65	12 hours fog 3 hours lt rain
	3	920603	5.21	12 hours fog and lt rain
	4	921124	5.92	5 hours fog
	5	921219	5.23	fog and haze all day
	6	960326	8.21	3 hours fog
	7	960421	5.2	none
Wolf Island NWA	8	921223	5.41	1 hour fog and 1 hour haze
Chassahowitzka NWA	9	920129	7.21	14 hours fog
	10	920130	7.92	fog and lt rain or drizzle most of day
	11	961227	8.49	16 hours mist and fog
Visibility Criteria			**5.0**	

Notes:

Based on CALPUFF Dispersion Model.

Weather for Okefenokee and Wolf Island NWAs is based on surface observations from Jacksonville.

Weather for Chassahowitzka NWA is based on surface observations from Tampa.

TABLE C-40
ANNUAL NITROGEN DEPOSITION RATES PREDICTED AT THE OKEFENOKEE, WOLF ISLAND AND CHASSAHOWTZKA NWA PSD CLASS I AREAS GP PALATKA LK4 AND CONTEMPORANEOUS PROJECTS

	Total Deposition (Wet & Dry)						Deposition Analysis Threshold[b]
	1990		1992		1996		
PSD Class I Area	($g/m^2/s$)	(kg/ha/yr)	($g/m^2/s$)	(kg/ha/yr)	($g/m^2/s$)	(kg/ha/yr)	(kg/ha/yr)
Okefenokee NWA	6.105E-12	0.0019	6.529E-12	0.0021	6.621E-12	0.0021	0.01
Wolf Island NWA	2.267E-12	0.0007	3.130E-12	0.0010	2.966E-12	0.0009	0.01
Chassahowitzka NWA	2.273E-12	0.0007	2.340E-12	0.0007	2.059E-12	0.0006	0.01

[a] Conversion factor is used to convert $g/m^2/s$ to kg/hectare (ha)/yr using following units:

$g/m^2/s$ x	0.001	kg/g
x	10000	m^2/hectare
x	3600	sec/hr
x	8760	hr/yr =kg/ha/yr
or		
$g/m^2/s$ x	3.1536E+08	= kg/ha/yr

[b] Deposition analysis thresholds (DAT) for nitrogen and sulfur deposition provided by the U.S. Fish and Wildlife Service, January 2002. A DAT is the additional amount of N or S deposition within a Class I area, below which estimated impacts from a proposed new or modified source are considered insignificant.

TABLEC-41
EXAMPLES OF REPORTED EFFECTS OF AIR POLLUTANTS AT CONCENTRATIONS BELOW NATIONAL SECONDARY AMBIENT AIR QUALITY STANDARDS

Pollutant	Reported Effect	Concentration ($\mu g/m^3$)	Exposure
SO_2[1]	Respiratory stress in guinea pigs.	427 to 854	1 hour
	Respiratory stress in rats.	267	7 hours/day; 5 day/week for 10 weeks
	Decreased abundance in deer mice.	13 to 157	Continually for 5 months
NO_2[2,3]	Respiratory stress in mice.	1,917	3 hours
	Respiratory stress in guinea pigs.	96 to 958	8 hours/day for 122 days
Particulates[1]	Respiratory stress, reduced respiratory disease defenses.	120 PbO_3	Continually for 2 months
	Decreased respiratory disease defenses in rats, same with hamsters.	100 $NiCl_2$	2 hours

Sources:
[1] Newman and Schreiber, 1988.
[2] Gardner and Graham, 1976.
[3] Trzeciak *et al.*, 1977.

TABLE APP-1
STRUCTURE DIMENSIONS FOR THE CHIP-N-SAW MILL USED IN THE MODELING ANALYSIS

Structure	Height		Length		Width	
	(ft)	(m)	(ft)	(m)	(ft)	(m)
Chip-N-Saw Building	25	7.6	116	35.4	112	34.1
Dry Finish Lumber Shed	20	6.1	200	61.0	50	15.2
Dry Rough Lumber Shed 1	20	6.1	200	61.0	50	15.2
Dry Rough Lumber Shed 2	20	6.1	200	61.0	80	24.4
Kiln 1	30	9.1	68	20.7	33	10.1
Kiln 2	30	9.1	68	20.7	33	10.1
Kiln Fuel Silo	72	21.9	28	8.5	28	8.5
Sorter	21.5	6.6	140	42.7	29	8.8
Stacker	21	6.4	84	25.6	37	11.3
Planer Mill	22	6.7	195	59.4	120	36.6

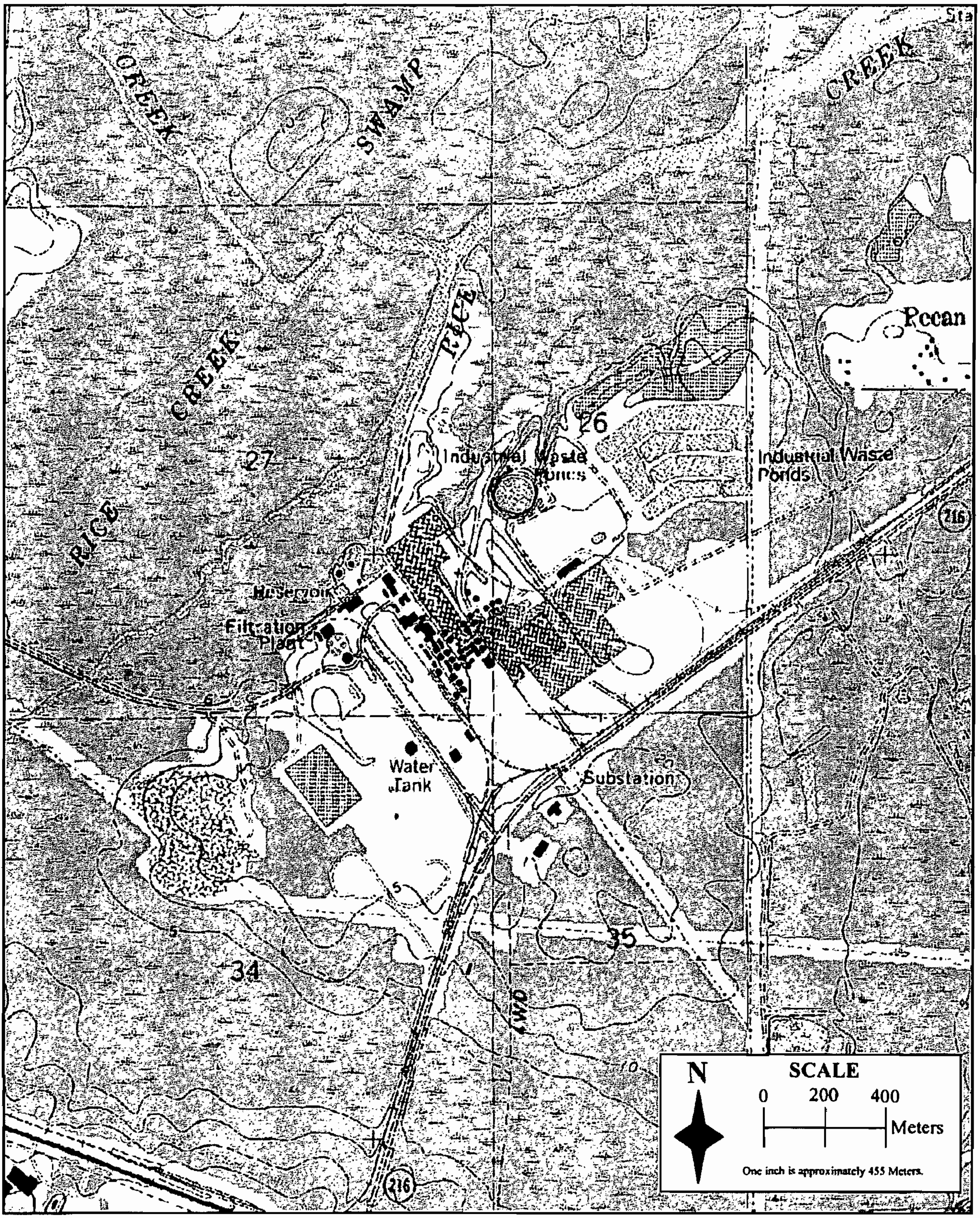

Figure C-1
Area Map
Georgia-Pacific Corporation, Palatka Paper Mill

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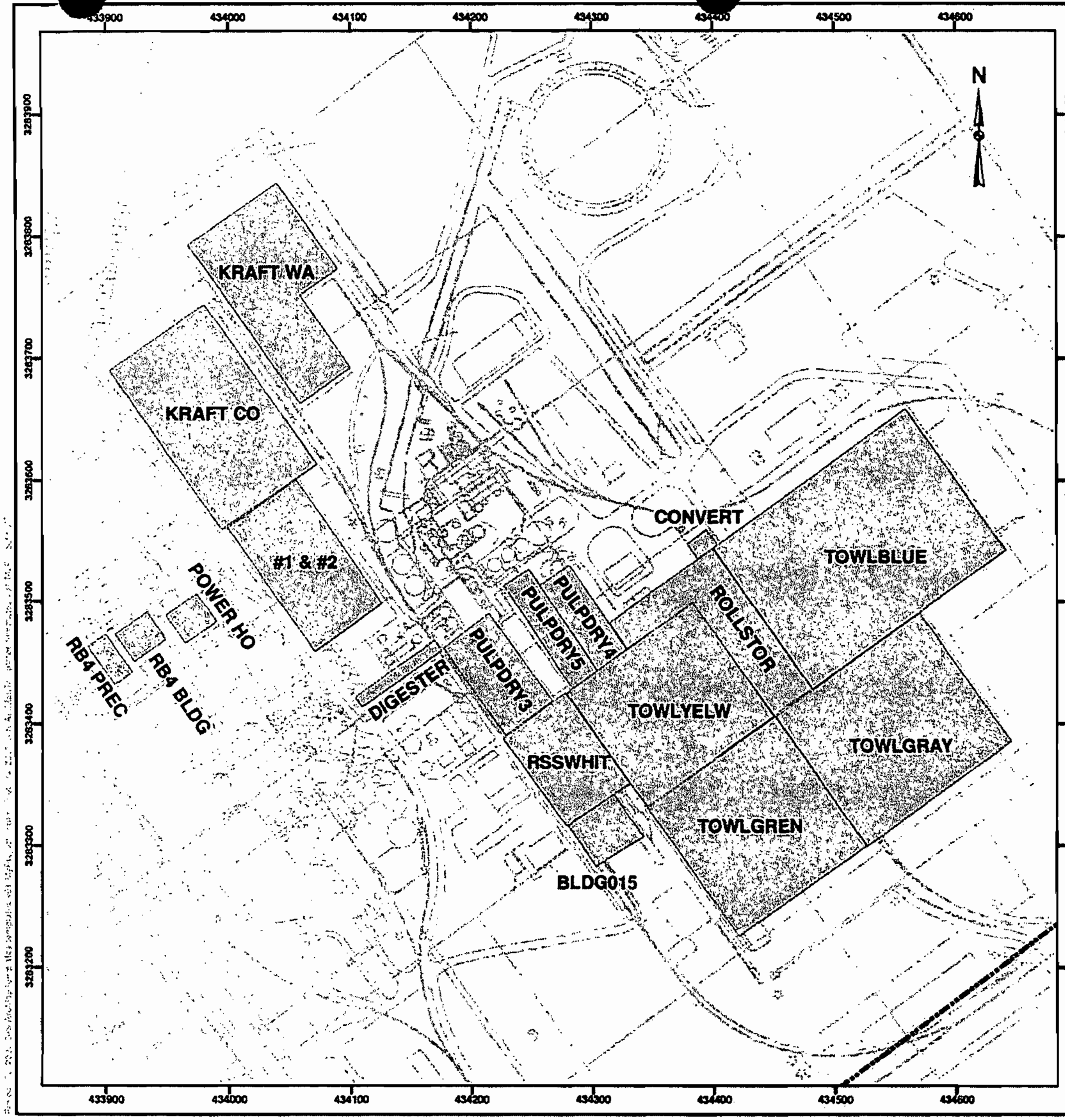


LEGEND

▨ Buildings

⬚ Property Boundary

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

0 37.5 75 150 Meters

PROJECT

GP PALATKA PROPOSED AND
CONTEMPORANEOUS PROJECTS

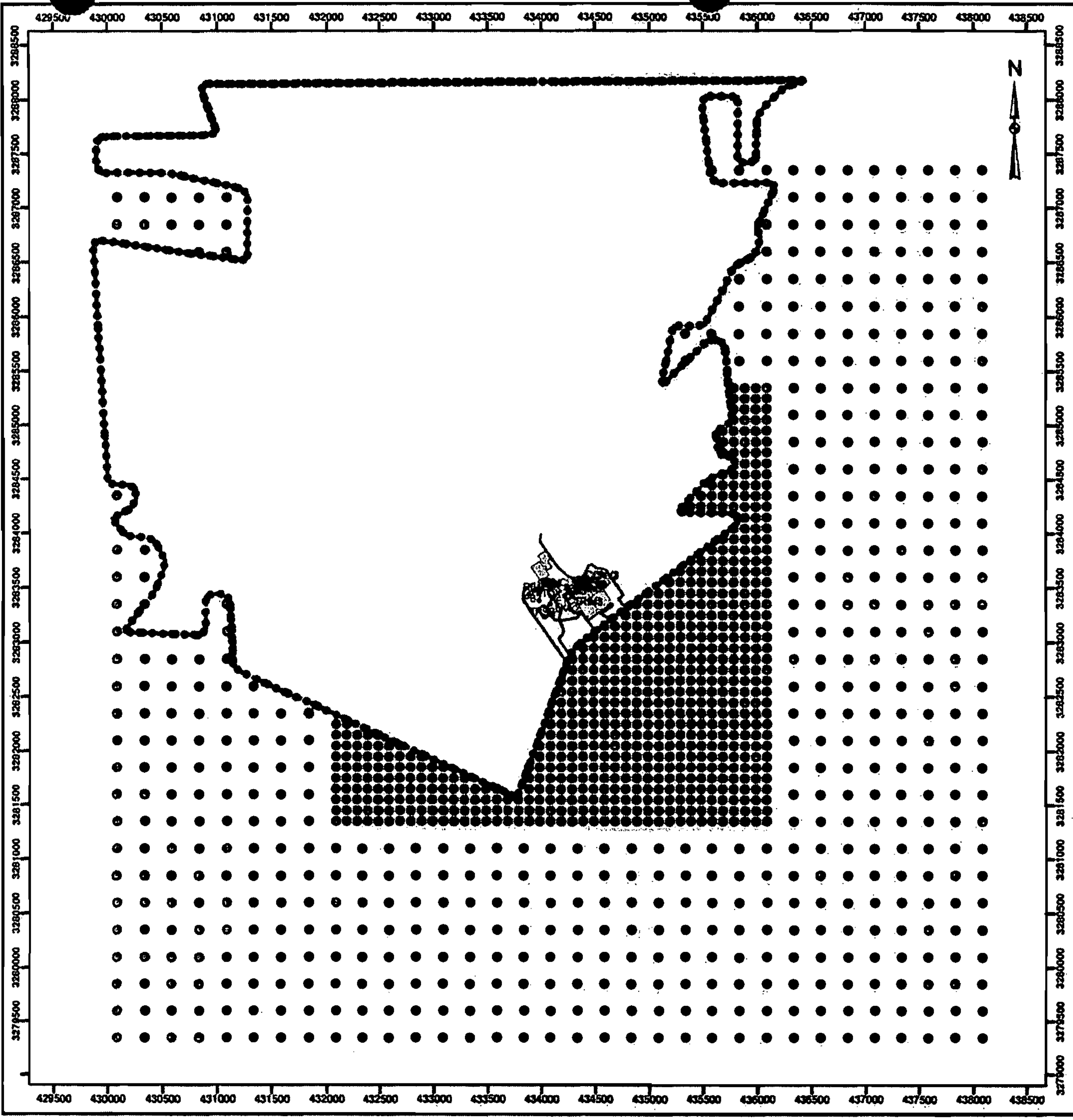
TITLE

Building Considered in Downwash Analysis

Golder Associates
Gainesville, Florida

PROJECT No. 053-7609-0100			SCALE AS SHOWN	REV. 0
GS	AB	10 Nov. 2005	**FIGURE: C-2**	

0537609/4.4/Figure C-2



LEGEND

Receptors

▬	Fenceline - 50m Spacing
▦	Receptor Grid - 100m Spacing
●	Receptor Grid - 250m Spacing
▨	Buildings
—	Source Locations

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

0 550 1,100 2,200 Meters

PROJECT

GP PALATKA PROPOSED AND
CONTEMPORANEOUS PROJECTS

TITLE

Receptor Grid Used for the Significant Impact Analysis

Golder Associates
Gainesville, Florida

PROJECT No. 053-7609-0100			SCALE AS SHOWN	REV. 0
DS	AS	10 Nov. 2006	**FIGURE: C-3**	

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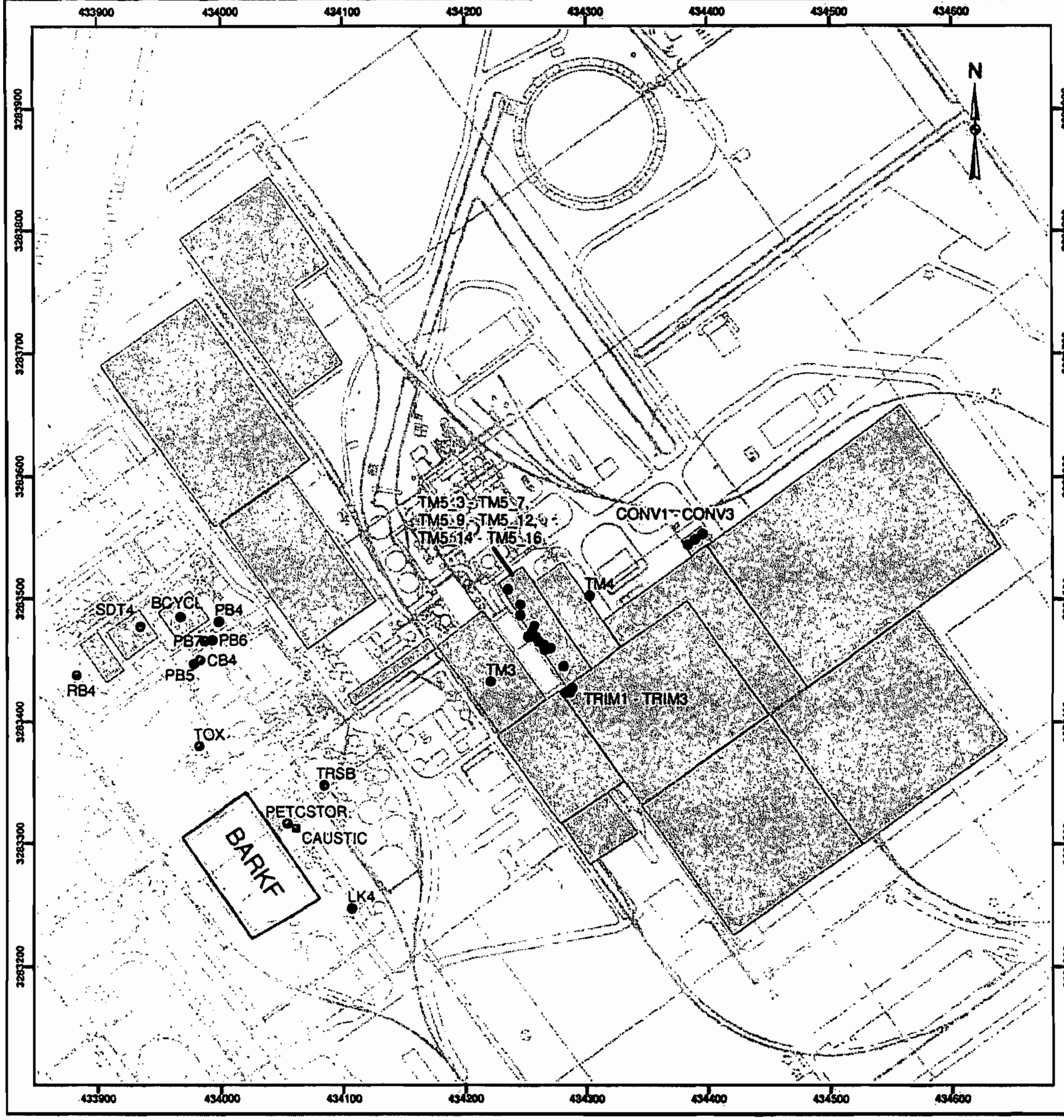

LEGEND

- ● Point Sources
- —— Area Source
- —— Volume Source
- ▨ Buildings

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

0 45 90 180 Meters

PROJECT

GP PALATKA PROPOSED AND
CONTEMPORANEOUS PROJECTS

TITLE

Point, Area and Non-Road Volume Source Arrangement

Golder Associates
Gainesville, Florida

PROJECT No. 053-7609-0100			SCALE AS SHOWN	REV. 0
GIS	AB	10 Nov. 2005	**FIGURE: C-4**	

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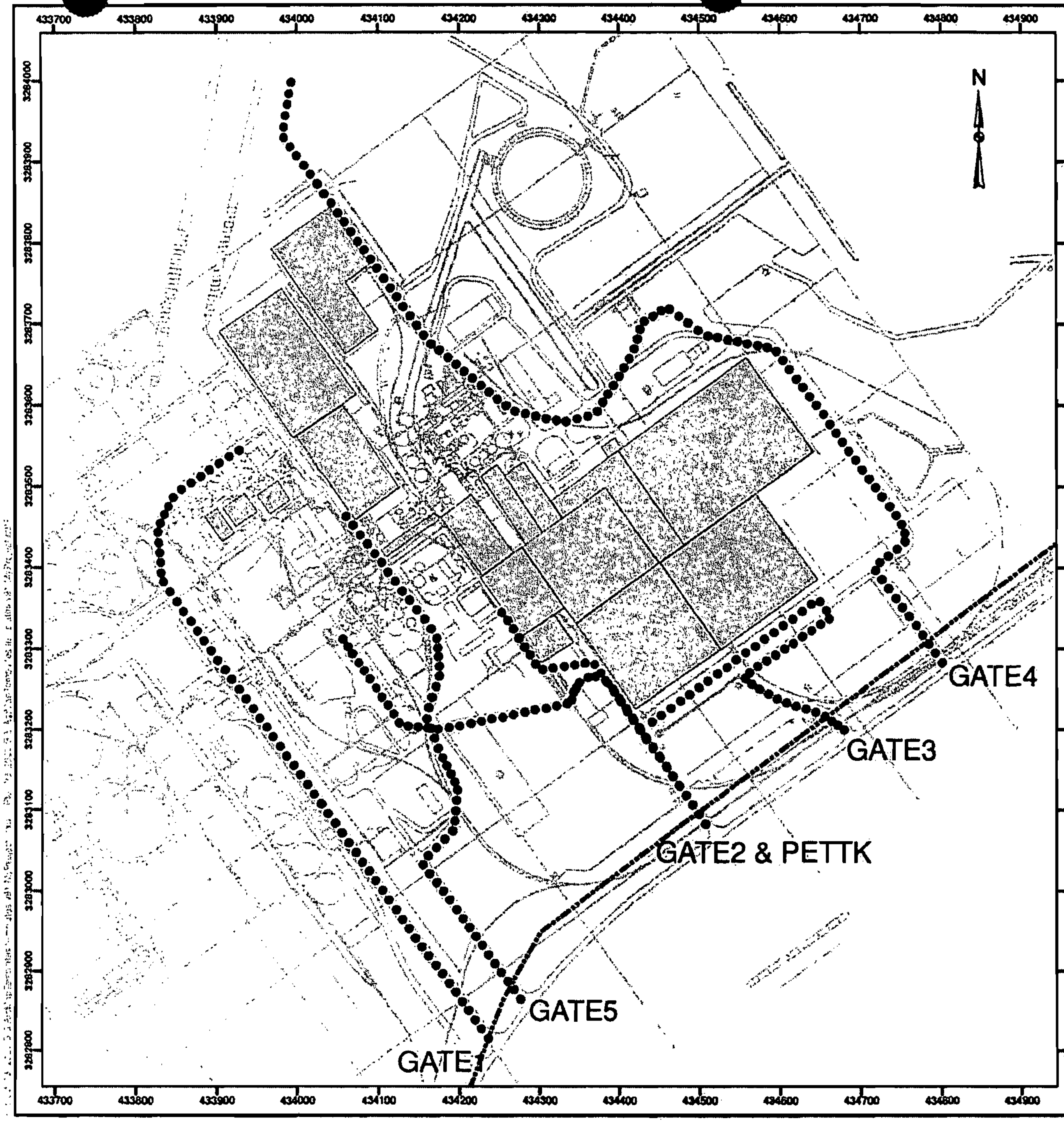


LEGEND

● Road Volume Sources
▨ Buildings
⬚ Property Boundary

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

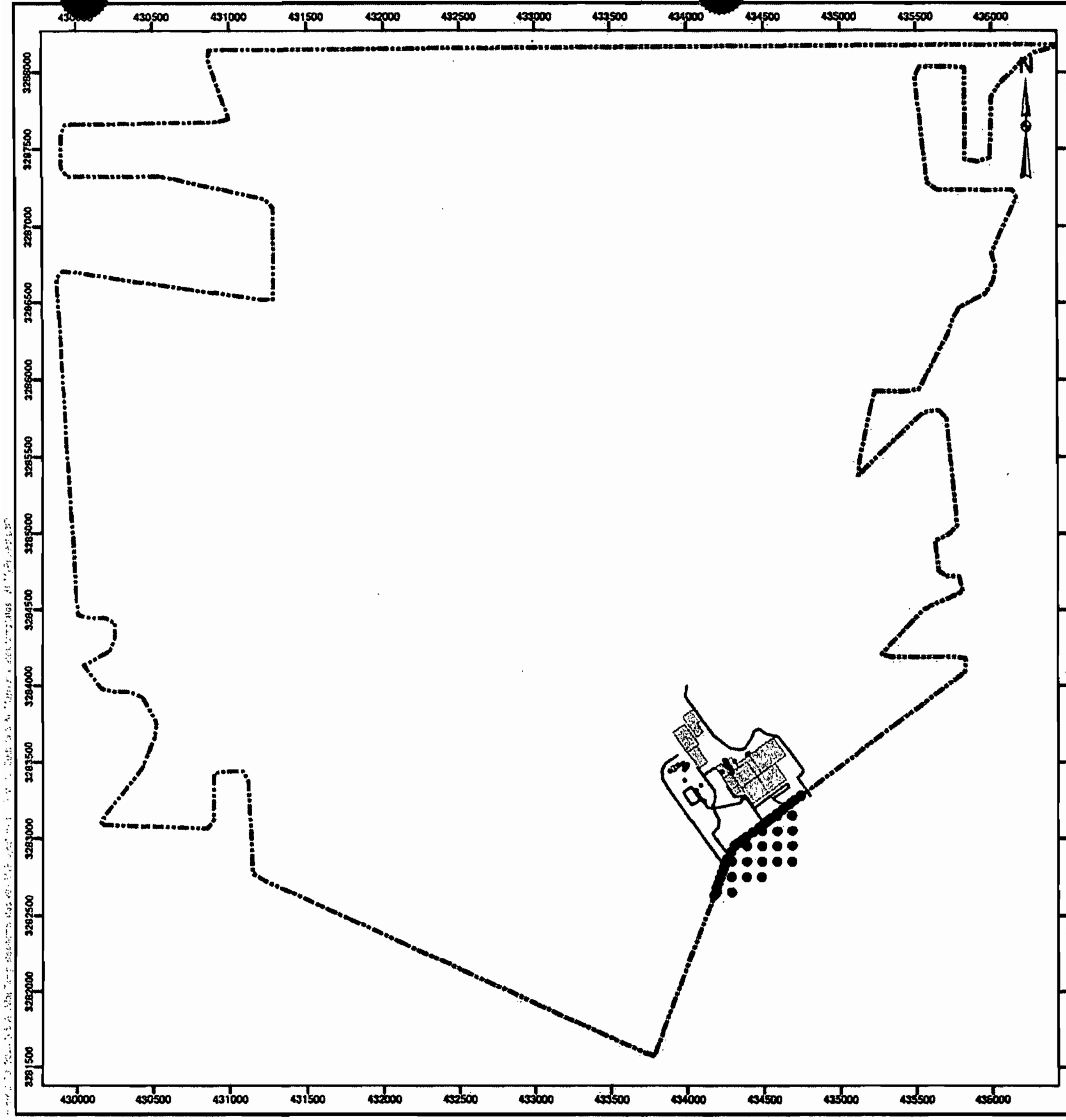
0 75 150 300 Meters

PROJECT
GP PALATKA PROPOSED AND
CONTEMPORANEOUS PROJECTS

TITLE
Road Volume Source Arrangement

Golder Associates
Gainesville, Florida

PROJECT No. 053-7609-0100			SCALE AS SHOWN	REV. 0
GIS	AB	10 Nov. 2006	**FIGURE: C-5**	



LEGEND

● Receptors with Concentrations > PM_{10} SIL

▨ Buildings

— Source Locations

-·-·- Property Boundary

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

0 425 850 1,700 Meters

PROJECT

GP PALATKA PROPOSED AND
CONTEMPORANEOUS PROJECTS

TITLE

Receptors with Concentrations > PM_{10} SIL

Golder Associates
Gainesville, Florida

PROJECT No. 053-7609-0100			SCALE AS SHOWN	REV 0
DJS	AB	10 Nov. 2005	**FIGURE: C-6**	

LEGEND

● Receptors with Concentrations > NO_2 SIL

▨ Buildings

— Source Locations

-··- Property Boundary

REFERENCE

Projection: Transverse Mercator Datum: NAD 27 Coordinate System: UTM Zone 17

0 400 800 1,600 Meters

PROJECT

GP PALATKA PROPOSED AND CONTEMPORANEOUS PROJECTS

TITLE

Receptors with Concentrations > NO_2 SIL

Golder Associates
Gainesville, Florida

PROJECT No. 053-7609-0100			SCALE AS SHOWN	REV. 0
GIS	AB	10 Nov. 2005	**FIGURE: C-7**	

FIGURE C-8
POPULATION AND HOUSEHOLD UNIT TRENDS IN PUTNAM COUNTY

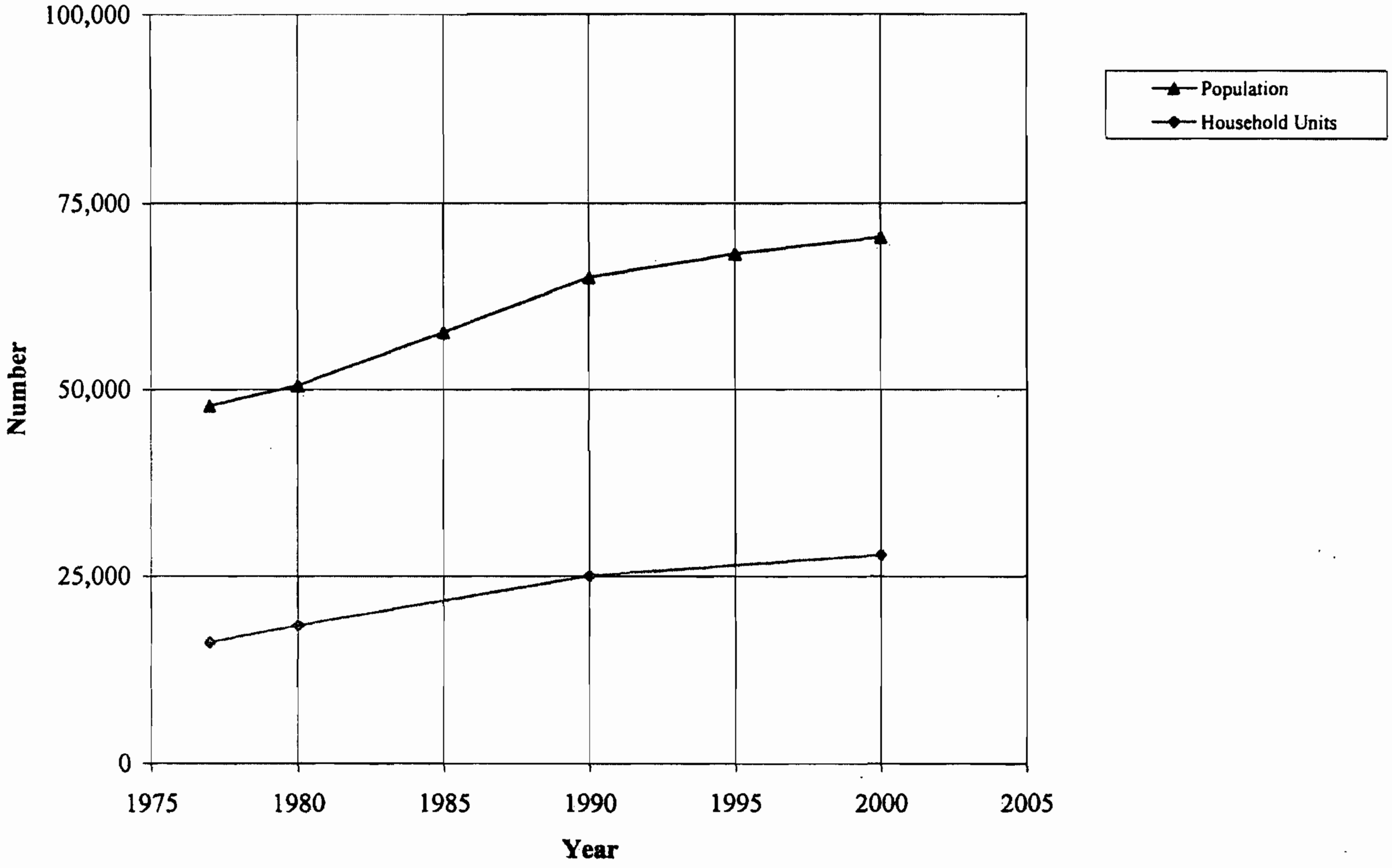


FIGURE C-9.
RETAIL AND WHOLESALE TRADE TRENDS IN PUTNAM COUNTY

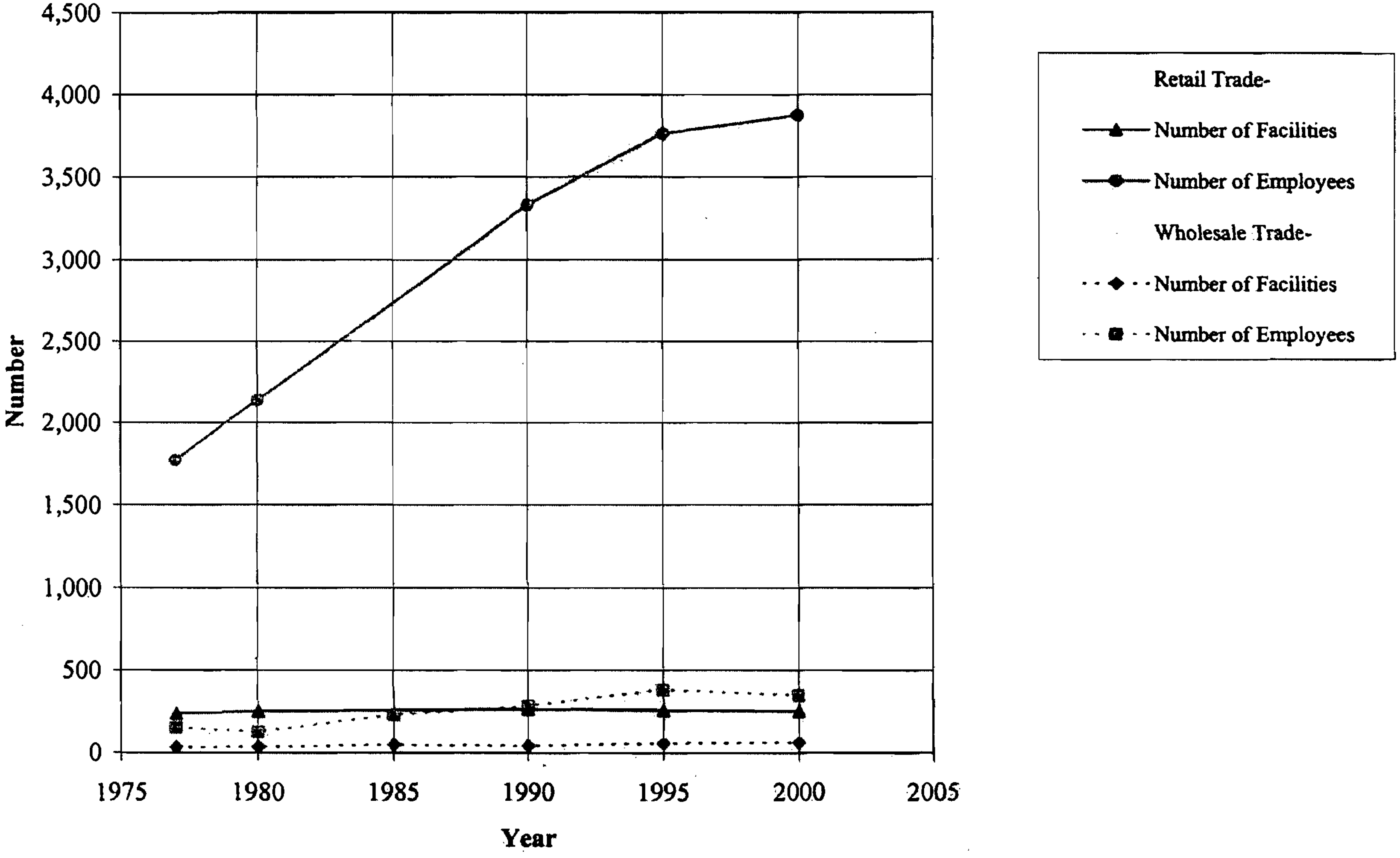


FIGURE C-10
LABOR FORCE TREND IN PUTNAM COUNTY

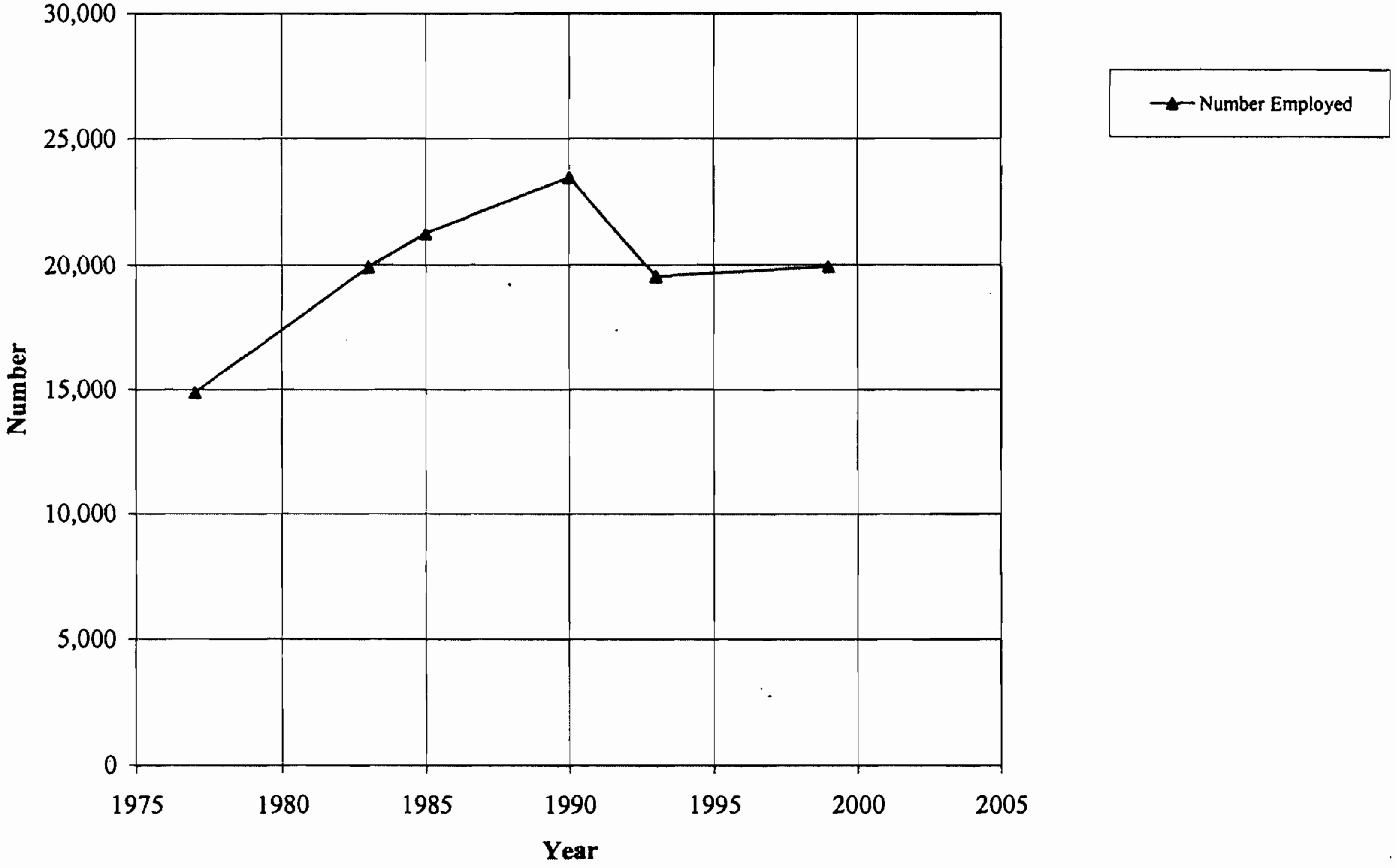


FIGURE C-11
HOTEL AND MOTEL TREND IN PUTNAM COUNTY

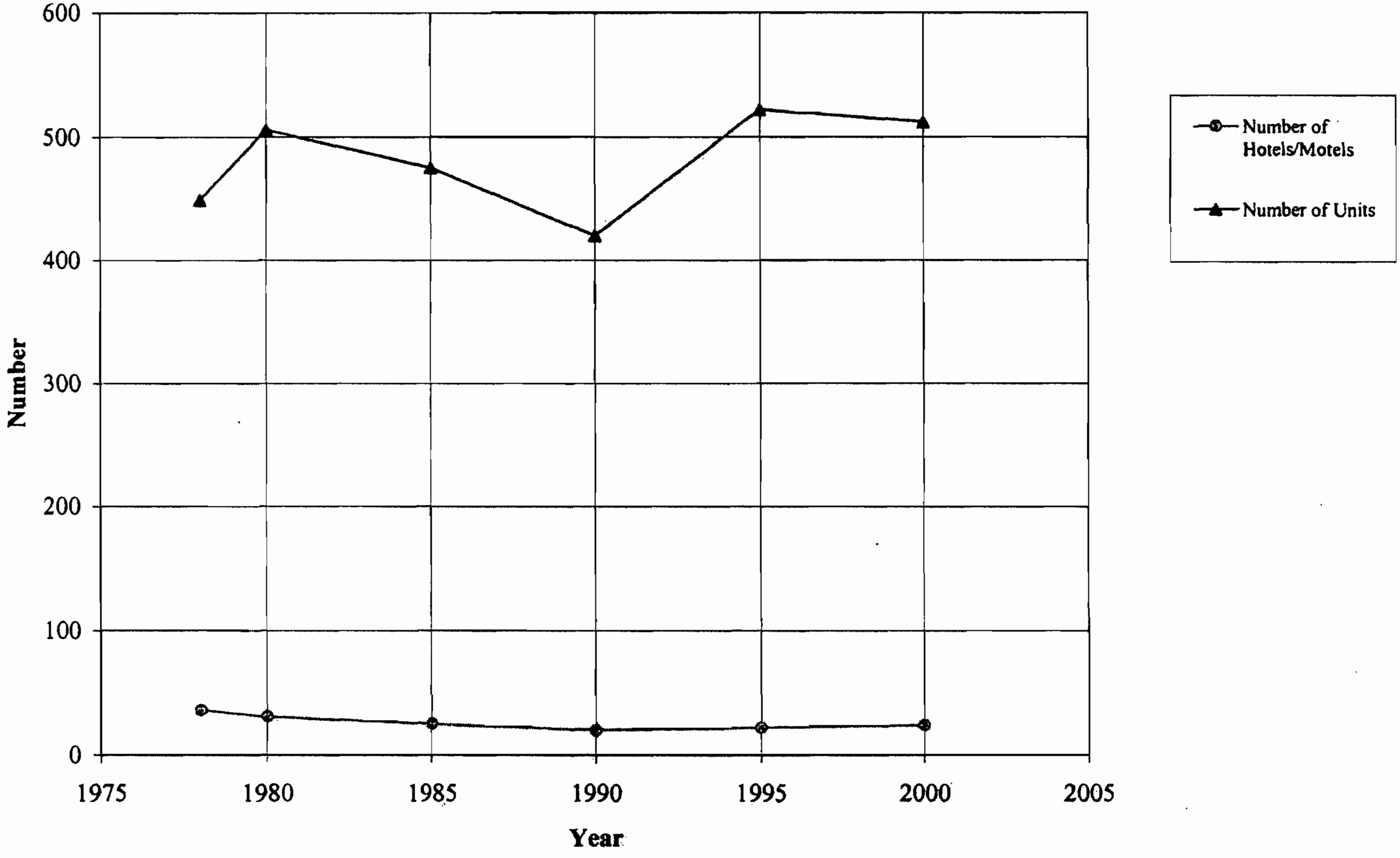


FIGURE C-12
VEHICLE MILES TRAVELED (VMT) ESTIMATES FOR MOTOR VEHICLES FOR PUTNAM COUNTY

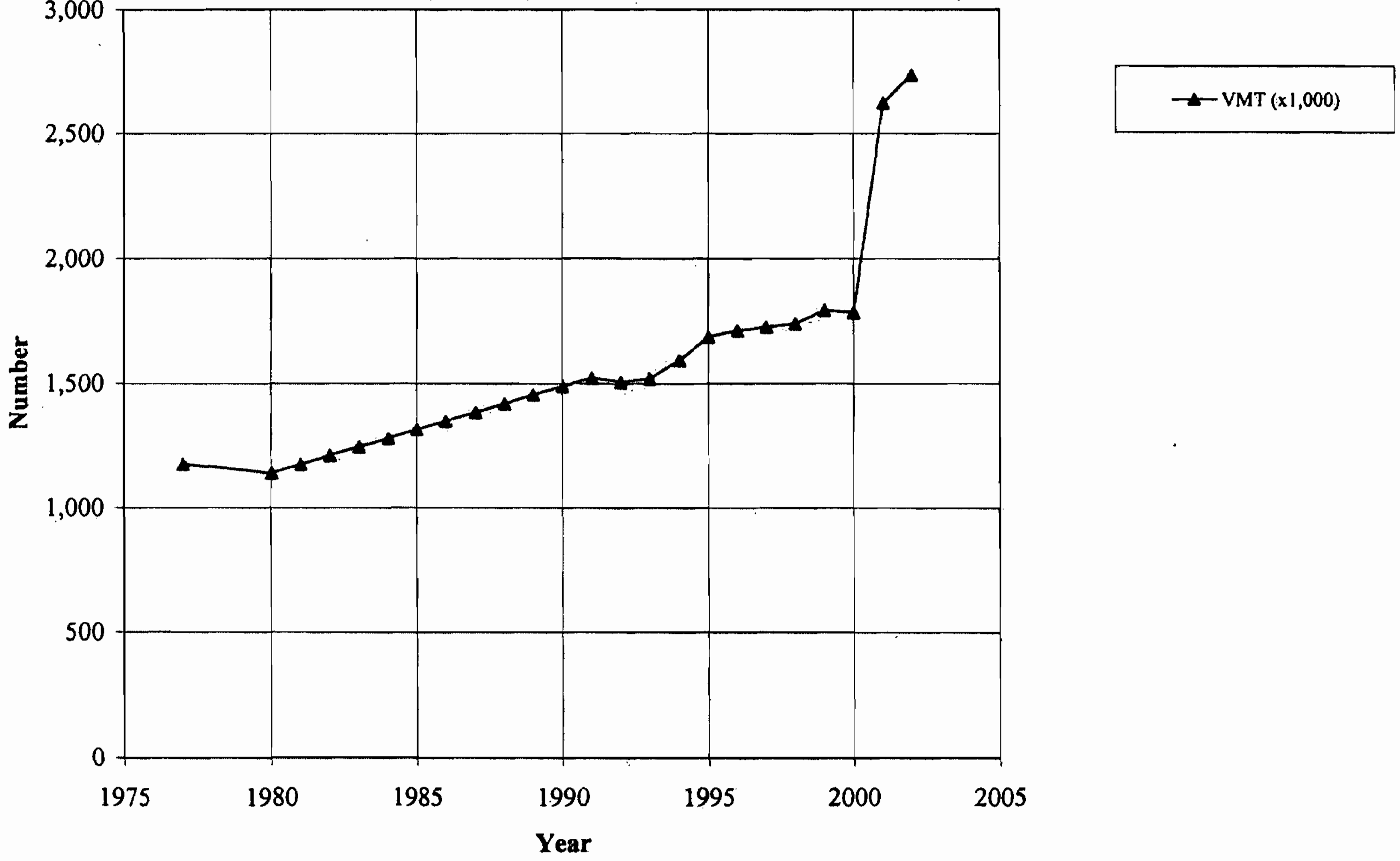


FIGURE C-13
MANUFACTURING AND AGRICULTURE TRENDS IN PUTNAM COUNTY

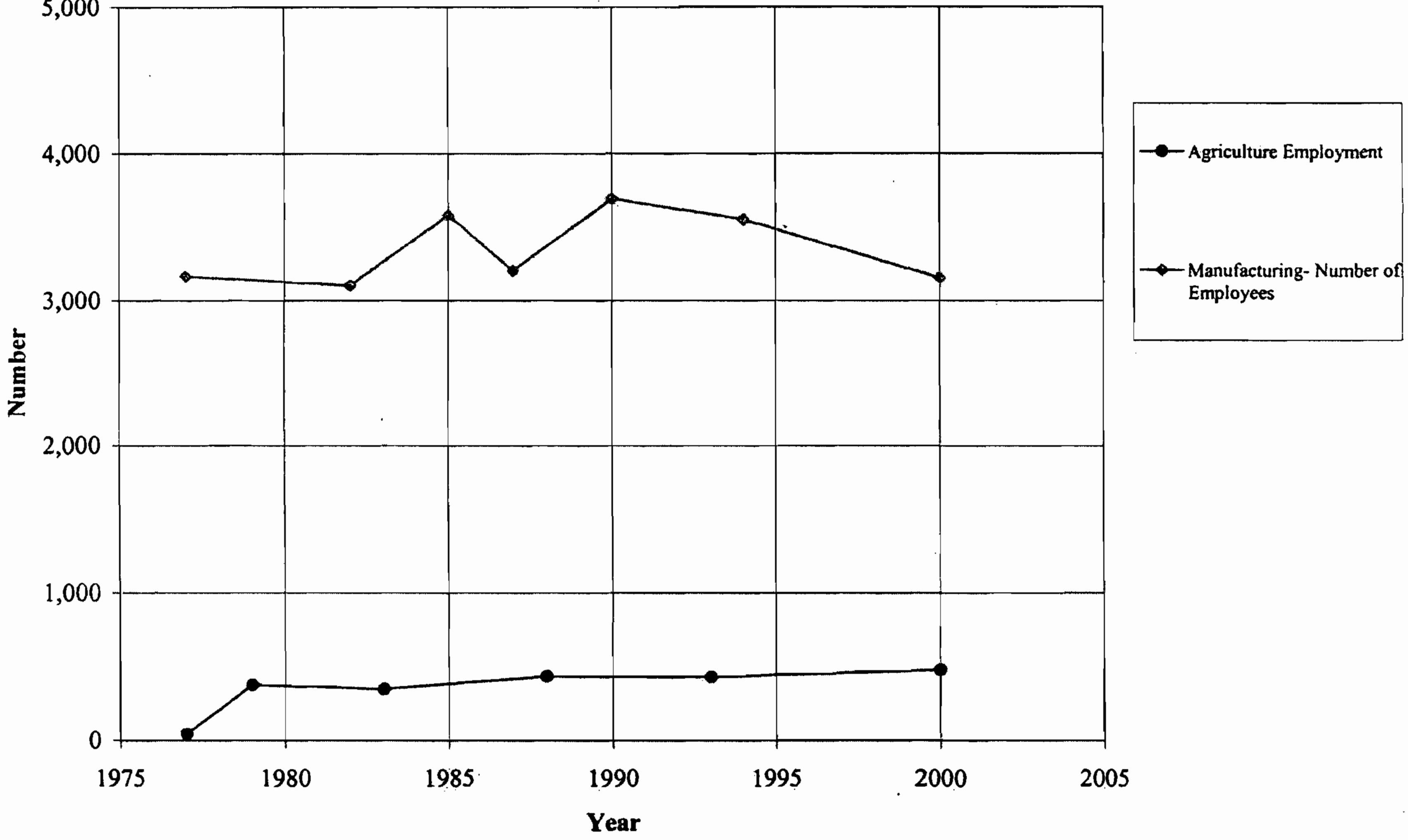


FIGURE C-14
ELECTRICAL POWER GENERATION CAPACITY IN PUTNAM COUNTY

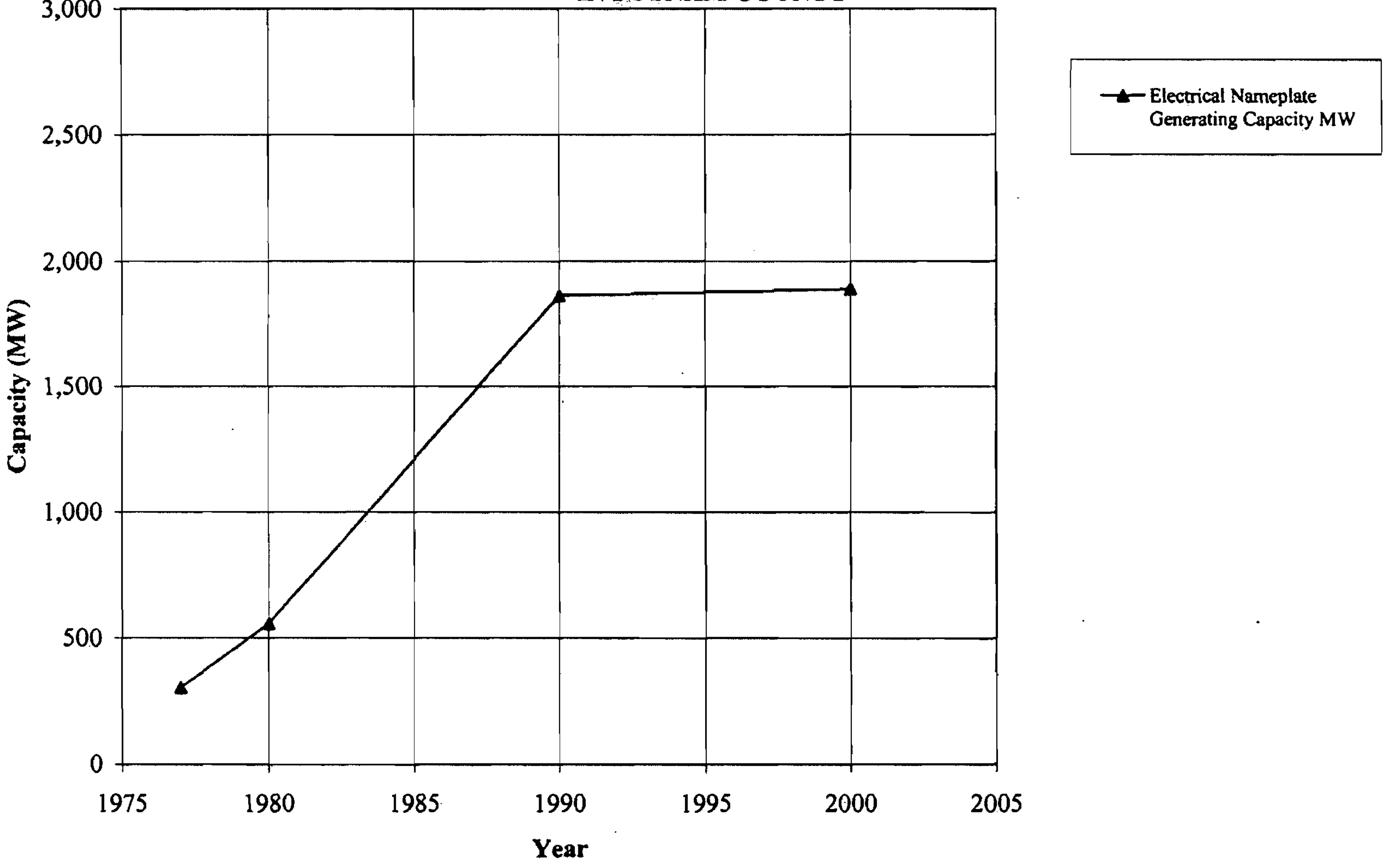


FIGURE C-15
MOBILE SOURCE EMISSIONS (TONS PER DAY) OF CO,NOC AND NOx IN PUTNAM COUNTY

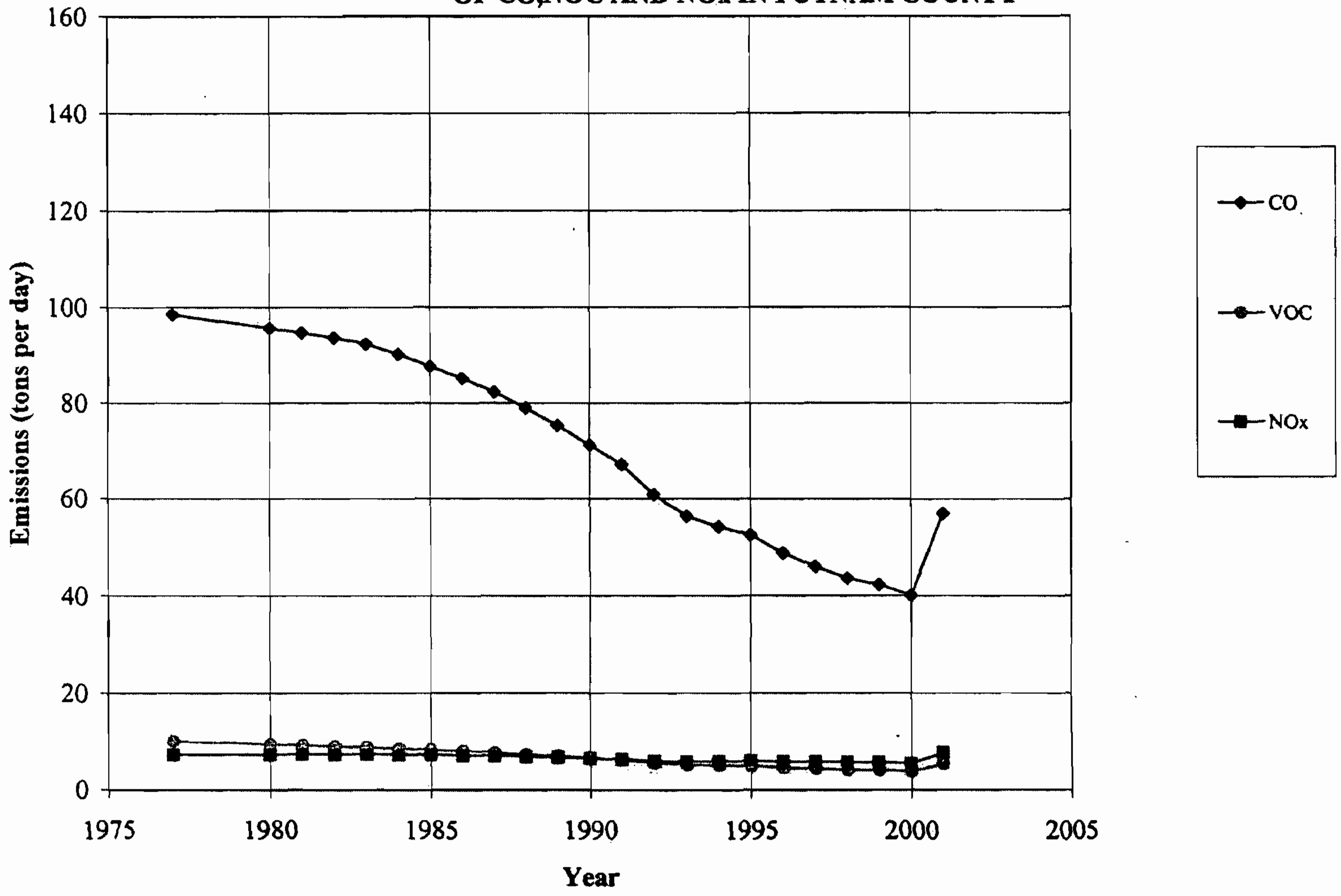


FIGURE C-16
MEASURED 3-HOUR AVERAGE SULFUR DIOXIDE CONCENTRATIONS
(2nd Highest Values) from 1984 to 2002- Putnam County

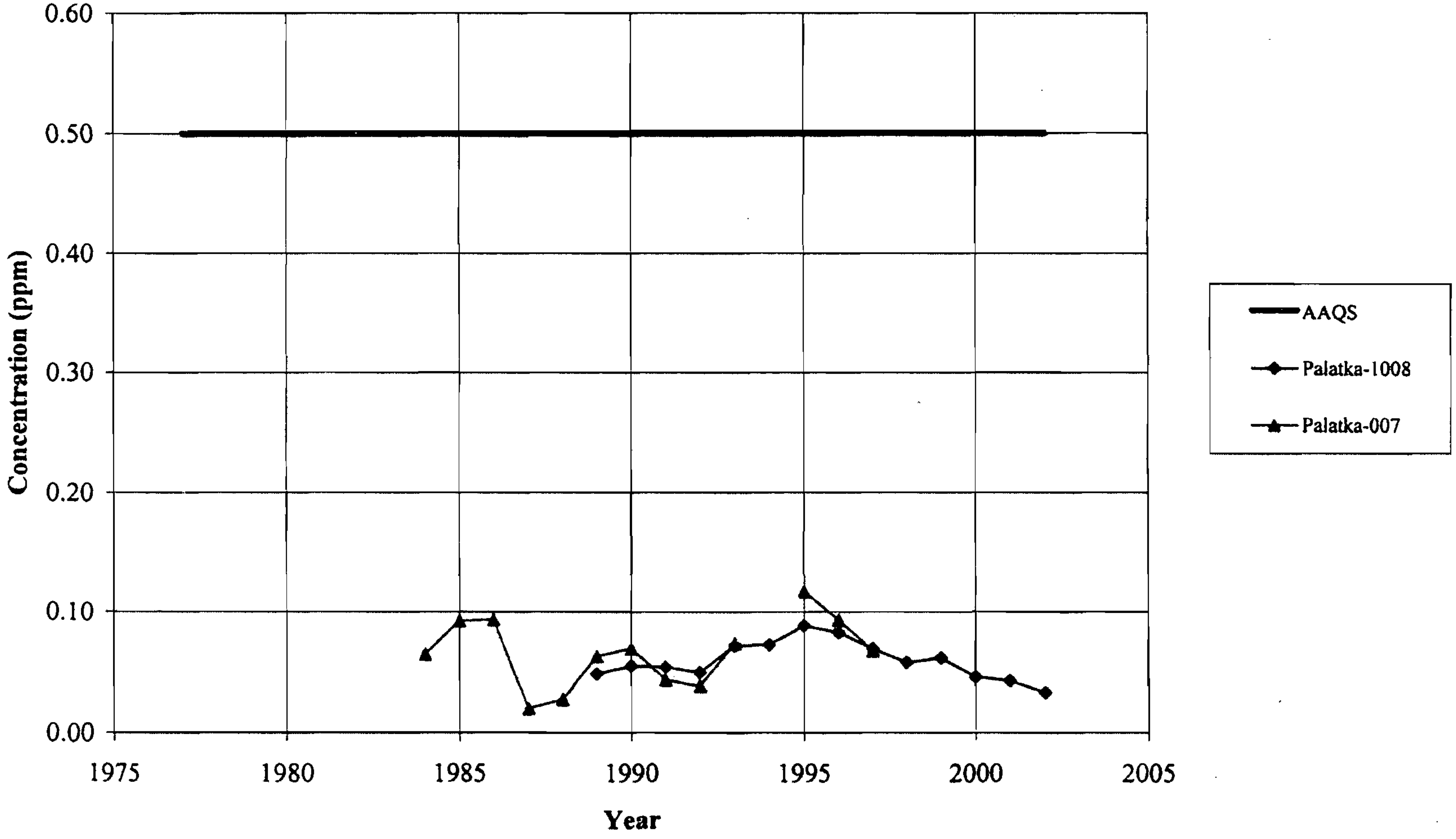


FIGURE C-17
MEASURED 24-HOUR AVERAGE SULFUR DIOXIDE CONCENTRATIONS
(2nd Highest Values) from 1984 to 2002- PutnamCounty

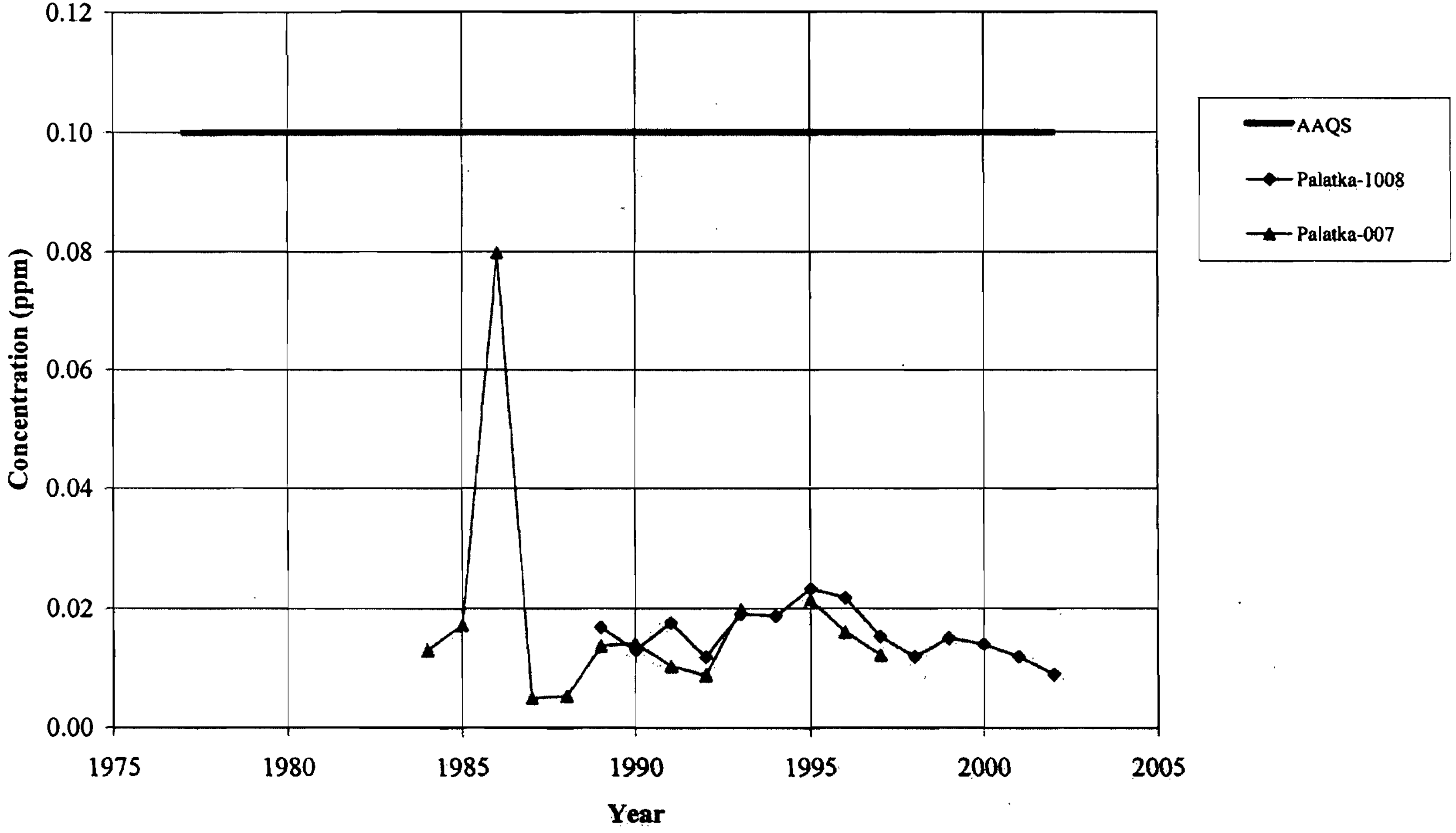


FIGURE C-18
MEASURED ANNUAL AVERAGE SULFUR DIOXIDE CONCENTRATIONS
(from 1984 to 2002- Putnam County)

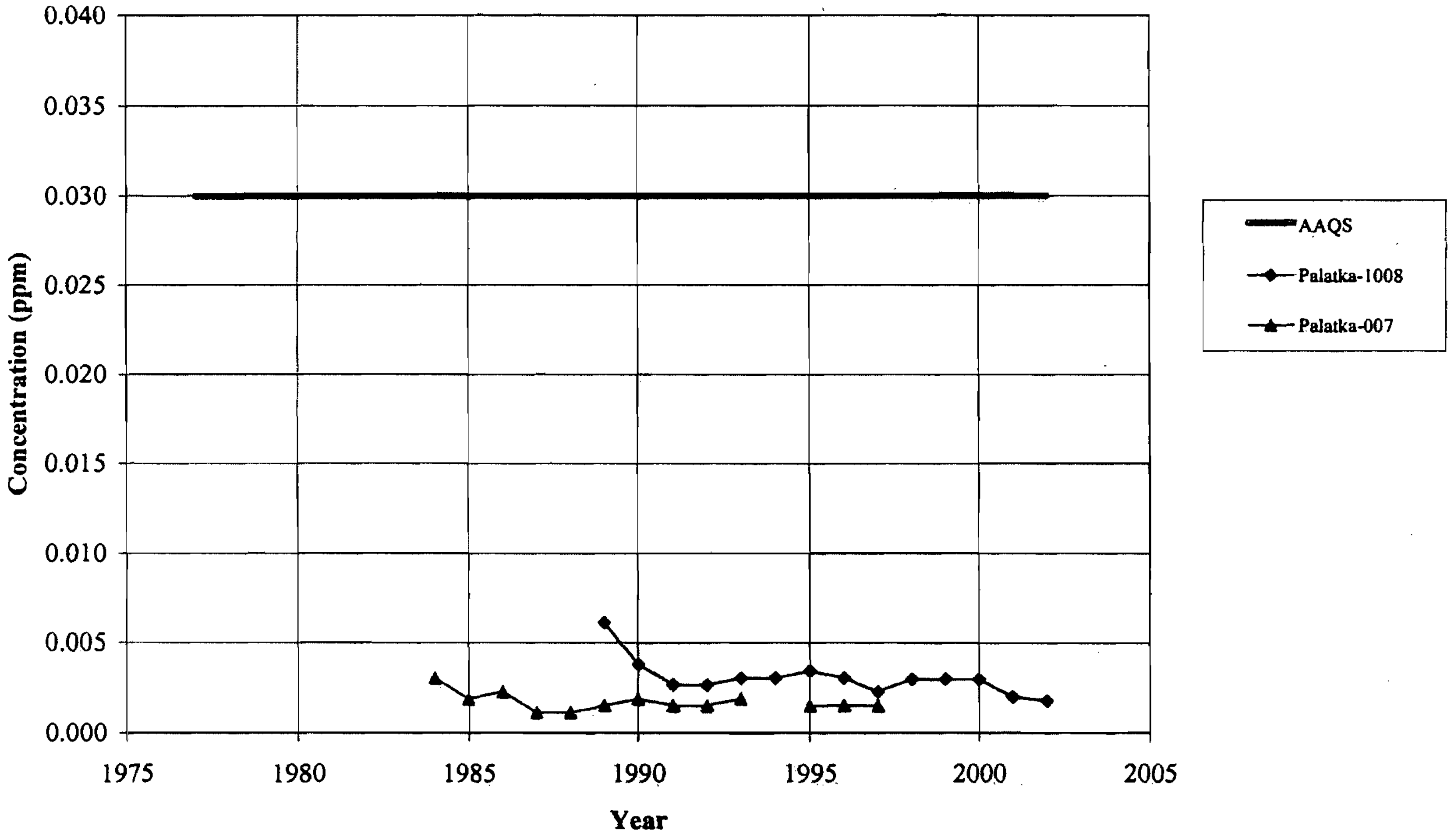


FIGURE C-19
MEASURED 24-HOUR AVERAGE PM_{10} CONCENTRATIONS
(1988 to 2002)
AND TOTAL SUSPENDED PARTICULATE CONCENTRATIONS
(1981 to 1987)
(2nd Highest Values) - Putnam County

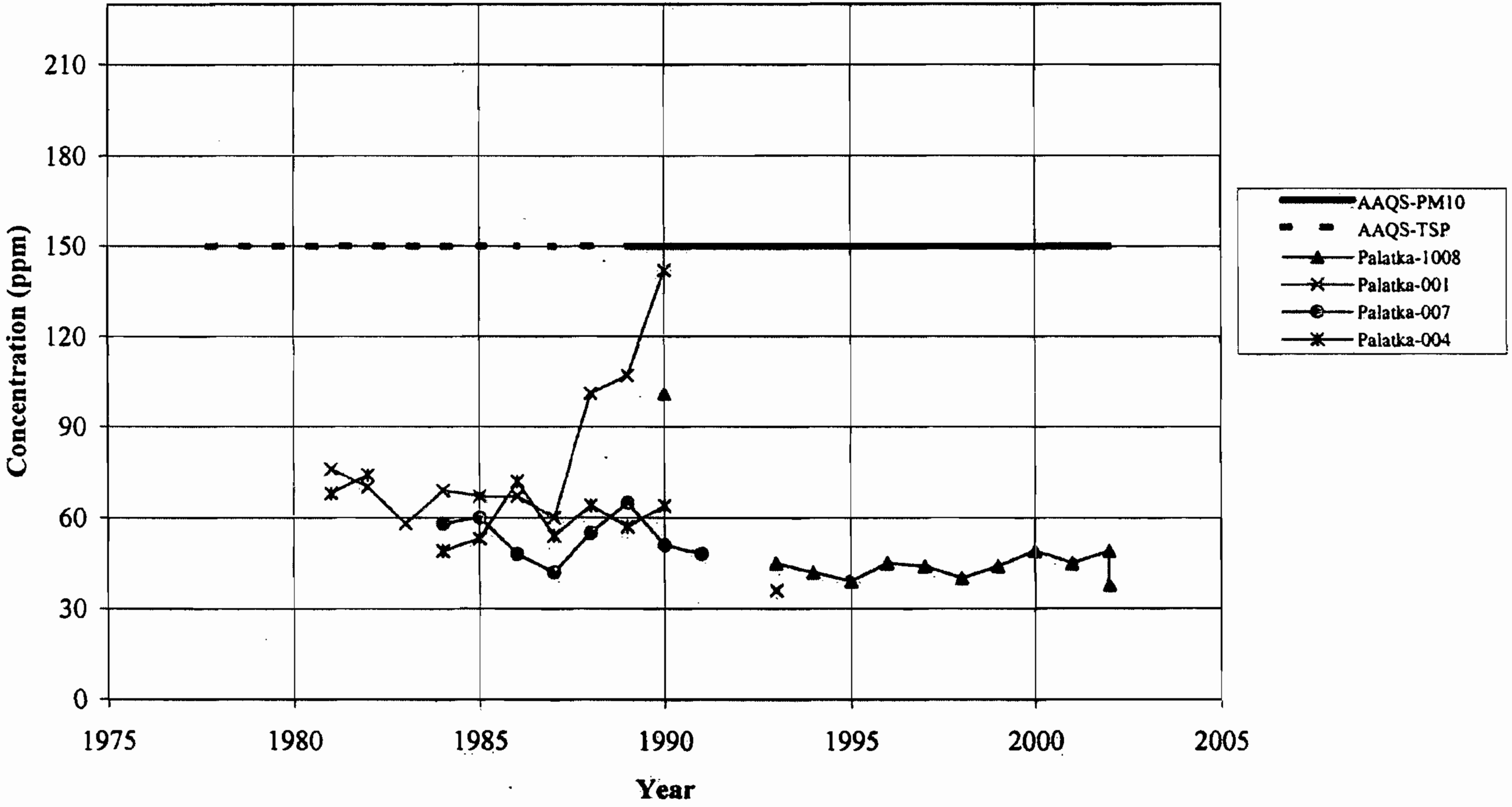


FIGURE C-20
MEASURED ANNUAL AVERAGE PM_{10} CONCENTRATIONS (1988 to 2002) AND TOTAL SUSPENDED PARTICULATE CONCENTRATIONS (1981 to 1987)
Putnam County

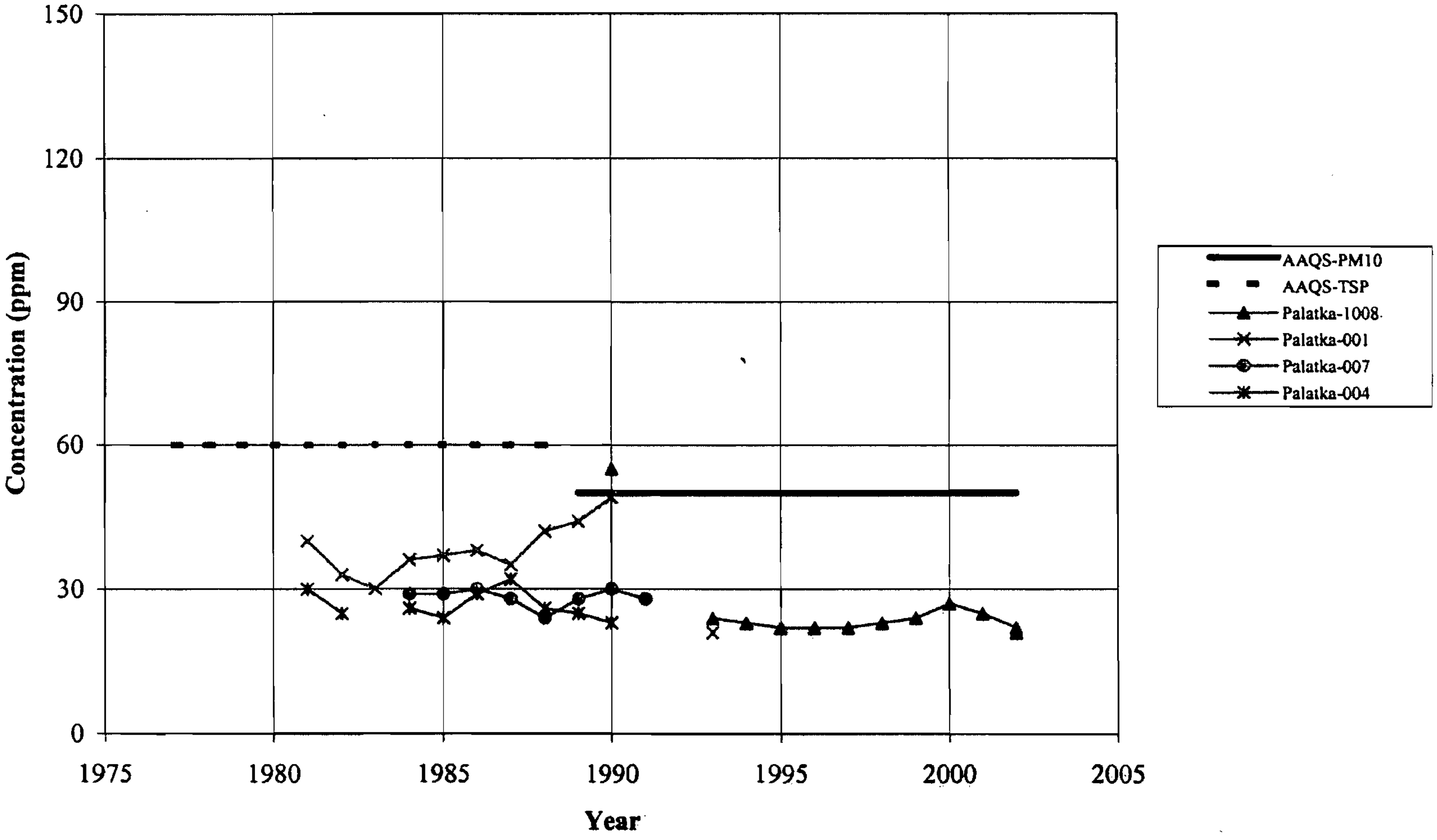


FIGURE C-21
MEASURED ANNUAL AVERAGE NITROGEN DIOXIDE CONCENTRATIONS FROM 1981 to 2002
Putnam County

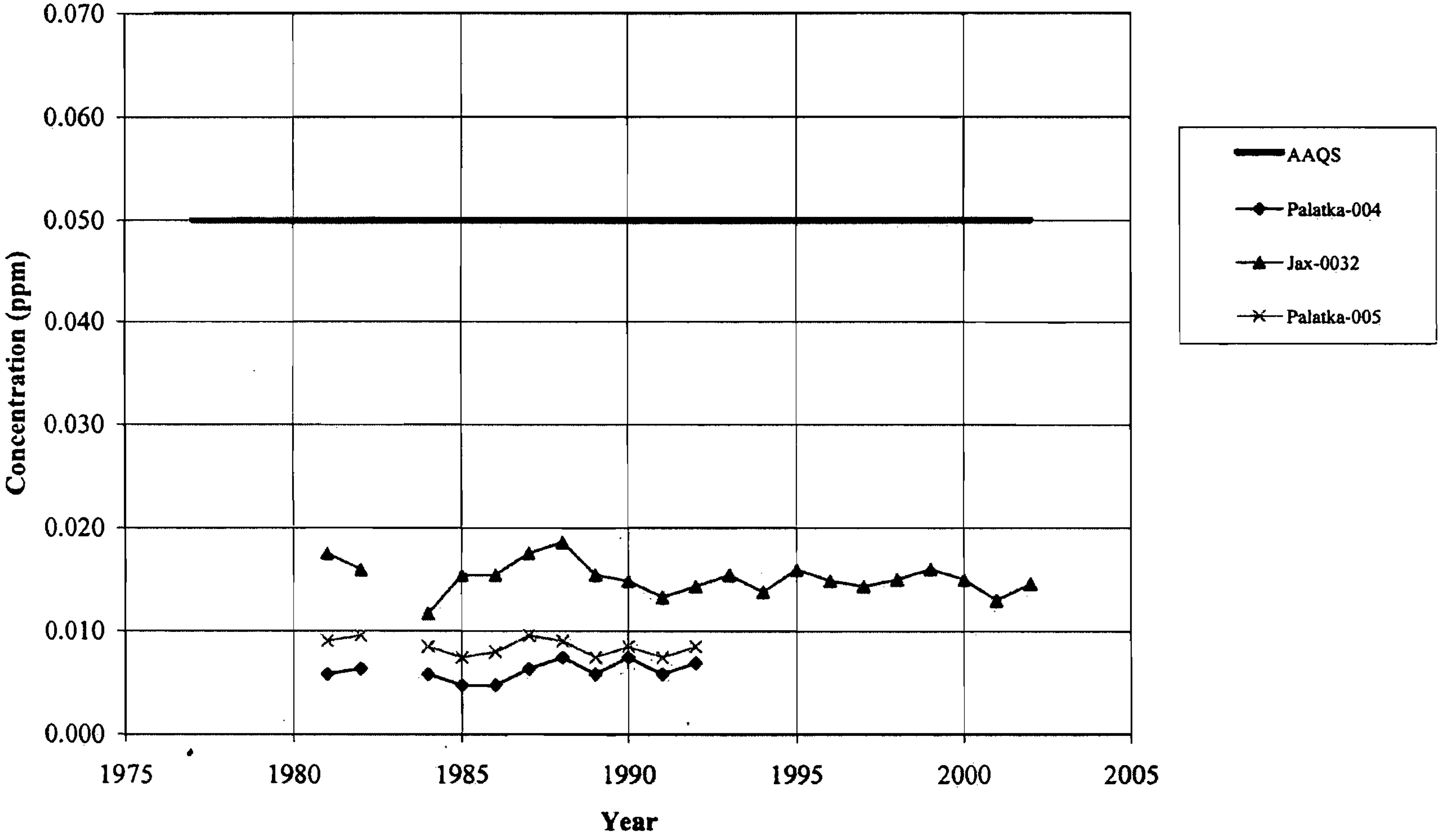


FIGURE C-22
MEASURED 1-HOUR AVERAGE CARBON MONOXIDE CONCENTRATIONS (2nd Highest Values) from 1981 to 2002 - Putnam County

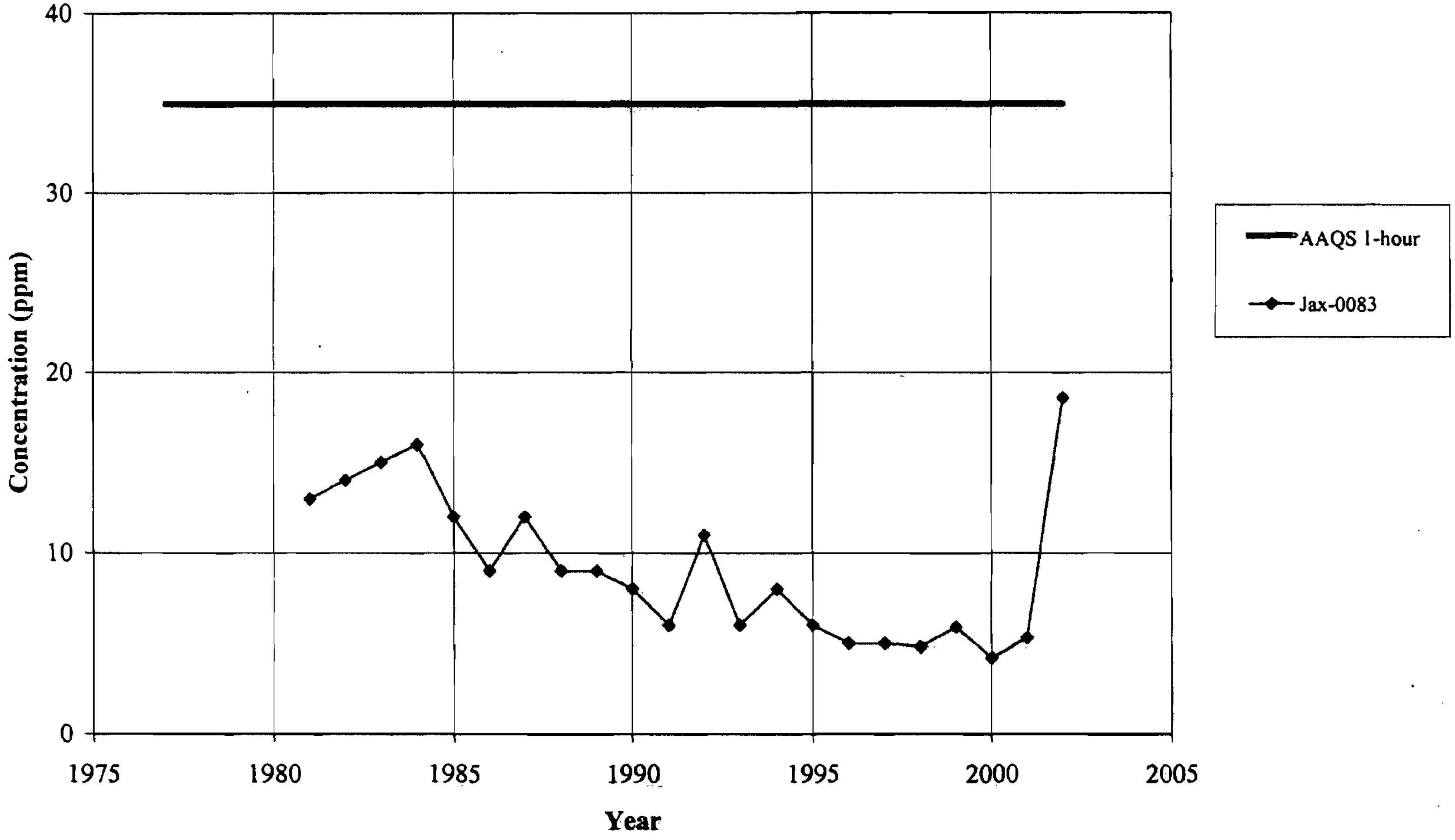


FIGURE C-23
MEASURED 8-HOUR AVERAGE CARBON MONOXIDE CONCENTRATIONS
(2nd Highest Values) from 1981 to 2002 - Putnam County

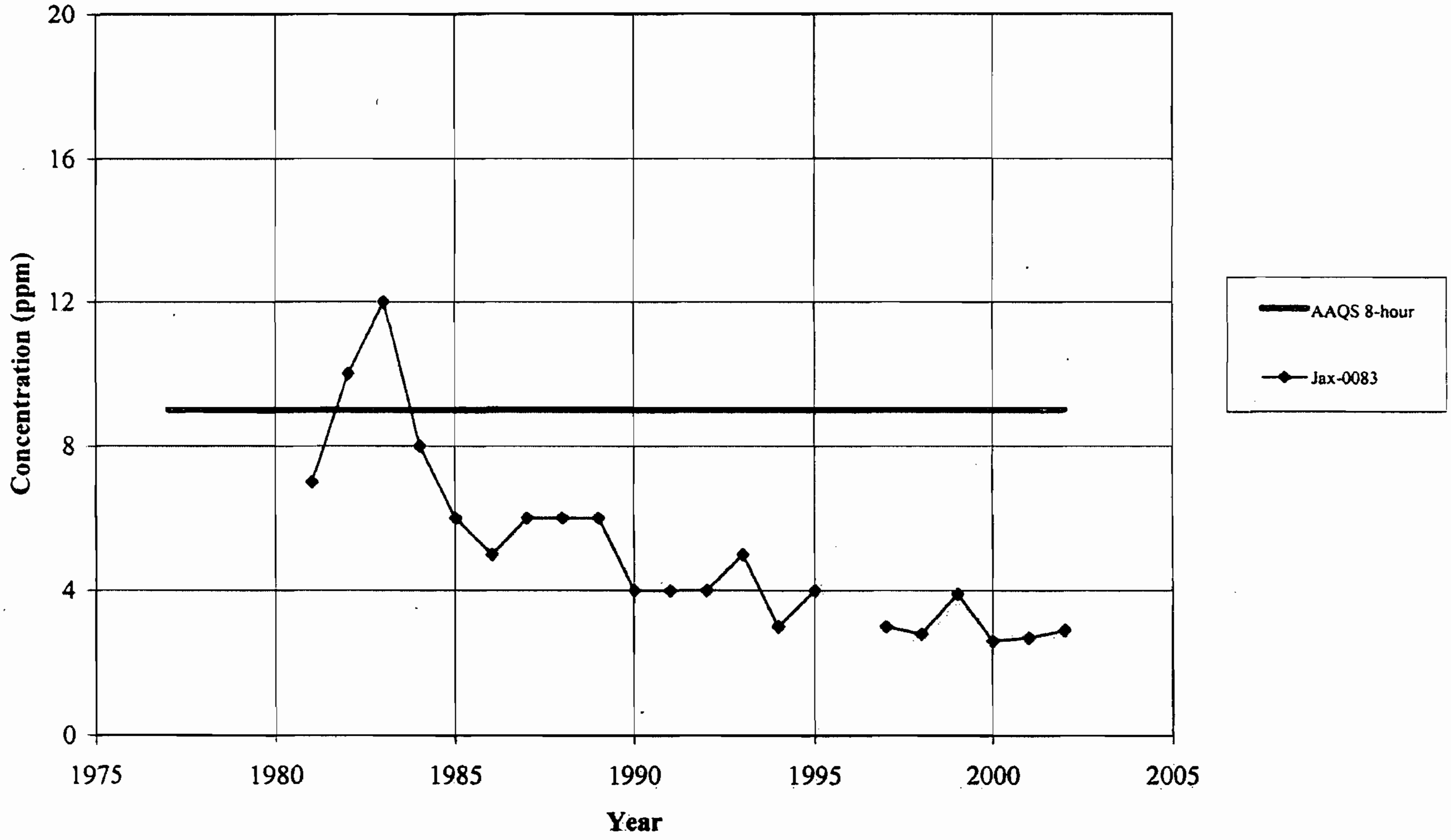


FIGURE C-24
MEASURED 1-HOUR AVERAGE OZONE CONCENTRATIONS (2nd Highest Values) from 1981 to 2002 Putnam County

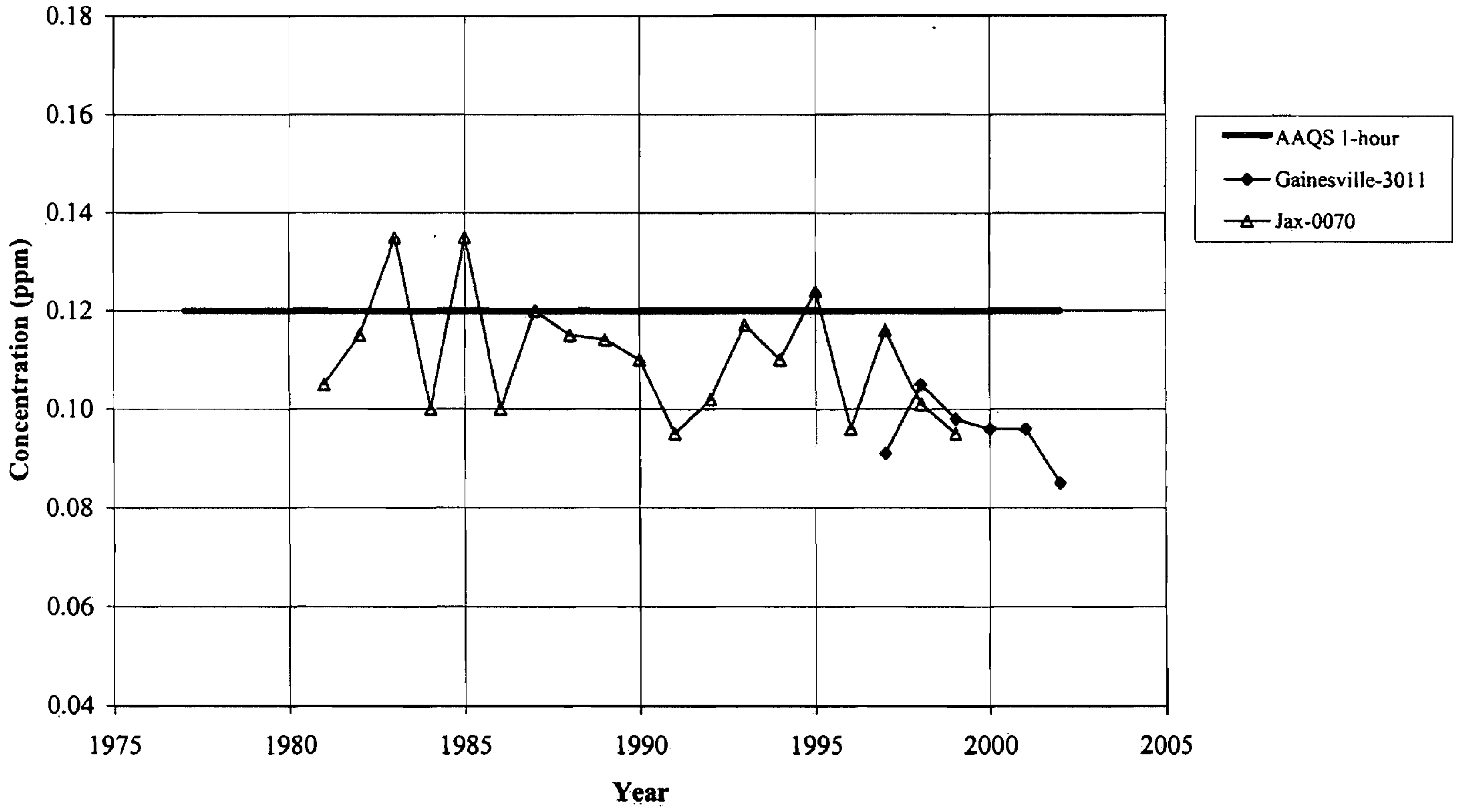
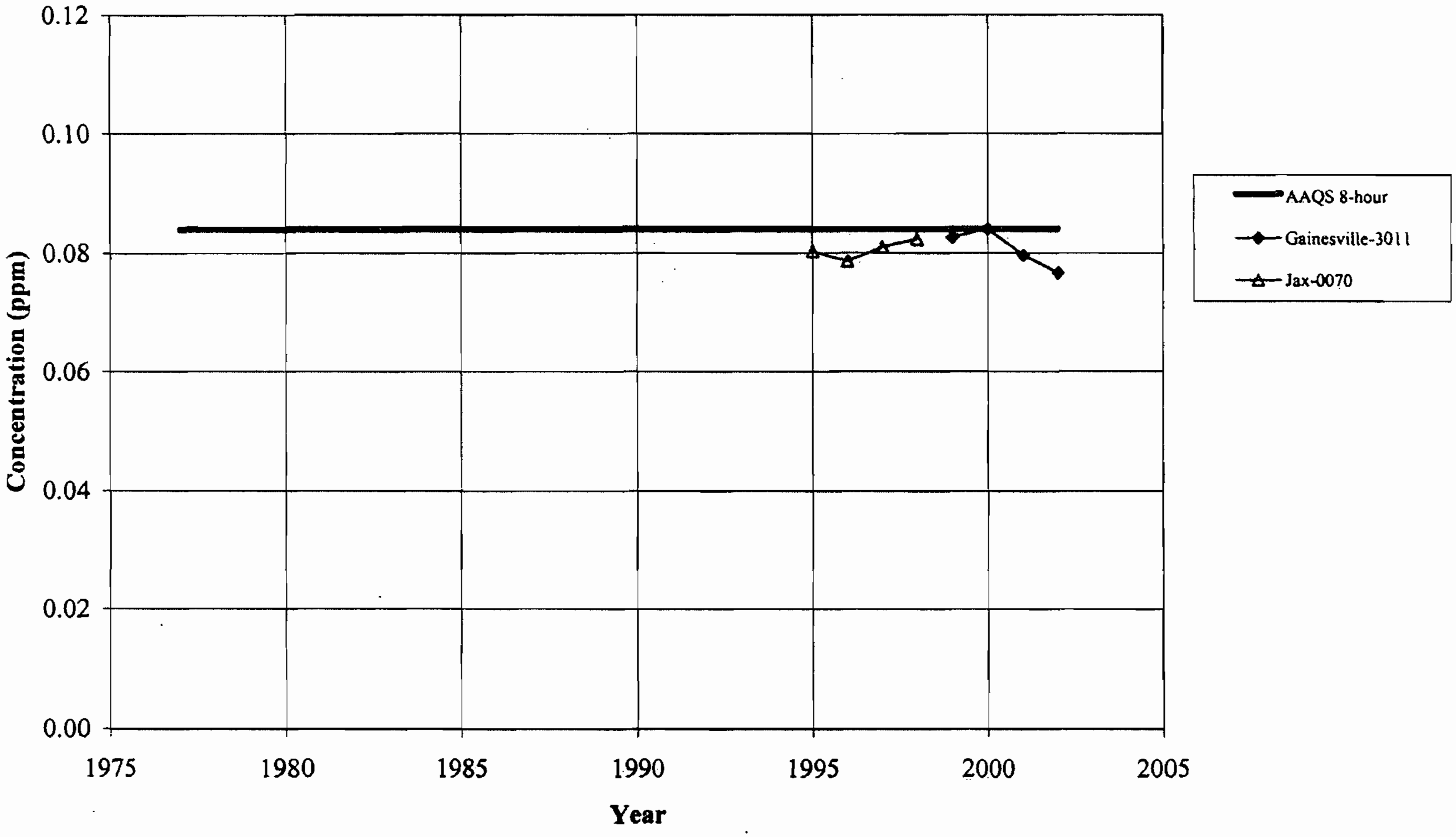


FIGURE C-25
MEASURED 8-HOUR AVERAGE OZONE CONCENTRATIONS
(3-Year Average of the 4th Highest Values) from 1995 to 2002
Putnam County



ATTACHMENT D

BACT ANALYSES

ATTACHMENT D
BEST AVAILABLE CONTROL TECHNOLOGY (BACT) REVIEW FOR NO. 4 RECOVERY BOILER

PROJECT DESCRIPTION

The Recovery Boiler is at the heart of the Kraft chemical recovery process. It fulfills the following essential functions:

(1) Evaporates residual moisture from the black liquor solids.
(2) Burns the organic constituents.
(3) Supplies heat for steam generation.
(4) Reduces oxidized sulfur compounds to sulfide.
(5) Recovers inorganic chemicals in molten form.
(6) Conditions the products of combustion to minimize chemical carryover.

Heavy black liquor from the pulping process is sprayed directly into the Boiler. The liquor droplets dry and partially pyrolyze before falling onto the char bed. Incomplete combustion in the porous char bed causes carbon and carbon monoxide to act as reducing agents, thus converting sulfate and thiosulfate to sulfide. The heat is sufficient to melt the sodium salts, which filter through the char bed to the floor of the Boiler. The "smelt" then flows by gravity through water-cooled spouts to the No. 4 Smelt Dissolving Tanks.

The No. 4 Recovery Boiler (Emission Unit 018) was originally constructed in the mid-1970s. The current, permitted capacity of the Boiler is 210,000 pounds per hour (lbs/hour) of black liquor solids (BLS) and 5.04 million pounds (MM lbs) of BLS per day. The Boiler is also permitted to combust natural gas, No. 6 fuel oil with a sulfur content not to exceed 2.35% by weight and on-spec used oil as start-up fuels. As part of this permitting action, the Mill is requesting that the allowable sulfur content of the fuel oil be lowered from the current 2.35% to 2.1%. The Recovery Boiler is equipped with an electrostatic precipitator (ESP) for particulate matter control.

This PSD application is being submitted to implement several projects for the No. 4 Recovery Boiler and associated evaporators. First, the Mill plans to replace a large percentage of the tubes in the Recovery Boiler. This includes tubes in the superheater, economizer, and generating banks of the Boiler. This major tube work is estimated to commence in May 2006 and conclude in 2008. The total cost of this work is estimated to be in the range of $24 million.

Although still in the preliminary engineering phase, the Mill is also considering replacement of, or changes to, the combustion air system for the Boiler. The objective of this part of the project is to lower peak furnace exit gas temperature and velocity into the superheater in an effort to reduce the potential for corrosion and pluggage of the superheater in the future. The new air system is also expected to reduce carry over and fouling in the Boiler convection banks. Through the staging of air, it is anticipated that emissions of some pollutants (*e.g.,* total reduced sulfur (TRS) compounds and carbon monoxide (CO)) will be more consistently controlled and/or reduced. At the same time, by reducing TRS and CO and increasing boiler efficiency, nitrogen oxide (NO_x) emissions are expected to increase slightly. The Mill is in the process of receiving vendor quotations for this work, including suggested scope. As such, the exact scope of this work is not available at this time.

A third project involves a modification to the black liquor evaporation system (No. 4 Evaporator Set). This change would increase the solids concentration of the black liquor to the Recovery Boiler from 65 percent solids to approximately 75 percent solids. When the new system is operational, the liquor from the concentrator will pass through a Crystallizer vessel to raise the temperature of the liquor. The liquor will then enter a storage/flash tank at lower pressure where the moisture will "flash off". The "flash" vapors will then be routed to the existing evaporator system and collected as part of the existing non-condensible gas (NCG) collection system. The purpose of the project is to increase Boiler efficiency by reducing the amount of water entering the Boiler with the liquor solids. By reducing the amount of water vaporization being performed by the Boiler, less supplemental fuel will be required to process the same amount of BLS. Furthermore, the increase in solids will improve the efficiency of the Boiler for steam production per pound of BLS, thus reducing the amount of steam produced from oil in the other boilers.

Finally, the Mill is considering the removal of some internal baffles and resizing some downcomer piping in the existing concentrators. The unit currently has scaling problems, leading to frequent "boil outs". The proposed changes will improve liquor circulation and increase velocity through the tubes, which should reduce scaling and fouling. This will increase the time between "boil outs". In addition, an external heat exchanger will be added to the existing concentrators to preheat the liquor with steam prior to entry into the concentrators. This will allow for increased evaporation surface, providing for a capability that more closely matches the capacity of the Recovery Boiler.

APPLICABILITY

The following pollutants are subject to PSD review as shown in Table 5-1 of the main text of this application package and are therefore subject to the BACT review for this project:

- Particulate matter (PM), including particulate matter less than 10 micrometers in aerodynamic diameter (PM_{10})
- Nitrogen oxides (NO_x)
- Carbon monoxide (CO)
- Sulfuric acid mist (SAM)
- Ozone (based on a significant increase in volatile organic compounds (VOCs))

Each of these pollutants is addressed in turn in the following section.

BACT ANALYSIS FOR THE NO. 4 RECOVERY BOILER

Particulate Matter (PM/PM_{10})

Step 1a-Identification of Control Technologies-Typical Technologies in Use in the United States

Emission control equipment that may be selected to control particulate matter emissions from recovery boilers includes ESPs, baghouses, and high efficiency wet scrubbers. Each of these types of control equipment, described more fully below, is capable of significantly reducing particulate matter emissions.

Electrostatic Precipitators (ESPs)

ESPs use electrical energy to charge and collect particles with very high removal efficiencies. The classification of ESPs may be as wet or dry systems and/or single-stage or two-stage systems. Dry systems are the predominant type used in industrial applications. Wet systems are gaining in use today since they eliminate the possibility of fires, which can sometimes occur in dry systems.

The principal components of an ESP include the housing, discharge and collection electrodes, power source, cleaning mechanism, and solids handling systems. The housing is gas-tight, weatherproof, and grounded for safety. Dust particles entering the housing are charged by ions from the discharge electrodes. Dust is collected on the collection electrodes. The collection electrodes are also referred to as plates. The system voltage and the distance between the discharge and collection electrodes govern the electric field strength and the amount of charge on the particles. ESPs are most effective at collecting coarse, larger particles above the 1 micron (μm) size. Particles smaller than this are difficult to remove because they can inhibit the generation of the charging corona in the inlet field, thereby reducing collection efficiency. Rappers and liquid washdown serve as the cleaning mechanisms for dry and wet ESPs, respectively. Dust hoppers collect the precipitated particles from a dry ESP. Wet sluicing is used to remove wet particles. Dry dust is removed continuously or periodically from the hopper and stored in a container until final disposition. Wet solids must be continuously removed and sent to a holding pond or to a wastewater treatment system.

ESPs are the predominant type of particulate matter control device used on recovery boilers in the U.S. today. ESPs can achieve particulate matter removal efficiencies as high as 99.9%. Some of their advantages over other types of particulate matter control devices are listed below:

- Low power requirements and associated electrical energy costs
- Capable of removing very small particles, even those not removable by other treatment technologies
- Dry dust collection often used, which may be useful for byproduct recovery
- Temperature changes very small with dry systems
- Small pressure drops (in the range of 1-2 inches water column (w.c.) pressure)
- Low maintenance due to few moving parts
- System tolerant of high temperatures
- System capacity can easily be expanded with the addition of partitions

Some of the disadvantages of using an ESP over other particulate matter control devices are listed below:

- High capital cost
- Space requirements large
- Gaseous wastes are not controlled
- Safety is a concern due to high voltage
- Wet systems produce sludges that may require dewatering before disposal

Baghouses

A baghouse, or fabric filter, is one of the most efficient devices for removing particulate matter. Baghouses have the capability of maintaining collection efficiencies above 99% for particles down to 0.3 μm in size. The basic components of a fabric filter unit consist of woven or felted fabric, usually in the form of bags that are suspended in a housing structure (baghouse), an induced draft or forced draft fan, a blow-back or reverse air fan for cleaning the bags, or a pulse-jet fan or a mechanical shaking mechanism for cleaning the bags. The emission stream is distributed by means of specially designed entry and exit plenum chambers, providing equal gas flow through the filtration medium. The particle collection mechanism for fabric filters includes inertial impaction, Brownian diffusion, gravity settling, and electrostatic attraction. The particles are collected in dry form on a cake of dust supported by the fabric or on the fabric itself. The process occurs with a relatively low-pressure drop requirement (usually within the range of 2-6 inches w.c.). Periodically, most of the cake dust is removed for disposal. Cake dust is removed by the use of a mechanical shaking or "rapping" system, with the use of reverse air, or with the use of a pulse-jet of air. Dust is collected in a hopper at the bottom of the baghouse and is removed through a valve and dumped into a storage container. Usually, the dust is disposed of at an industrial landfill.

Some of the advantages of using baghouses over other types of particulate matter control devices are listed below:

- High collection efficiency down to small particle sizes (99% control down to 0.3 μm)
- Relatively low capital cost
- Dry dust collection may be useful for byproduct recovery

- Low pressure drop

Some of the disadvantages of using baghouses compared to other types of particulate matter control devices are listed below:

- High maintenance costs due to the presence of many moving parts
- Maximum operating temperatures of about 550 degrees Fahrenheit (°F)
- Gaseous wastes are not controlled
- Space requirements large
- Cannot operate with saturated (wet) gas streams

Wet Scrubbers

Wet scrubbers are collection devices that trap wet particles in order to remove them from a gas stream. They utilize inertial impaction and/or Brownian diffusion as the particle collection mechanism. Wet scrubbers generally use water as the cleaning liquid. Water usage and wastewater disposal requirements are important factors in the evaluation of a scrubber alternative. Types of scrubbers include spray scrubbers, cyclone scrubbers, packed-bed scrubbers, plate scrubbers, and venturi scrubbers. The most common particulate matter removal scrubber is the venturi scrubber because of its simplicity (*e.g.,* no moving parts) and high collection efficiency. In this type of scrubber, a gas stream is passed through a venturi section, before which, a low-pressure liquid (usually water) is added to the throat. The liquid is atomized by the turbulence in the throat and begins to collect particles impacting the liquid as a result of differing velocities for the gas stream and atomized droplets. A separator is used to remove the particles or liquid from the gas stream. The most important design consideration is the pressure drop across the venturi. Generally, the higher the pressure drop, the higher the removal efficiency.

Advantages of using a wet scrubber compared to other particulate matter control devices are listed below:

- Adsorbs gas phase emissions, as well as particulate matter as long as proper scrubbing media is used
- Compact size
- Efficient through wide loading range
- Insensitive to moisture content
- Venturi – no moving parts

Disadvantages of using a wet scrubber compared to other particulate matter control devices are listed below:

- Inefficient with high-temperature gases
- Requires high power input to create large pressure drop and high collection efficiency
- Waste scrubber liquid handling required

Step 1b-Identification of Control Technologies-Review of RACT/BACT/LAER Clearinghouse (RBLC)

Searches of the RBLC were conducted to identify control technologies for the control of PM/PM_{10} emissions from recovery boilers.

The specific categories searched are listed below:

- External Combustion-Other-11.999
- Kraft Pulp Mills-30.002

- Pulp & Paper Production Other than Kraft-30.004
- Other Wood Products Industry Sources-30.999

The results of the search are listed in Table D-1a. As can be seen in Table D-1a, all of the entries, with just a few exceptions, indicate the use of ESPs to control PM/PM_{10} emissions from recovery boilers.

Step 1c-Identification of Control Technologies-Review of Technologies in Use at Georgia-Pacific Corporation Facilities

Georgia-Pacific operates numerous pulp and paper mills in the United States, with many of these employing Kraft recovery boilers. All of the recovery boilers at these facilities use ESPs to control PM/PM_{10} emissions. One facility, located in Camas, Washington (listed in the RBLC as James River Corporation, but now owned by GP), has two recovery boilers equipped with both ESPs and wet scrubbers. The wet scrubbers were installed to recover heat and make hot process water for use in the Mill. The wet scrubbers were not installed to control particulate matter emissions, which is accomplished by the ESPs.

Step 2-Technical Feasibility Analysis-Eliminate Technically Infeasible Options

While baghouses can achieve high levels of particulate matter control, the exhaust gas streams from the recovery boilers have relatively high moisture contents (25 to 30%) that cause the particulate matter to be hydroscopic in nature. These characteristics will cause the bag filters in the baghouse to "blind-up" and plug. These problems indicate that a baghouse is not an appropriate technology for recovery boilers. Therefore, baghouses are not considered further as part of this BACT analysis.

ESPs and wet scrubbers are feasible technologies for reducing particulate matter emissions from recovery boilers.

Step 3-Ranking the Technically Feasible Control Alternatives to Establish a Control Hierarchy

ESPs are most effective in controlling fine particulate matter emissions from recovery boilers. As discussed above, ESPs are the predominant particulate matter control device listed in EPA's RBLC for Kraft recovery boilers. ESPs control particulate matter from recovery boilers at levels that exceed 99+%.

Wet scrubbers will not have any problem with the high moisture content in recovery boiler exhaust gas streams. However, the particulate matter control efficiency for a scrubber will be approximately 98% versus a control efficiency of 99+% attained by an ESP.

Step 4-Control Effectiveness Evaluation

This step of the BACT analysis is only necessary when the top control technology from Step 3 is not selected as BACT. Since the Mill already uses an ESP to collect particulate matter emissions, which is the top control technology, a control effectiveness evaluation is not necessary.

Nearly all recovery boilers in the United States employ ESPs as the particulate matter control technology. This is validated by the RBLC listings in Table D-1a, which indicate the predominant use of ESPs as BACT.

Since an ESP is the most effective technology for removing particulate matter from the No. 4 Recovery Boiler, and since the unit already utilizes an ESP to control particulate matter emissions, no additional controls are proposed.

Step 5-Select BACT

The NSPS (40 CFR 60, Subpart BB) for particulate matter from Kraft recovery boilers is 0.044 grain per dry standard cubic foot (grain/dscf) at 8% oxygen (O_2). The Maximum Achievable Control Technology (MACT) rule, promulgated in January 2001, also specifies a particulate matter emission limit of 0.044 grain/dscf at 8% oxygen. However, the No. 4 Recovery Boiler already has a Title V Permit limit of 0.03 grain/dscf at 8% O_2, which is more stringent than either the NSPS or MACT standards.

The limits listed for other recovery boilers in Table D-1a range from 0.021 grain/dscf to 0.15 grain/dscf. Therefore, BACT for the No. 4 Recovery Boiler should be the use of an ESP with a limit set equal to the current Prevention of Significant Deterioration (PSD) and Title V Permit limit of 0.03 grain/dscf at 8% O_2. This is at the low end of the limits contained in Table D-1a.

Nitrogen Oxides (NO_x)

Step 1a-Identification of Control Technologies-Typical Technologies in Use in the United States

NO_x is formed during combustion processes by the thermal oxidation of nitrogen in the combustion air (*i.e.,* thermal NO_x) and the oxidation of nitrogen in the fuel (*i.e.,* fuel-bound NO_x). In a recovery boiler, black liquor nitrogen content, or fuel NO_x, is the most important factor affecting NO_x formation. Fuel properties, temperature, and the stoichiometric conditions present during combustion are additional variables that affect NO_x formation. Excess oxygen in the zone where the bulk of black liquor combustion takes place is also an important factor for NO_x formation.

There are two main approaches that can be used to reduce nitrogen oxides emissions from boilers. The first is combustion modification and the second is post-combustion controls.

Combustion Modification Techniques

There are a number of combustion modification techniques available for reducing NO_x emissions. These include:

- Staged combustion using overfire air in burners (20-50% reduction)
- Addition of levels of staged air combustion (percent reduction dependent upon the number of existing levels and number of levels added)
- Low-NO_x burners (20-50% reduction)
- Flue gas recirculation (15-20% reduction)
- Low excess air (0-30% reduction)

The combustion modification techniques listed above all reduce NO_x by minimizing its formation in the combustion chamber of the Boiler by using less oxygen than is stoichiometrically required for complete combustion of the fuel. This lowers the temperature in the combustion chamber, thus reducing the amount of thermal NO_x that is formed. To complete the combustion process, excess air is added later in the combustion process. Each of these modifications requires additional equipment, such as new fans or burners, as well as controls, to operate properly.

Post-Combustion Controls

The technologies for post-combustion control include:

- Selective non-catalytic reduction (SNCR) (25-70% reduction)
- Selective catalytic reduction (SCR) (up to 90% reduction)

Post-combustion technologies work by several different methods as explained in the following sections.

SNCR systems work by injecting ammonia or urea into the combustion chamber of the boiler, thereby converting NO_x to elemental nitrogen, carbon dioxide, and water vapor. The reaction must take place between specific temperature ranges or more NO_x will be formed instead of less NO_x. The optimum temperature range for a system that uses ammonia is 1,600 to 2,000 °F and for a system that uses urea, the optimum temperature range is 1,650 to 2,100 °F. Increasing the residence time available for mass transfer and chemical reactions generally increases NO_x removal. Variations in boiler steam load or flue gas temperature make the design and operation of an SNCR system more difficult.

SCR systems work by passing the contaminated exhaust gas stream through a catalyst bed and injecting aqueous or anhydrous ammonia just in front of the catalyst bed. This system also converts NO_x to elemental nitrogen, carbon dioxide, and water vapor, similar to an SNCR system. This reaction also has an optimum temperature range to work efficiently. The optimum temperature range for the catalyst to work efficiently is 550 to 1,000 °F (best temperature window is between 700 and 750 °F). Since the optimum temperature window for the SCR process is less than that for the SNCR process, reaction of NO_x is designed to take place downstream of the combustion chamber, as opposed to inside the combustion chamber as is the case for an SNCR system. Most designs install the reaction chamber downstream of the economizer, but upstream of the air pre-heater, where the metal oxide-based catalyst works best. Reheating of the flue gas is required for reaction chambers located downstream of the air pre-heater.

Most of the operating parameters discussed above for an SNCR system are valid for an SCR system as well, except for catalyst management. Catalysts can lose their activity over time for a number of reasons as discussed below:

> *Poisoning*-certain fuel constituents released during the combustion process can act as catalyst poisons. Catalyst poisons include calcium and magnesium oxides, potassium, sodium, arsenic, chlorine, fluorine, and lead. These constituents deactivate the catalyst by diffusing into active pore sites and occupying them irreversibly.
>
> *Thermal Sintering*-high flue gas temperatures cause sintering (*i.e.,* a permanent loss of catalyst activity due to a change in pore structure of the catalyst). Thermal sintering can occur at temperatures as low as 450 °F. The amount of sintering that occurs is dependent upon the composition and structure of the catalyst.
>
> *Binding/Plugging/Fouling*-ammonia salts, fly ash, and other particulate matter in the flue gas can cause binding, plugging, and/or fouling of the catalyst. The particulate matter deposits in the active pore sites of the catalyst, which results in a decrease in the number of sites available for NO_x reduction and an increase in flue gas pressure loss across the catalyst bed.
>
> *Erosion and Aging*-catalysts with hardened leading edges or increased structural strength are less susceptible to erosion. Increasing catalyst strength by hardening reduces the number of active pore sites. Catalyst aging occurs over a period of time, which changes the physical and chemical properties of the catalyst.

There are methods available to minimize the possibility of the catalyst from deactivating over time (because of the reasons listed above). These include the use of soot blowers to dislodge deposits of particulate matter on the catalyst, turning vanes and rectifier grids to remove some of the particulate matter from the flue gas before it reaches the catalyst, and replacing the catalyst on a routine basis before it becomes poisoned or deactivated. Catalyst replacement can be a significant part of the operating costs for an SCR system

Similar to an SNCR system, an SCR system requires an aqueous or anhydrous ammonia or urea storage, feed, and control system, to operate properly.

Step 1b-Identification of Control Technologies-Review of RACT/BACT/LAER Clearinghouse

Searches of the RBLC were conducted to identify control technologies for the control of NO_x emissions from recovery boilers.

The specific categories searched are listed below:

- External Combustion-Other-11.999
- Kraft Pulp Mills-30.002
- Pulp & Paper Production Other than Kraft-30.004
- Other Wood Products Industry Sources-30.999

The results of the searches are listed in Table D-1b and are summarized below:

- No controls feasible
- Boiler design and good combustion practices
- Low-NO_x burner for natural gas combustion
- Proper combustion techniques and operating practices
- Staged combustion
- Boiler design and operation
- Combustion control
- Addition of 4th level of air

Step 1c-Identification of Control Technologies-Review of Technologies in Use at Georgia-Pacific Corporation Facilities

Some of the recovery boilers located at GP mills utilize four levels of staged combustion control, some of the boilers utilize three levels of staged combustion control, and some of the boilers utilize only two levels of staged combustion control. None of the boilers use any type of add-on control, such as SCR, to control NO_x emissions. Average NO_x emission rates during normal operations from GP's recovery boilers range from 70-150 parts per million by volume (ppmv).

Step 2-Technical Feasibility Analysis-Eliminate Technically Infeasible Options

Combustion modification techniques as a control option are technically feasible for recovery boilers and most recovery boilers employ one type of combustion technique or another. Probably the most widely used combustion technique is staged combustion where there are two to four different stages of combustion air supplied to the boiler at successively higher points in the body of the boiler.

Relative to flue gas treatment as a control option, SNCR is not considered technically feasible for Kraft recovery boilers based on the fact that a recovery boiler is a complete, chemical reaction system and any disruption of the delicate chemistry could potentially damage the boiler, impact the quality of the product, or otherwise unacceptably affect the system. The injection of a urea solution or ammonia gas would have a detrimental effect upon the chemistry inside of a recovery boiler. For these reasons, SNCR is considered technically infeasible for a recovery boiler and it is not considered further in this BACT analysis.

It is questionable if an SCR system is technically feasible for the treatment of flue gases generated by a recovery boiler. The toxic metals present in the flue gas exhaust, even after passing through the ESP, are of sufficient quantity to build-up on the surface of the catalyst bed and poison the catalyst within relatively short periods of time. Additionally, the flue gas exhaust would need to be heated from a temperature of about 425

°F to at least 700 °F in order for the catalyst to work efficiently. This will add significant cost for a duct burner combusting natural gas, as well as add NO_x emissions back into the environment.

To verify that an SCR system is not economically feasible for a recovery boiler, a cost estimate for the installation and operation of an SCR system is presented under Step 4 of this section (see below), even though an SCR system is probably not suitable because of the likelihood of catalyst poisoning.

Low-NO_x burners represent a method for lowering NO_x emissions for the combustion of fossil fuels in a recovery boiler, however, the Mill only burns No. 6 fuel oil in the No. 4 Recovery Boiler for periods of start-up and shut-down, and not during normal operations. Natural gas is only burned to fuel a pilot light which in turn is used to light the No. 6 fuel oil. It would not be practical to use low-NO_x burners for short periods of time that are not representative of normal operation for the boiler.

Step 3-Ranking the Technically Feasible Control Alternatives to Establish a Control Hierarchy

SNCR was eliminated due to technical infeasibility. SCR and combustion modification techniques are the only remaining control technologies to be evaluated. As stated earlier, SCR control systems can reduce NO_x emissions by as much as 90%. Combustion modification techniques can reduce NO_x emissions by varying amounts, depending upon the technology selected and the baseline emission rate. Each of these technologies is discussed under Step 4 below.

Step 4-Control Effectiveness Evaluation

A cost effectiveness evaluation for installation of an SCR system for the No. 4 Recovery Boiler is presented in Table D-2. The cost data presented in Table D-2 were used with EPA's cost factors contained in EPA's Cost Control Manual to develop the cost effectiveness for an SCR system. Based on the data contained in Table D-2, the overall costs for an SCR system are estimated to be greater than $19,575 per ton of NO_x reduced. This is based on the average 2003-2004 NO_x emission rate of 425.4 tons per year from the Recovery Boiler and an assumed 90% reduction of NO_x emissions with the SCR system. This cost effectiveness value is economically infeasible and cannot be justified for a recovery boiler.

While very little, if anything, can be done to affect black liquor nitrogen content, staged air combustion, which is integral to the operation of most recovery boilers, is the most effective strategy for minimizing NO_x formation in a recovery boiler. The No. 4 Recovery Boiler at the Palatka Mill currently employs staged combustion with primary, secondary, and tertiary combustion air. As part of the project to increase boiler efficiency, the Mill is planning to install a fourth level of combustion air. Since the Mill is installing this technology, a cost effectiveness analysis is not necessary.

Step 5-Select BACT

There is no NSPS limit for NO_x emissions from recovery boilers. As stated earlier, typical NO_x emissions from recovery boilers range from 75 to 150 ppmv, depending upon how many levels of combustion air (and the configuration of the air system in general) are used to control NO_x emissions. Table D-1b provides a listing of the NO_x BACT determinations for recovery boilers, which indicate NO_x permit limits that range from 70 to 210 ppmv. The BACT control technologies listed in Table D-1b include combustion control, staged combustion, boiler design and operation, and process controls. One entry lists low-NO_x burners, but this technology applies to a supplemental burner that fires natural gas. One entry lists the addition of a fourth level of combustion air with a NO_x emission limit of 100 ppmv.

The current Title V and PSD NO_x permit limit for the No. 4 Recovery Boiler is 80 ppmvd @ 8% O_2 and 168.5 pounds per hour

To determine what the NO_x emission rate would be by installing a fourth level of staged air combustion, the Mill obtained proposals from a number of vendors. The guaranteed NO_x emission estimates from the vendors for the addition of a fourth level of air in the No. 4 Recovery Boiler ranged from 78 to 90 ppmv, corrected to 8% oxygen. These emission estimates are based on a black liquor solids content of 75%, which is the expected level after the crystallizer project is implemented. As the result of the project to increase boiler efficiency, TRS and CO emission rates will be reduced. However, this will result in a slight increase in NO_x emissions. To keep the NO_x emission rate from increasing beyond its current level (with only three levels of combustion air), a fourth level of combustion air is necessary.

Based on the emission guarantees from the vendors, the Mill believes that BACT should be equal to a fourth level of combustion air with the same NO_x emission rate 168.1 lbs/hr (equivalent to 80 ppmvd, corrected to 8% oxygen) as contained in the current Title V Permit. The 80 ppmvd value is at the low end of the emission estimates obtained from the vendors.

Carbon Monoxide (CO)

Step 1a-Identification of Control Technologies-Typical Technologies in Use in the United States

CO is generated in a recovery boiler when there is insufficient oxygen present to achieve complete combustion of the black liquor solids in the combustion chamber of the boiler. CO generation is inversely proportional to the generation of NO_x emissions. In other words, if NO_x emissions are minimized through the use of internal combustion modification techniques, it is likely that CO emissions will be increased and vice-versa. Therefore, efforts to minimize CO emissions in a recovery boiler must be balanced so that NO_x emissions are not significantly increased.

There are two approaches that can be used to reduce CO emissions from recovery boilers. The first is combustion modification and the second is post-combustion controls (*e.g.*, oxidation catalysts).

Combustion Control

Minimizing the formation of CO emissions is usually performed by ensuring efficient combustion in the combustion chamber of a boiler. This is achieved by having the correct controls in place to assure the proper black liquor solids to combustion air ratio in the combustion chamber of the boiler.

Oxidation Catalysts

Oxidation catalysts can be used as a post-combustion technique to reduce CO emissions by as much as 90% from the uncontrolled emission rate. The catalysts work best when the temperature of the gas stream being oxidized is between 600 and 1,100 °F, with an optimum temperature of 800 °F. If the exhaust gas stream temperature of the boiler in question is lower than the optimum temperature range, then additional heat must be used in order to raise the temperature to the desired level (the Palatka Mill's No. 4 Recovery Boiler exhaust temperature is approximately 425 °F). This may add significant operating costs to the control system since fuel must be combusted in a duct burner in order to supply the additional heat.

Oxidation catalysts are typically only used in combustion applications that use natural gas or light grade fuel oils (*i.e.*, No. 1 and No. 2 fuel oils). This is because oxidation catalysts are sensitive to heavy metals that are contained in higher-grade fuel oils or black liquor. Heavy metals, such as zinc, lead, mercury, copper, potassium, magnesium, arsenic and vanadium, will poison the catalyst once a build up of 0.2% (by weight) accumulates on the surface of the catalyst. Most of the referenced heavy metal contaminants are present in black liquor. When the No. 4 Recovery Boiler is burning black liquor, these contaminants will build-up on the surface of the catalyst, thereby poisoning the catalyst and rendering it useless for reducing CO emissions.

Even after consideration of pollution control equipment to remove particulate matter emissions from the flue gas exhaust from the No. 4 Recovery Boiler, a sufficient quantity of heavy metals will still be present to degrade or even poison the catalyst. For these reasons, it is not technically feasible to use an oxidation catalyst for reducing CO emissions from the No. 4 Recovery Boiler.

Step 1b-Identification of Control Technologies-Review of RACT/BACT/LAER Clearinghouse

Searches of the RBLC were conducted to identify control technologies for the control of CO emissions from recovery boilers.

The specific categories searched are listed below:

- External Combustion-Other-11.999
- Kraft Pulp Mills-30.002
- Pulp & Paper Production Other than Kraft-30.004
- Other Wood Products Industry Sources-30.999

The results of the searches are listed in Table D-1c and are summarized below:

- No controls feasible
- Boiler design and good combustion practices
- Proper combustion techniques and operating practices
- Boiler design and good combustion practices
- Combustion control
- Good combustion control of flame temperature and excess air
- Boiler design and operation
- Efficient operation

Step 1c-Identification of Control Technologies-Review of Technologies in Use at Georgia-Pacific Corporation Facilities

All of the recovery boilers at GP's mills utilize varying degrees of staged combustion controls to balance CO and NO_x emissions. The recovery boilers at GP's mills emit varying quantities of CO emissions during normal operations that range from 60 to 450 ppmv, with the higher values coming from older boilers and/or boilers with fewer than three levels of combustion air, and the lower values coming from newer boilers and/or boilers with three or more levels of combustion air.

Step 2-Technical Feasibility Analysis-Eliminate Technically Infeasible Options

As stated earlier, it is not technically feasible to use an oxidation catalyst to reduce CO emissions due to catalyst poisoning from heavy metal contamination. Combustion control is technically feasible for minimizing CO emissions and is inherent in the design of recovery boilers due to the use of staged combustion techniques.

Step 3-Ranking the Technically Feasible Control Alternatives to Establish a Control Hierarchy

The only remaining control technology is combustion control.

Step 4-Control Effectiveness Evaluation

The most effective control technology for minimizing carbon monoxide emissions from recovery boilers is combustion control through the use of staged combustion. As discussed previously, the Palatka No. 4 Recovery Boiler employs staged combustion with primary, secondary, and tertiary combustion air.

Step 5-Select BACT

There is no NSPS limit for CO emissions from recovery boilers. The existing Title V and PSD permits limit CO emissions to 800 ppmv @ 8% O_2 on a 3-hour average basis and 400 ppmv @ 8% O_2 on a 24-hour and annual average basis.

Based on the entries shown in Table D-1c from the RBLC, CO emission limits for recovery boilers range anywhere from 200 to 3,000 ppmv, depending upon the age of the boiler and the averaging time. As stated earlier, the CO emission rate from a recovery boiler is dependent upon the age of the boiler and its inherent design. The BACT control technologies listed in Table D-1c include combustion control, boiler design and operation, and process controls.

GP is not proposing any changes to the CO emission limits for the No. 4 Recovery Boiler as part of this BACT analysis. GP further proposes that BACT for the No. 4 Recovery Boiler be defined as "Boiler Design and Combustion Control".

Sulfuric Acid Mist (SAM)

Step 1a-Identification of Control Technologies-Typical Technologies in Use in the United States

SAM forms as a byproduct of SO_2 emissions when condensation occurs in the gas stream. The quantity of SAM generated is small compared to the amount of SO_2 generated, usually no more than 2-4% of the SO_2 emissions.

There are three approaches that can be used to reduce SAM emissions from recovery boilers. These include mist eliminators, wet ESPs, and combustion control.

Mist Eliminators

The predominant method for controlling SAM emissions from industrial processes and sources of combustion, other than internal design, is mist eliminators. SAM particles are very small, usually in the submicron range. Mist eliminators are designed to remove fine particles, down to 0.5 micron in size. For example, one type of mesh pad manufactured by Enviro-Chem is advertised to remove 99.9% of all particles greater than 2 microns in size and 70% of particles less than 2 microns in size. This efficiency is achieved with a pressure drop of less than 3 inches w.c. pressure.

Wet ESPs

Wet ESPs may also be used to control SAM emissions from recovery boilers. Wet ESPs work similar to dry ESPs, except that the particles are washed off of the electrodes with water sprays, instead of the use of a rapping system for dry ESPs. Also, wet ESPs must be constructed of materials that are resistant to acids, otherwise, the structure of the ESP would corrode very quickly due to the acidic environment. Wet ESPs will remove 90 to 95% of the inlet SAM emissions.

Combustion Control

Combustion control to reduce SO_2 emissions is inherent in the design of a recovery boiler due to the chemical reactions that take place inside of the combustion chamber when black liquor is combusted. Since SAM emissions make up 2 to 4% of SO_2 emissions, minimizing the generation of SO_2 emissions means that SAM emissions will be minimized as well.

Step 1b-Identification of Control Technologies-Review of RACT/BACT/LAER Clearinghouse

Searches of the RBLC were conducted to identify control technologies for the control of SAM emissions from recovery boilers.

The specific categories searched are listed below:

- External Combustion-Other-11.999
- Kraft Pulp Mills-30.002
- Pulp & Paper Production Other than Kraft-30.004
- Other Wood Products Industry Sources-30.999

The results of the searches are listed in Table D-1d and are summarized below:

- No controls
- Boiler design
- Firing rate and pulp production limits

Step 1c-Identification of Control Technologies-Review of Technologies in Use at Georgia-Pacific Corporation Facilities

All of the recovery boilers in use at GP's mills utilize combustion control to minimize the formation of SO_2 and SAM emissions.

Step 2-Technical Feasibility Analysis-Eliminate Technically Infeasible Options

As stated earlier in this analysis, the average exhaust temperature for the No. 4 Recovery Boiler is about 425 °F. At this temperature, SAM emissions would be in a gaseous state. Mist eliminators are not designed to remove gases, rather, they are designed to remove very small liquid droplets. Therefore, the use of mist eliminators for a recovery boiler is not technically feasible unless the unit already had in place a wet scrubber or other means to condense the sulfuric acid gases into a liquid mist. The No. 4 Recovery Boiler at the Palatka Mill does not have a wet scrubber or other device installed to condense the gases into a liquid mist.

The use of a wet ESP and combustion control are technically feasible options for the control of SAM emissions.

Step 3-Ranking the Technically Feasible Control Alternatives to Establish a Control Hierarchy

Combustion control can reduce SO_2 emissions by 99% or more, which means that SAM emissions can be reduced by a similar amount. Wet ESPs will remove 90-95% of SAM emissions.

Step 4-Control Effectiveness Evaluation

The most effective control technology for reducing SAM emissions from recovery boilers is combustion control. Based on stack test data collected over the 5-year period, 1999 through 2003, SAM emissions are generally less than 1.5 lbs/hour and 0.5 ppmv.

GP is unaware of any recovery boilers in the United States that employ mist eliminators to control SAM emissions.

GP selects the only remaining control technology, combustion control, as BACT.

Step 5-Select BACT

There is no NSPS limit for SAM emissions from recovery boilers. Table D-1d provides a listing of the SAM BACT determinations for recovery boilers. These limits range from 2.2 to 20 pounds per hour. The BACT control technologies listed in Table D-1d include "boiler design" and "no controls".

The current Title V Permit limit for SAM emissions is 0.81 ppmv. Based on recent stack test results (2003-2004), SAM emissions are less than the permit limit. GP proposes that BACT for the No. 4 Recovery Boiler be defined as "Boiler Design and Combustion Control" with an emissions limit of 3.6 lbs/hr, which is equivalent to the current Title V Permit limit of 0.81 ppmv.

Volatile Organic Compounds (VOCs)

Step 1a-Identification of Control Technologies-Typical Technologies In Use in the United States

The VOC emission rate is an inverse function of combustion efficiency. In other words, maintaining high combustion efficiencies will lower the VOC emission rate. This holds true in most combustion-related processes, including recovery boilers.

The same two approaches that can be used to reduce CO emissions from recovery boilers can also be used for reducing VOC emissions. The first approach is combustion control and the second approach is post-combustion controls (*e.g.,* oxidation catalysts):

Combustion Control

Just as efficient combustion will minimize the formation of CO emissions, VOC emissions will also be minimized by ensuring efficient combustion in the combustion chamber of a recovery boiler. This is achieved by having the correct controls in place to assure the proper black liquor solids to combustion air ratio in the combustion chamber of the boiler.

Oxidation Catalysts

Oxidation catalysts that are used as a post-combustion technique to reduce CO emissions will also reduce VOC emissions by as much as 90 to 95% from the uncontrolled emission rate. The catalysts work best when the temperature of the gas stream being oxidized is between 600 and 1,100 °F, with the optimum temperature of 800 °F. If the exhaust gas stream temperature of the boiler in question is lower than the optimum temperature range, then additional heat must be added in order to raise the temperature to the desired level. This may add significant operating costs to the control system since fuel must be combusted in a duct burner in order to supply the additional heat.

Oxidation catalysts are typically only used in combustion applications that use natural gas or light grade fuel oils (*i.e.,* No. 1 and No. 2 fuel oils). This is because oxidation catalysts are sensitive to heavy metals that are contained in higher-grade fuel oils or black liquor. Heavy metals, such as zinc, lead, mercury, copper, potassium, magnesium, arsenic and vanadium, will poison the catalyst once a build up of 0.2% (by weight) accumulates on the surface of the catalyst. Most of the referenced heavy metal contaminants are present in black liquor. When the No. 4 Recovery Boiler is burning black liquor, these contaminants will build-up on the surface of the catalyst, thereby poisoning the catalyst and rendering it useless for reducing VOC emissions.

Even after consideration of pollution control equipment to remove particulate matter emissions from the flue gas exhaust from the No. 4 Recovery Boiler, a sufficient quantity of heavy metals will still be present to degrade or even poison the catalyst. For these reasons, it is not technically feasible to use an oxidation catalyst for reducing VOC emissions from the No. 4 Recovery Boiler.

Step 1b-Identification of Control Technologies-Review of RACT/BACT/LAER Clearinghouse

Searches of the RBLC were conducted to identify control technologies for the control of VOC emissions from recovery boilers.

The specific categories searched are listed below:

- External Combustion-Other-11.999
- Kraft Pulp Mills-30.002
- Pulp & Paper Production Other than Kraft-30.004
- Other Wood Products Industry Sources-30.999

The results of the searches are listed in Table D-1e and are summarized below:

- No controls
- Combustion control
- Boiler design and good combustion practices
- Low odor design

Step 1c-Identification of Control Technologies-Review of Technologies in Use at Georgia-Pacific Corporation Facilities

As described above for CO, the recovery boilers in use at GP facilities utilize varying degrees, or stages, of combustion air to maintain adequate combustion efficiency and low CO emission rates. The same control technique also minimizes VOC emissions.

Step 2-Technical Feasibility Analysis-Eliminate Technically Infeasible Options

As stated earlier in this report, it is not technically feasible to use an oxidation catalyst to reduce VOC emissions due to catalyst poisoning from heavy metal contamination. Combustion control is technically feasible for minimizing VOC emissions and is inherent in the design of recovery boilers due to the use of staged combustion techniques.

Step 3-Ranking the Technically Feasible Control Alternatives to Establish a Control Hierarchy

The only remaining control technology is combustion control.

Step 4-Control Effectiveness Evaluation

The most cost effective control technology for minimizing VOCs from recovery boilers is combustion control through the use of staged combustion. As discussed previously, the No. 4 Recovery Boiler employs staged combustion with primary, secondary and tertiary combustion air.

Step 5-Select BACT

There is no NSPS limit for VOC emissions from recovery boilers. Table D-1e provides a listing of the VOC BACT determinations for recovery boilers. These limits range from 2.8 to 50 ppmv and 3.7 to 233 pounds per hour. The current Title V Permit limit for VOC emissions from the No. 4 Recovery Boiler is 31.5 lbs/hr, which is based on an emission factor of 0.3 lb/ton of black liquor solids. Based on recent stack test results (2003-2004), the No. 4 Recovery Boiler is in compliance with the current Title V Permit limits for VOCs.

GP proposes that BACT for the No. 4 Recovery Boiler be defined as Boiler Design and Combustion Control, with no changes in the current Title V Permit limit.

TAB[illegible]a-PM/PM_{10}

FACILITY NAME	STATE	PERMIT DATE	THRUPUT	THRUPUT UNITS	EMISSIONS	EMISSION UNITS	CONTROL TECHNOLOGY DESCRIPTION
SIMPSON LEE PAPER CO.	CA	1/14/1975	8000	GAL/H B.L.	0.15	GR/DSCF	ESP
ALABAMA RIVER PULP CO., INC	AL	11/6/1975	1088	T ADP/D	0.044	GR/DSCF AT 8% O2	ESP
UNION CAMP CORP.	AL	11/15/1977	1340	T ADP/D	0.044	GR/DSCF AT 8% O2	ESP
LEAP RIVER FOREST	MS	3/14/1980	999999	MMBTU/HR	0.044	GR/DSCF	DRY COLLECTION & SCRUBBER
HAMMERMILL PAPER	AL	3/26/1980	382	MMBTU/H	4	LB/ADTP	ESP
HAMMERMILL PAPER	AL	3/28/1980	737	MMBTU/H	68.2	LB/HR	ESP
WEYERHAEUSER CO.	MS	5/22/1980	155	T/H BLS	0.044	GR/DSCF	ESP
KIRBY FOREST INDUSTRIES	TX	6/14/1980	935	MMBTU/H	83.4	LB/HR	WET BOTTOM ESP
WILLAMETTE INDUSTRIES, INC.	KY	12/3/1980	540	T/H	0.04	GR/DSCF	ESP
SCOTT PAPER	AL	1/15/1981	1100	T/D ADP	0.044	GR/DSCF	ESP
WESTVACO CORP.	SC	2/24/1981	187500	LB/H BLS	0.027	GR/DSCF	ESP
CHAMPION INTERNATIONAL CORP.	MI	3/17/1981	380000	LB/H	0.044	GR/DSCF	ESP
UNION CAMP CORP.	SC	2/25/1982	2.3	MM LB/D BLS	0.044	GR/DSCF	ESP AT 8% O2
BOWATER CAROLINA CO.	SC	5/3/1982	900	T/D ADP	0.044	GR/DSCF	ESP
INDEPENDENT KRAFT CORP.	AL	2/23/1983	763	T ADP/D	0.044	GR/DSCF AT 8% O2	ESP
POTLATCH	ID	4/25/1983	90	T/H BLS	58	LB/HR SEE NOTE 2	ESP
WEYERHAEUSER CO.	WA	1/17/1984	4.5	MMLB/D BLS	0.06	GR/DSCF CORRECTED TO	ESP
WILLAMETTE INDUSTRIES, INC.	KY	8/6/1984	600	T/D ADP	0.04	GR/DSCF AT 8% O2	ESP
NEKOOSA PAPER CO.	AR	10/1/1985	4.4	MMLB/D BLS	0.044	GR/DSCF	ESP
GEORGIA-PACIFIC CORP.	FL	11/15/1985	807500	LB/H STEAM AT 900F	0.044	GR/DSCF CORR TO 8% O	ESP
S.D. WARREN CO.	ME	6/23/1988	375	MMBTU/H	0.021	GR/DSCF	ESP
WILLAMETTE INDUSTRIES	SC	9/29/1988	840	T/D ADP	0.03	GR/DSCF AT 8% O2	ESP
MEAD COATED BOARD	AL	10/1/1988	1500	T ADP/D	0.044	GR/DSCF AT 8% O2	ESP & INCINERATION
LOUISIANA PACIFIC CORP.	CA	2/22/1989	830	T/D ADP	0.025	GR/DSCF	ESP
GEORGIA-PACIFIC CORP.	ME	4/12/1989	1450	T/D ADP	0.021	GR/DSCF	ESP
UNION CAMP PULP AND PAPER MILL	SC	5/1/1989	1483	T/D ADP	0.03	DR/DSCF AT 8% O2	ESP
UNION CAMP PULP AND PAPER MILL	SC	5/1/1989	822	T/D ADP	0.036	GR/DSCF AT 8% O2	ESP
CHAMPION INTERNATIONAL	AL	7/18/1989	4.18	MMLBS/D BLS	0.027	GR/SDCF AT 8% O2	ESP
BOISE CASCADE CORP.	ME	7/18/1989	4	MMLB/D BLS	0.044	GR/DSCF	ESP
WEYERHAEUSER CO.	MS	10/24/1989	5	MMLB/D BLS	0.03	GR/DSCF AT 8% O2	ESP
GREAT SOUTHERN PAPER	GA	12/8/1989	83.56	T/H BLS	46	LB/HR	ESP
ALABAMA RIVER PULP CO.	AL	1/22/1990	5.5	MMLB/DAY BLS	0.025	GR/DSCF AT 8% O2	ESP
LONGVIEW FIBRE CO	WA	7/27/1990	1100	T ADP/D	0.027	GR/DSCF AT 8% O2	ESP
RIVERWOOD INTERNATIONAL	GA	12/21/1990	3.5	MMLB/D BLS	0.027	GR/DSCF	ESP
CHESAPEAKE CORP.	VA	3/1/1991	82.5	T BLS/H	0.03	GR/DSCF AT 8% O2	ESP
GULF STATES PAPER	AL	3/12/1991	3.3	MMLB/D BLS	0.025	GR/DSCF AT 8% O2	ESP
GEORGIA-PACIFIC CORPORATION	FL	6/12/1991	–	MMBTU/HR	0.033	GR/DSCF AT 8% O2	ESP
JAMES RIVER CORP.	WA	9/26/1991	523	MMBTU/H	0.033	GR/DSCF AT 8% O2	ESP W/HEAT RECOVERY SCRUBBER
JAMES RIVER CORP.	WA	9/26/1991	770	MMBTU/H	0.033	GR/DSCF AT 8% O2	ESP W/HEAT RECOVERY SCRUBBER
BOISE CASCADE CORPORATION	AL	4/1/1992	32600	LB BLS/DAY	0.021	GR/DSCF AT 8% O2	ESP
LEAF RIVER FOREST PRODUCTS	MS	7/14/1992	8.4	MM LB/DAY BLS	0.04	GR/DSCF @ 8% O2	ESP, COMBUSTION CONTROL
PENNTECH PAPERS INC. SUBSIDIARY WILLAMETTE IND.	PA	12/9/1992	630	ADT/DAY	0.027	GR/DSCF AT 8% O2	ESP
PENNTECH PAPERS INC. SUBSIDIARY WILLAMETTE IND.	PA	12/9/1992	630	ADT/DAY	0.027	GR/DSCF AT 8% O2	ESP
WILLAMETTE INDUSTRIES	KY	9/14/1993	87500	LB/HR	0.025	GR/DSCF AT 8% O2	ESP
GEORGIA-PACIFIC CORPORATION	FL	9/21/1995	118	TPH ADUP	0.03	GR/DSCF AT 8% O2	ESP REBUILT IN 1991
WILLAMETTE INDUSTRIES - MARLBORO MILL	SC	4/17/1996	4	MM LB BLS/DAY	0.021	GR/DSCF	ESP
WEYERHAEUSER COMPANY	MS	9/10/1996	7	MM LBS/DAY	0.023	GR/DSCF @ 8% O2	ESP MOD. # M.O.420296 ENVIR. ELEM. CORP.
MEAD COATED BOARD, INC.	AL	10/9/1998	2.7	MM LBS BLS PER DAY	0.036	GR/DSCF @ 8% O2	ESP
TENNECO PACKAGING COMPANY	TN	6/17/1997	180180	LB/HR	0.027	GR/DSCF, 8% OXYGEN	ESP
GULF STATES PAPER CORPORATION	AL	12/10/1997	3.94	MM LBS BLS/DAY	0.021	GR/DSCF @ 8% O2	ESP
ROANOKE RAPIDS MILL	NC	7/31/1998	2.77	MM LBS BLS/DAY	0.021	GR/DSCF @ 8% O2	MULTIFIELD ESP
GAYLORD CONTAINER CORPORATION	LA	3/18/1999	908	MM BTU/HR	0.044	GR/DSCF	EXISTING ESP
DONAHUE INDUSTRIES	TX	10/17/2000			50.5	LB/HR	NONE INDICATED
MOSINEE PAPER CORPORATION	WI	12/18/2000	250	MM BTU/HR	79.76	T/YR	ESP
POPE & TALBOT	OR	3/2/2001	1350	TBLS/DAY	1.1	LB/TON BLS	NOT IN PERMIT
CROWN PAPER	LA	4/29/2001	68.75	TBLS/DAY	34.38	LB/TON BLS	ELECTROSTATIC PRECIPITATOR
INTERNATIONAL PAPER-MANSFIELD MILL	LA	8/14/2001	71	TBLS/HR	96.5	LB/HR	ESP
BOWATER COATED PAPER DIVISION	SC	10/31/2001			0.038	GR/DSCF @ 6% O2	ESP
LONGVIEW FIBRE COMPANY-RF # 18	WA	12/10/2001	1200	TBLS/DAY	219	TON/YR	FACILITY WILL HAVE A FEDERAL LIMIT OF PM_{10} REPRESENTING A 20% REDUCTION FROM THE CURRENTLY ALLOWED EMISSION LEVELS. WITH THIS NEW BASELINE FOR POTENTIAL PM_{10}, BACT IS NO FURTHER CONTROL APPLICATION.
LONGVIEW FIBRE COMPANY-RF # 19	WA	12/10/2001	2000	TBLS/DAY	292	TON/YR	FACILITY WILL HAVE A FEDERAL LIMIT OF PM_{10} REPRESENTING A 20% REDUCTION FROM THE CURRENTLY ALLOWED EMISSION LEVELS. WITH THIS NEW BASELINE FOR POTENTIAL PM_{10}, BACT IS NO FURTHER CONTROL APPLICATION.
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 1	LA	1/25/2002	2.81	MM LBS BLS/DAY	37.3	LB/HR	ELECTROSTATIC PRECIPITATOR
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 2	LA	1/25/2002	3.96	MM LBS BLS/DAY	56.0	LB/HR	ELECTROSTATIC PRECIPITATOR
GEORGIA-PACIFIC CORP.-CEDAR SPRINGS MILL	GA	7/25/2002			49.7	LB/HR	ESP
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 1	LA	10/4/2002	2.61	MM LBS BLS/DAY	37.3	LB/HR	ELECTROSTATIC PRECIPITATOR
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 2	LA	10/4/2002	3.96	MM LBS BLS/DAY	56.0	LB/HR	ELECTROSTATIC PRECIPITATOR
WEYERHEAUSER COMPANY-MARLBORO PAPER MILL	SC	12/10/2002	4.4	MM LBS BLS/DAY	0.021	GR/DSCF @ 8% O2	ELECTROSTATIC PRECIPITATOR
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 1	MS	5/14/2004	861.4	MM Btu/hr	0.044	GR/DSCF @ 8% O2	ELECTROSTATIC PRECIPITATOR
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 2	MS	5/14/2004	861.4	MM Btu/hr	0.044	GR/DSCF @ 8% O2	ELECTROSTATIC PRECIPITATOR

Ta[illegible]-1b-NO$_x$

FACILITY NAME	STATE	PERMIT DATE	THRUPUT	THRUPUT UNITS	EMISSIONS	EMISSION UNITS	CONTROL TECHNOLOGY DESCRIPTION
HAMMERMILL PAPER	AL	3/26/1980	737	MMBTU/H	114.2	LB/HR	BOILER DESIGN & GOOD COMBUSTION PRACTICES
WEYERHAEUSER CO.	MS	5/22/1980	155	TON/HR BLS	70	PPM	EQUIPMENT OPERATION
KIRBY FOREST INDUSTRIES	TX	8/14/1980	935	MM BTU/HR	87.8	LB/HR	LOW NOX BURNER, CONTINUOUS O2 MON
SCOTT PAPER	AL	1/15/1981	1100	TON/DAY ADP	242	LB/HR	EQUIPMENT OPERATION
WESTVACO CORP.	SC	2/24/1981	187500	LB/HR BLS	0.25	LB/MMBTU	BOILER DESIGN
UNION CAMP CORP.	SC	2/25/1982	2.3	MM LB/DAY BLS	210	PPMV DRY T	NO CONTROLS
INDEPENDENT KRAFT CORP.	AL	2/23/1983	763	TON ADP/DAY	31.8	LB/HR	NO CONTROLS
POTLATCH	ID	4/25/1983	90	TON/HR BLS	321	LB/H SEE NOTE 3	NO CONTROLS
POTLATCH CORPORATION	ID	12/3/1984	--	--	160	LB/HR	NO CONTROLS
GEORGIA-PACIFIC CORP.	FL	11/15/1985	607500	LB/H STEAM AT 900F	--	--	PROPER EQUIPMENT OPERATION
CONSOLIDATED PAPERS, INC.-KRAFT DIV.	WI	1/1/1987	1400000	LB BLS/DAY	80	PPMDV	PROPER COMB. TECH. & OPER. PRACTICES
S.D. WARREN CO.	ME	6/23/1988	375	MM BTU/HR	97	PPMDV	COMBUSTION CONTROL
WILLAMETTE INDUSTRIES	SC	9/29/1988	840	TON/DAY ADP	150	PPM, DRY BASIS	BOILER DESIGN & GOOD COMBUSTION PRACTICES
MEAD COATED BOARD	AL	10/1/1988	1500	TON ADP/DAY	112	PPMV AT 8% O2	NO CONTROLS
LOUISIANA PACIFIC CORP.	CA	2/22/1989	830	TON/DAY ADP	0.1	LB/MMBTU	BOILER DESIGN
GEORGIA-PACIFIC CORP.	ME	4/12/1989	1450	TON/DAY ADP	80	PPMDV	COMBUSTION CONTROL
UNION CAMP PULP AND PAPER MILL	SC	5/1/1989	1463	TON/DAY ADP	150	PPM, DRY BASIS AT 8%	BOILER DESIGN & GOOD COMBUSTION PRACTICES
UNION CAMP PULP AND PAPER MILL	SC	5/1/1989	822	TON/DAY ADP	200	PPM AT 8% O2	BOILER DESIGN & GOOD COMBUSTION PRACTICES
BOISE CASCADE	MN	5/12/1989	571	MM BTU/HR	80	PPMDV AT 8% O2	COMBUSTION CONTROL
BOISE CASCADE CORP.	ME	7/18/1989	4	MM LB/DAY BLS	134	LB/HR	COMBUSTION CONTROL
CHAMPION INTERNATIONAL	AL	7/18/1989	4.18	MM LBS/DAY BLS	75	PPMV AT 8% O2	NO CONTROLS FEASIBLE
WEYERHAEUSER CO.	MS	10/24/1989	5	MM LB/DAY BLS	70	PPMVD AT 4% O2	PROCESS CONTROLS
GREAT SOUTHERN PAPER	GA	12/8/1989	63.56	TON/HR BLS	154	LB/HR	NO CONTROLS FEASIBLE
STONE CONTAINER CORP.	LA	1/9/1990	800	TON ADP/DAY	198	LB/HR	COMBUSTION CONTROL
ALABAMA RIVER PULP CO.	AL	1/22/1990	5.5	MM LB/DAY BLS	75	PPMV AT 8% O2	NO CONTROLS FEASIBLE
LONGVIEW FIBRE CO	WA	7/27/1990	1100	TON ADP/DAY	95	PPM AT 8% O2	BOILER DESIGN & GOOD COMBUSTION PRACTICES
JAMES RIVER PENNINGTON	AL	8/16/1990	5.4	MM LB/DAY BLS	115	PPMV AT 8% O2	COMBUSTION CONTROLS
RIVERWOOD INTERNATIONAL	GA	12/21/1990	3.5	MM LB/DAYBLS	120	PPM	STAGED COMBUSTION
WILLAMETTE INDUSTRIES INC	LA	2/4/1991	1400	TON ADP/DAY	206.1	LB/HR	DESIGN & OPERATION
INTERNATIONAL PAPER COMPANY	LA	2/24/1991	1117	TON ADP	137.9	LB/H, NOTE 4	COMBUSTION CONTROL/DESIGN
CHESAPEAKE CORP.	VA	3/1/1991	62.5	TON BLS/HR	112	PPMDV AT 8% O2	FURNACE DESIGN & OPERATION
GULF STATES PAPER	AL	3/12/1991	3.3	MM LB/DAY BLS	90	PPMV AT 8% OXYGEN	BOILER DESIGN
LEAF RIVER FOREST PRODUCTS	MS	4/9/1991	6	MM LB/DAY BLS	80	PPM AT 8% O2	COMPUTER OPERATED COMBUSTION CONTROL
GEORGIA-PACIFIC CORPORATION	FL	8/12/1991	--	MM BTU/HR	100	PPMVD AT 8% O2	COMBUSTION CONTROL
JAMES RIVER CORP.	WA	9/26/1991	523	MM BTU/HR	2.13	LB/ADUT	DESIGN & OPERATION
JAMES RIVER CORP.	WA	9/26/1991	770	MM BTU/HR	2.44	LB/ADUT	DESIGN & OPERATION
BOISE CASCADE CORPORATION	AL	4/1/1992	32600	LB BLS/DAY	0.0115	PPMV @ 8% OXYGEN AND	NOT DESIGNED
LEAF RIVER FOREST PRODUCTS	MS	7/14/1992	8.4	MM LB/DAY BLS	110	PPM @ 8% O2	COMPUTER OPERATED COMBUSTION CONTROL
PENNTECH PAPERS INC. SUBSIDIARY WILLAMETTE IND.	PA	12/9/1992	630	ADT/DAY	110	PPM AT 8% O2	GOOD BOILER DESIGN AND OPERATIONAL PRACTICES.
WILLAMETTE INDUSTRIES	KY	9/14/1993	87500	LB/HR	150	PPM AT 8% O2	NO CONTROLS LISTED
INTERNATIONAL PAPER COMPANY	PA	12/21/1994	375000	CF/HR	0.2	LB/MMBTU	NO CONTROLS FEASIBLE
GEORGIA-PACIFIC CORPORATION	FL	9/21/1995	118	TPH ADUP	80	PPMVD AT 8% O2	COMBUSTION MODIFICATION COMBUSTION CONTROL TECHNOLOGY
WILLAMETTE INDUSTRIES - MARLBORO MILL	SC	4/17/1996	4	MM LB BLS/DAY	100	PPM	GOOD COMBUSTION CONTROL
WEYERHAEUSER COMPANY	MS	9/10/1996	7	MM LBS/DAY	80	PPMVD @ 8% O2	STAGED COMBUSTION
MEAD COATED BOARD, INC.	AL	10/9/1996	2.7	MM LBS BLS PER DAY	112	PPMDV @ 8% O2	COMBUSTION CONTROL
TENNECO PACKAGING COMPANY	TN	6/17/1997	180180	LB/HR	110	PPM @ 8% O2	COMBUSTION CONTROL AND GOOD OPERATING/ENGINEERING PRACTICES
GULF STATES PAPER CORPORATION	AL	12/10/1997	3.94	MM LBS BLS/DAY	90	PPMDV @ 8% O2	PROPER DESIGN AND OPERATION
ROANOKE RAPIDS MILL	NC	7/31/1998	2.77	MM LBS BLS/DAY	110	PPM @ 8% O2	FURNACE DESIGN AND COMBUSTION OPTIMIZATION
LOUISIANA-PACIFIC SAMOA, INC.	CA	4/12/1999	3	MMLB/D	78	PPM @8% O2 (12 H)	LOW NOX BURNER FOR NATURAL GAS COMBUSTION.
POTLATCH CORPORATION - CYPRESS BEND MILL	AR	3/3/2000	2.57	MMLB BLS/D	110	PPMDV	PROPER DESIGN AND OPERATION
MOSINEE PAPER CORPORATION	WI	12/18/2000	250	MM BTU/HR	95	PPM @ 8% O2	GOOD COMBUSTION OPERATIONS BY MONITORING TEMPERATURE OF THE GAS STREAM AND THE IN-SITU OXYGEN CONTENT OF THE FLUE GAS
POPE & TALBOT	OR	3/2/2001	1350	TBLS/DAY	1.25	LB/TON BLS	NONE INDICATED
RIEGELWOOD MILL	NC	5/10/2001	557	MM BTU/HR	586.5	LB/HR	GOOD COMBUSTION PRACTICE
INTERNATIONAL PAPER-MANSFIELD MILL	LA	8/14/2001	71	TBLS/HR	147.8	LB/HR	GOOD PROCESS CONTROLS
BOWATER COATED PAPER DIVISION	SC	10/31/2001			80	PPMDV @ 8% O2	GOOD COMBUSTION CONTROL
LONGVIEW FIBRE COMPANY-RF # 18	WA	12/10/2001	1200	TBLS/DAY	95	PPMDV @ 8% O2	GOOD COMBUSTION PRACTICE
LONGVIEW FIBRE COMPANY-RF # 19	WA	12/10/2001	2000	TBLS/DAY	95	PPMDV @ 8% O2	GOOD COMBUSTION PRACTICE
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 1	LA	10/4/2002	2.81	MM LBS BLS/DAY	142	LB/HR	STAGED COMBUSTION, GOOD EQUIPMENT DESIGN AND PROPER COMBUSTION TECHNIQUES.
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 2	LA	10/4/2002	3.96	MM LBS BLS/DAY	192.1	LB/HR	STAGED COMBUSTION, GOOD EQUIPMENT DESIGN AND PROPER COMBUSTION TECHNIQUES.
WEYERHEAUSER COMPANY-MARLBORO PAPER MILL	SC	12/10/2002	4.4	MM LBS BLS/DAY	100	PPM @ 8% O2	ADDITION OF 4TH LEVEL OF AIR TO RECOVERY FURNACE/GOOD COMBUSTION PRACTICE
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 1	MS	5/14/2004	881.4	MM Btu/hr	200.2	LB/HR	STAGED AIR COMBUSTION
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 2	MS	5/14/2004	861.4	MM Btu/hr	200.2	LB/HR	STAGED AIR COMBUSTION

TABLE D-1c-CO

FACILITY NAME	STATE	PERMIT DATE	THRUPUT	THRUPUT UNITS	EMISSIONS	EMISSION UNITS	CONTROL TECHNOLOGY DESCRIPTION
HAMMERMILL PAPER	AL	3/26/1980	737	MM BTU/HR	456.6	LB/HR	BOILER DESIGN & GOOD COMBUSTION PRACTICES
KIRBY FOREST INDUSTRIES	TX	8/14/1980	935	MM BTU/HR	82.5999	LB/HR	CONTINUOUS O2 MONITORING
SCOTT PAPER	AL	1/15/1981	1100	TON/DAY ADP	770	LB/HR	EQUIPMENT OPERATION
UNION CAMP CORP.	SC	2/25/1982	2.9	MM LB/D BLS	2	LB/T ADP	NO CONTROLS
INDEPENDENT KRAFT CORP.	AL	2/23/1983	763	TON ADP/DAY	63.6	LB/HR	NO CONTROLS
POTLATCH	ID	4/25/1983	90	TON/HR BLS	1223	LB/HR	NO CONTROLS
GEORGIA-PACIFIC CORP.	FL	11/15/1985	607500	LB/HR STEAM AT 900F	–	–	PROPER EQUIPMENT OPERATION
S.D. WARREN CO.	ME	6/23/1988	375	MM BTU/HR	169	PPMDV	COMBUSTION CONTROL
WILLAMETTE INDUSTRIES	SC	9/29/1988	840	TON/DAY ADP	2	LB/T ADP	BOILER DESIGN & GOOD COMBUSTION PRACTICES
MEAD COATED BOARD	AL	10/1/1988	1500	TON ADP/DAY	879	PPMV AT 8% O2	NO CONTROLS
LOUISIANA PACIFIC CORP.	CA	2/22/1989	830	TON/DAY ADP	250	PPM	BOILER DESIGN
GEORGIA-PACIFIC CORP.	ME	4/12/1989	1450	TON/DAY ADP	215	PPMDV	COMBUSTION CONTROL
UNION CAMP PULP AND PAPER MILL	SC	5/1/1989	1463	TON/DAY ADP	6	LB/T ADP	BOILER DESIGN & GOOD COMBUSTION PRACTICES
UNION CAMP PULP AND PAPER MILL	SC	5/1/1989	822	TON/DAY ADP	8	LB/T ADP	BOILER DESIGN & GOOD COMBUSTION PRACTICES
BOISE CASCADE	MN	5/12/1989	571	MM BTU/HR	600	PPMDV AT 8% O2	COMBUSTION CONTROL
BOISE CASCADE CORP.	ME	7/18/1989	4	MM LB/DAY BLS	222	LB/HR	COMBUSTION CONTROL
CHAMPION INTERNATIONAL	AL	7/18/1989	4.18	MM LB/DAY BLS	200	PPMV AT 6% O2	NO CONTROLS
WEYERHAEUSER CO.	MS	10/24/1989	5	MM LB/DAY BLS	2.2	LB/METRIC TON OF BLS	PROCESS CONTROLS
GREAT SOUTHERN PAPER	GA	12/8/1989	63.56	TON/HR BLS	480	LB/HR	SEE NOTE#3
STONE CONTAINER CORP.	LA	1/9/1990	800	TON ADP/DAY	434.6	LB/HR	COMBUSTION CONTROL
ALABAMA RIVER PULP CO.	AL	1/22/1990	5.5	MM LB/DAY BLS	200	PPMV AT 8% O2	NO CONTROLS
LONGVIEW FIBRE CO	WA	7/27/1990	1100	TON ADP/DAY	300	PPM AT 8% O2	BOILER DESIGN & GOOD COMBUSTION PRACTICES
RIVERWOOD INTERNATIONAL	GA	12/21/1990	3.5	MM LB/DAY BLS	146.5	LB/HR	NO CONTROLS
WILLAMETTE INDUSTRIES INC	LA	2/4/1991	1400	TON ADP/DAY	350	LB/HR	DESIGN & OPERATION
INTERNATIONAL PAPER COMPANY	LA	2/24/1991	1117	TON ADP	209.9	LB/HR, NOTE 5	COMBUSTION CONTROL/DESIGN
CHESAPEAKE CORP.	VA	3/1/1991	62.5	TON BLS/HR	250	PPMDV AT 8% O2	FURNACE DESIGN & OPERATION
GULF STATES PAPER	AL	3/12/1991	3.3	MM LB/DAY BLS	300	PPMV AT 8% OXYGEN	BOILER DESIGN
LEAF RIVER FOREST PRODUCTS	MS	4/9/1991	6	MM LB/DAY BLS	300	PPM AT 8% O2	COMPUTER OPERATED COMBUSTION CONTROL
GEORGIA-PACIFIC CORPORATION	FL	8/12/1991	–	MM BTU/HR	400	PPMVD AT 8% O2	COMBUSTION CONTROL
JAMES RIVER CORP.	WA	9/26/1991	523	MM BTU/H	2755	TON/YR	DESIGN & OPERATION
JAMES RIVER CORP.	WA	9/26/1991	770	MM BTU/H	2755	TON/YR	DESIGN & OPERATION
PENNTECH PAPERS INC. SUBSIDIARY WILLAMETTE IND.	PA	12/9/1992	630	ADT/DAY	300	PPM AT 8% O2	GOOD COMBUSTION
GEORGIA-PACIFIC CORPORATION	FL	9/21/1995	118	TPH ADUP	800 400	PPM AT 8% O2 (3-hr avg.) PPM AT 8% O2 (24-hr avg.)	GOOD COMBUSTION COMBUSTION CONTROLS
WILLAMETTE INDUSTRIES - MARLBORO MILL	SC	4/17/1996	4	MM LB BLS/DAY	200	PPM	GOOD COMBUSTION CONTROL
WEYERHAEUSER COMPANY	MS	9/10/1996	7	MM LBS/DAY	300	PPMVD @ 8% O2	EFFICIENT OPERATION
MEAD COATED BOARD, INC.	AL	10/9/1996	2.7	MM LBS BLS PER DAY	300	PPMDV @ 8% O2	BOILER DESIGN AND COMBUSTION CONTROL
TENNECO PACKAGING COMPANY	TN	6/17/1997	180180	LB/HR	300	PPMDV @ 8% O2	COMBUSTION CONTROL AND GOOD OPERATING/ENGINEERING PRACTICES
GULF STATES PAPER CORPORATION	AL	12/10/1997	3.94	MM LBS BLS/DAY	250	PPMDV @ 8% O2	PROPER DESIGN AND OPERATION
ROANOKE RAPIDS MILL	NC	7/31/1998	2.77	MM LBS BLS/DAY	300	PPMDV @ 8% O2	FURNACE DESIGN & COMBUSTION OPTIMIZATION
U S ALLIANCE	AL	9/25/1998		UNKNOWN	200	PPM	NO CONTROLS LISTED
POTLATCH CORPORATION - CYPRESS BEND MILL	AR	3/3/2000	2.57	MM LB BLS/DAY	300	PPMDV	PROPER DESIGN AND COMBUSTION CONTROLS
DONAHUE INDUSTRIES, INC	TX	10/17/2000			112.5	LB/HR	NONE INDICATED
MOSINEE PAPER CORPORATION	WI	12/18/2000	250	MM BTU/HR	3000 1000	PPM @ 8% O2 (1-hr. max.) PPM @ 8% O2 (3-hr. vg.)	GOOD COMBUSTION OPERATIONS BY MONITORING TEMPERATURE OF THE GAS STREAM AND THE IN-SITU OXYGEN CONTENT OF THE FLUE GAS
POPE & TALBOT	OR	3/2/2001	1350	TON BLS/DAY	3.7	LB/TON BLS	NONE INDICATED
CROWN PAPER	LA	4/29/2001	68.75	TON BLS/DAY	354.08	LB/HR	GOOD OPERATING PRACTICES
RIEGELWOOD MILL	NC	5/10/2001	557	MM BTU/HR	357.1	LB/HR	GOOD COMBUSTION PRACTICES
INTERNATIONAL PAPER-MANSFIELD MILL	LA	8/14/2001	71	TON BLS/DAY	754	LB/HR	GOOD PROCESS CONTROLS
LONGVIEW FIBRE COMPANY-RF # 18	WA	12/10/2001	1200	TON BLS/DAY	360	LB/HR	GOOD COMBUSTION CONTROL OF FLAME TEMPERATURE AND EXCESS AIR
LONGVIEW FIBRE COMPANY-RF # 19	WA	12/10/2001	2000	TON BLS/DAY	600	LB/HR	GOOD COMBUSTION CONTROL OF FLAME TEMPERATURE AND EXCESS AIR
GEORGIA-PACIFIC CORPORATION-PORT HUDSON	LA	1/25/2002	2.8	MM LB/DAY	308.9	LB/HR	GOOD EQUIPMENT DESIGN AND PROPER COMBUSTION TECHNIQUES
GEORGIA-PACIFIC CORPORATION-PORT HUDSON	LA	1/25/2002	3.96	MM LB/DAY	417.76	LB/HR	GOOD EQUIPMENT DESIGN AND PROPER COMBUSTION TECHNIQUES
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 1	LA	10/4/2002	2.81	MM LBS BLS/DAY	308.9	LB/HR	GOOD EQUIPMENT DESIGNS AND PROPER COMBUSTION TECHNIQUES
GEORGIA-PACIFIC CORP.-PORT HUDSON MILL RF # 2	LA	10/4/2002	3.96	MM LBS BLS/DAY	417.8	LB/HR	GOOD EQUIPMENT DESIGNS AND PROPER COMBUSTION TECHNIQUES
WEYERHEAUSER COMPANY-MARLBORO PAPER MILL	SC	12/10/2002	4.4	MM LBS BLS/DAY	200	PPM	GOOD COMBUSTION PRACTICE
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 1	MS	5/14/2004	661.4	MM Btu/hr	735.6	LB/HR	COMBUSTION CONTROL
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 2	MS	5/14/2004	861.4	MM Btu/hr	735.6	LB/HR	COMBUSTION CONTROL

TABLE [illegible]-1d- SAM

FACILITY NAME	STATE	PERMIT DATE	THRUPUT	THRUPUT UNITS	EMISSIONS	EMISSION UNITS	CONTROL TECHNOLOGY DESCRIPTION
MEAD COATED BOARD	AL	10/1/1988	1500	TON ADP/DAY	20	LB/HR	NO CONTROLS
ALABAMA RIVER PULP CO.	AL	1/22/1990	5.5	MM LB/DAY BLS	15.7	LB/HR	NO CONTROLS
GULF STATES PAPER	AL	3/12/1991	3.3	MM LB/DAY BLS	12.6	LB/HR	BOILER DESIGN
MEAD COATED BOARD, INC.	AL	10/9/1996	2.7	MM LBS BLS/DAY	12.2	LB/HR	BOILER DESIGN
GULF STATES PAPER CORPORATION	AL	12/10/1997	3.94	MM LBS BLS/DAY	12.6	LB/HR	NO CONTROLS
WEYERHEAUSER COMPANY-MARLBORO PAPER	SC	12/10/2002	4.4	MM LBS BLS/DAY	2.2	LB/HR	RECOVERY FURNACE FIRING RATE AND PULP PRODUCTION LIMITS
WEYERHEAUSER COMPANY-VALLIANT MILL	OK	10/13/2004			0.5	PPM@8% O2	GOOD COMBUSTION PRACTICES
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 2	MS	5/14/2004	861.4	MM Btu/hr		NONE	COMBUSTION CONTROL

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FACILITY NAME	STATE	PERMIT DATE	THRUPUT	THRUPUT UNITS	EMISSIONS	EMISSION UNITS	CONTROL TECHNOLOGY DESCRIPTION
LOUISIANA PACIFIC CORP.	CA	3/17/1989	830	TON/DAY ADP	40	PPM	BOILER DESIGN
MEAD COATED BOARD	AL	6/1/1989	1500	TON ADP/DAY	0.03	LB/MMBTU	NONE INDICATED
BOISE CASCADE	MN	7/1/1989	571	MM BTU/HR	2.8	PPMDV AT 8% O2	COMBUSTION CONTROL
BOISE CASCADE CORP.	ME	9/29/1989	4	MM LB/DAY BLS	3.7	LB/HR	COMBUSTION CONTROL
CHAMPION INTERNATIONAL	AL	9/29/1989	4.18	MM LBS/DAY BLS	0.048	LB/MMBTU	NO CONTROLS
GEORGIA-PACIFIC CORP.	ME	9/29/1989	1450	TON/DAY ADP	0.7	LB/TON ADP	COMBUSTION CONTROL
STONE CONTAINER CORP.	LA	2/28/1990	800	TON ADP/DAY	34.4	LB/HR	COMBUSTION CONTROL
ALABAMA RIVER PULP CO.	AL	1/22/1990	5.5	MM LB/DAY BLS	0.048	LB/MMBTU	NO CONTROLS
WEYERHAEUSER CO.	MS	3/31/1991	5	MM LB/DAY BLS	0.6	LB/SHORT T OF BLS	GOOD COMBUSTION PRACTICES
INTERNATIONAL PAPER COMPANY	LA	5/21/1991	1117	TON ADP	24	LB/HR, NOTE 8	COMBUSTION CONTROL/DESIGN
LONGVIEW FIBRE CO	WA	8/1/1991	1100	TON ADP/DAY	1	TON/DAY	BOILER DESIGN & GOOD COMBUSTION PRACTICES
JAMES RIVER CORP.	WA	1/31/1992	523	MM BTU/HR	219	TON/YR	DESIGN & OPERATION
WILLAMETTE INDUSTRIES	SC	7/7/1993	840	TON/DAY ADP	2	LB/TON ADP	BOILER DESIGN & GOOD COMBUSTION PRACTICES
GEORGIA-PACIFIC CORPORATION	FL	7/19/1994	--	MM BTU/HR	0.52	LB/TON BLS	COMBUSTION CONTROL
GULF STATES PAPER	AL	3/24/1995	3.3	MM LB/DAY BLS	0.048	LB/MM BTU AND	BOILER DESIGN
CHESAPEAKE CORP.	VA	3/24/1995	62.5	TON BLS/HR	0.048	LB/MM BTU	FURNACE DESIGN & OPERATION
WILLAMETTE INDUSTRIES INC	LA	3/24/1995	1400	TON ADP/DAY	116.6	LB/HR	DESIGN & OPERATION
GEORGIA-PACIFIC CORPORATION	FL	1/31/1996	118	TON/HR ADUP	0.3	LB/TON BLS	GOOD COMBUSTION COMBUSTION CONTROL
BOISE CASCADE CORP.	MN	5/31/1996	571	MM BTU/HR	0.6	LB/BDT OF BLS	COMBUSTION CONTROL
MEAD COATED BOARD, INC.	AL	5/31/1997	2.7	MM LBS BLS PER DAY	0.048	LBS/MMBTU	BOILER DESIGN AND COMBUSTION CONTROL
TENNECO PACKAGING COMPANY	TN	6/17/1997	180180	LB/HR	110	PPM @ 8% O2	COMBUSTION CONTROL AND GOOD OPERATING/ENGINEERING PRACTICES
WILLAMETTE INDUSTRIES - MARLBORO MILL	SC	3/26/1998	4	MM LB BLS/DAY	40	PPM	GOOD COMBUSTION CONTROL
GULF STATES PAPER CORPORATION	AL	4/24/1998	3.94	MM LBS BLS/DAY	0.03	LB/MM BTU	PROPER DESIGN AND OPERATION
ROANOKE RAPIDS MILL	NC	7/31/1998	2.77	MM LBS BLS/DAY	50	PPM @ 8% O2	FURNACE DESIGN AND COMBUSTION OPTIMIZATION
DONAHUE INDUSTRIES	TX	10/17/2000			20.27	LB/HR	NONE INDICATED
POPE & TALBOT	OR	3/2/2001	1350	TON BLS/DAY	0.024	LB/TON BLS	NONE INDICATED
RIEGELWOOD MILL	NC	5/10/2001	557	MM BTU/HR	37	LB/HR	GOOD COMBUSTION PRACTICES
LONGVIEW FIBRE COMPANY-RF # 18	WA	12/10/2001	1200	TON BLS/DAY	612	TON/YR	GOOD COMBUSTION CONTROL OF FLAME TEMPERATURE AND EXCESS AIR.
LONGVIEW FIBRE COMPANY-RF # 19	WA	12/10/2001	2000	TON BLS/DAY	1020	TON/YR	GOOD COMBUSTION CONTROL OF FLAME TEMPERATURE AND EXCESS AIR.
WEYERHEAUSER COMPANY-MARLBORO PAPER MILL	SC	12/10/2002	4.4	MM LBS BLS/DAY	40	PPMDV @ 8% O2	LOW ODOR RECOVERY FURNACE
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 1	MS	5/14/2004	861.4	MM Btu/hr	14	LB/HR	COMBUSTION CONTROL
GEORGIA-PACIFIC CORP.-Monticello Mill RB # 2	MS	5/14/2004	861.4	MM Btu/hr	14	LB/HR	COMBUSTION CONTROL
WEYERHEAUSER COMPANY-VALLIANT MILL	OK	10/13/2004			40	PPMDV @ 8% O2	STAGED COMBUSTION AND NON-DIRECT CONTACT EVAPORATORS

TABLE D-2
USE OF SCR TO REDUCE NO_x EMISSIONS FROM RECOVERY FURNACE NO. 4

Cost Items	Cost Factors	2005 dollars
DIRECT CAPITAL COSTS (DCC):		
(1) Purchased Equipment Cost		
(a) Basic Equipment/Services	Based on Engineering Calculations (See Appendix D-1)	$13,460,000
(2) Direct Installation		included
Total DCC:	(1a) + (2)	$13,460,000
INDIRECT CAPITAL COSTS (ICC):		
(3) Indirect Installation Costs		
(a) Technology License Fee	included with 1a	$0
(b) Engineering & Supervision	included with 1a	$0
(c) Construction & Field Expenses	included with 1a	$0
(d) Construction Contractor Fee	included with 1a	$0
(e) Contingencies	(0.15) x (DCC)	$2,019,000
(4) Other Indirect Costs		
(a) Startup & Testing	Estimated	$10,000
(b) Working Capital	30-day DOC	$444,024
Total ICC:	(3) + (4)	$2,473,024
TOTAL CAPITAL INVESTMENT (TCI):	DCC + ICC	$15,933,024
DIRECT OPERATING COSTS (DOC):		
(5) Operating Labor	assume 1 hr/day x 365 day/yr	
Operator	$22.37/man-hr	$8,165
Supervisor	assume 15% of operating labor cost	$1,225
(6) Maintenance		
Labor	assume 1.5% of TCI	$238,995
(7) Utilities		
(a) Ammonia Injection System Electricity	assume 600 Kw/hr & 0.061/Kw-hr	$320,616
(8) Chemical Costs-ammonia reagent	assume 600 lb/hr @ $0.10/lb	$525,600
(9) Natural gas cost to heat flue gas with a duct burner to 700 °F	$5.85/MM Btu x 82.745 MM Btu/hr x 8,760 hr/yr = $/yr	$4,240,350
Total DOC:	(5) + (6) + (7) + (8) + (9)	$5,328,291
INDIRECT OPERATING COSTS (IOC):		
(10) Overhead	10% of oper. labor & maintenance	$24,839
(11) Property Taxes	1% of total capital investment	$159,330
(12) Insurance	1% of total capital investment	$159,330
(13) Administration	2% of total capital investment	$318,660
Total IOC:	(7) + (8) + (9) + (10)	$662,159
CAPITAL RECOVERY FACTOR	n=yrs; i = %	0.0944
CAPITAL RECOVERY COSTS (CRC):	CRF of 0.0944 times TCI (20 yrs @ 7%)	$1,503,965
ANNUALIZED COSTS (AC):	DOC + IOC + CRC	$7,494,415
UNCONTROLLED NO_x EMISSIONS (TPY):	Average Emissions-2003-2004	425.4
TOTAL NO_x REMOVED TPY:	tons NO_x removed (425.4 -42.5 = 382.9)	382.9
COST EFFECTIVENESS:	$ per ton of NO_x Removed	$19,575

Notes:
Cost factors based on data contained in Chapter 2 of US EPA's Cost Control Manual
to reflect better estimates of what true costs would be.

*The CRF is computed according to the standard formula:

CRF = i(1+i)n/[(1+i)n-1]

where: i = annual interest rate (decimal)
n = control system life (years)

ATTACHMENT E

EMISSION FACTOR REFERENCES FROM

AP-42 AND NCASI

Table 1.3-1. CRITERIA POLLUTANT EMISSION FACTORS FOR FUEL OIL COMBUSTION[a]

Firing Configuration (SCC)[a]	SO_2[b]		SO_3[c]		NO_x[d]		CO[e]		Filterable PM[f]	
	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING
Boilers > 100 Million Btu/hr										
No. 6 oil fired, normal firing (1-01-004-01), (1-02-004-01), (1-03-004-01)	157S	A	5.7S	C	47	A	5	A	9.19(S)+3.22	A
No. 6 oil fired, normal firing, low NO_x burner (1-01-004-01), (1-02-004-01)	157S	A	5.7S	C	40	B	5	A	9.19(S)+3.22	A
No. 6 oil fired, tangential firing, (1-01-004-04)	157S	A	5.7S	C	32	A	5	A	9.19(S)+3.22	A
No. 6 oil fired, tangential firing, low NO_x burner (1-01-004-04)	157S	A	5.7S	C	26	E	5	A	9.19(S)+3.22	A
No. 5 oil fired, normal firing (1-01-004-05), (1-02-004-04)	157S	A	5.7S	C	47	B	5	A	10	B
No. 5 oil fired, tangential firing (1-01-004-06)	157S	A	5.7S	C	32	B	5	A	10	B
No. 4 oil fired, normal firing (1-01-005-04), (1-02-005-04)	150S	A	5.7S	C	47	B	5	A	7	B
No. 4 oil fired, tangential firing (1-01-005-05)	150S	A	5.7S	C	32	B	5	A	7	B
No. 2 oil fired (1-01-005-01), (1-02-005-01), (1-03-005-01)	157S	A	5.7S	C	24	D	5	A	2	A
No.2 oil fired, LNB/FGR, (1-01-005-01), (1-02-005-01), (1-03-005-01)	157S	A	5.7S	A	10	D	5	A	2	A

Table 1.3-1. (cont.)

Firing Configuration (SCC)[a]	SO_2[b]		SO_3[c]		NO_x[d]		CO[e]		Filterable PM[f]	
	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING
Boilers < 100 Million Btu/hr										
No. 6 oil fired (1-02-004-02/03) (1-03-004-02/03)	157S	A	2S	A	55	A	5	A	10	B
No. 5 oil fired (1-03-004-04)	157S	A	2S	A	55	A	5	A	9.19(S)+3.22	A
No. 4 oil fired (1-03-005-04)	150S	A	2S	A	20	A	5	A	7	B
Distillate oil fired (1-02-005-02/03) (1-03-005-02/03)	142S	A	2S	A	20	A	5	A	2	A
Residential furnace (A2104004/A2104011)	142S	A	2S	A	18	A	5	A	0.4[g]	B

[a] To convert from $lb/10^3$ gal to $kg/10^3$ L, multiply by 0.120. SCC = Source Classification Code.

[b] References 1-2,6-9,14,56-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.

[c] References 1-2,6-8,16,57-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.

[d] References 6-7,15,19,22,56-62. Expressed as NO_2. Test results indicate that at least 95% by weight of NO_x is NO for all boiler types except residential furnaces, where about 75% is NO. For utility vertical fired boilers use 105 $lb/10^3$ gal at full load and normal (>15%) excess air. Nitrogen oxides emissions from residual oil combustion in industrial and commercial boilers are related to fuel nitrogen content, estimated by the following empirical relationship: lb $NO_2/10^3$ gal = 20.54 + 104.39(N), where N is the weight % of nitrogen in the oil. For example, if the fuel is 1% nitrogen, then N = 1.

[e] References 6-8,14,17-19,56-61. CO emissions may increase by factors of 10 to 100 if the unit is improperly operated or not well maintained.

[f] References 6-8,10,13-15,56-60,62-63. Filterable PM is that particulate collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Particulate emission factors for residual oil combustion are, on average, a function of fuel oil sulfur content where S is the weight % of sulfur in oil. For example, if fuel oil is 1% sulfur, then S = 1.

[g] Based on data from new burner designs. Pre-1970's burner designs may emit filterable PM as high as 3.0 $lb/10^3$ gal.

Table 10.2-3 (Metric Units). CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE-SPECIFIC EMISSION FACTORS FOR A RECOVERY BOILER WITHOUT A DIRECT-CONTACT EVAPORATOR BUT WITH AN ESP[a]

EMISSION FACTOR RATING: C

Particulate Size (µm)	Cumulative Mass % ≤ Stated Size		Cumulative Emission Factor (kg/Mg of Air-Dried Pulp)	
	Uncontrolled	Controlled	Uncontrolled	Controlled
15	ND	78.8	ND	0.8
10	ND	74.8	ND	0.7
6	ND	71.9	ND	0.7
2.5	78.0	67.3	90	0.6
1.25	40.0	51.3	46	0.5
1.00	30.0	42.4	35	0.5
0.625	17.0	29.6	20	0.3
Total	100	100	115	1.0

[a] Reference 7. ND = no data.

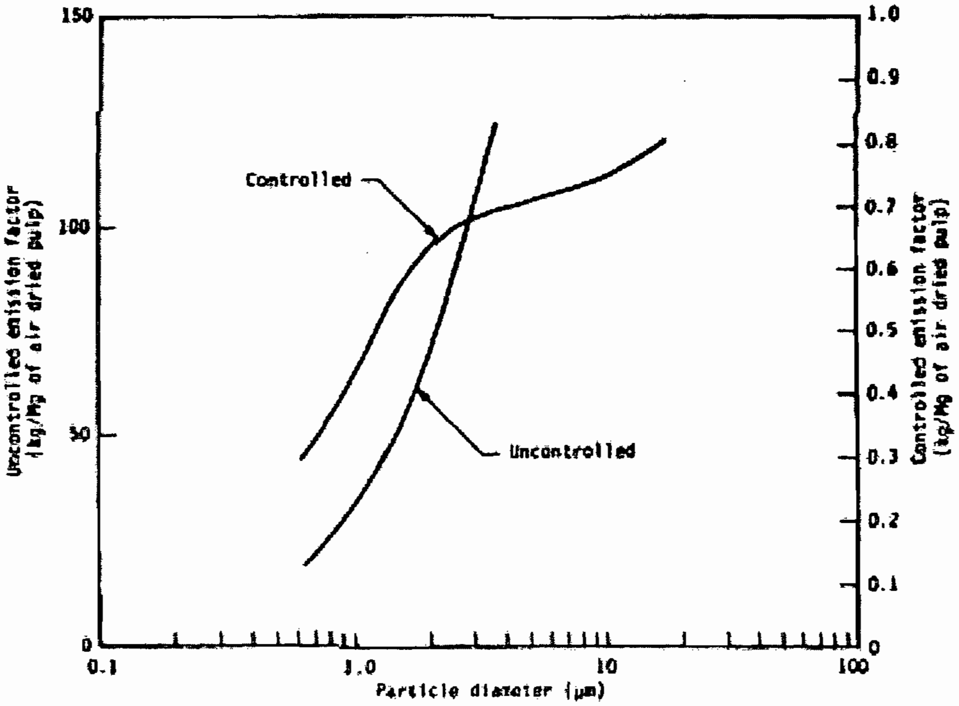

Figure 10.2-3. Cumulative particle size distribution and size-specific emission factors for recovery boiler without direct-contact evaporator but with ESP.

Table 10.2-4 (Metric Units). CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE-SPECIFIC EMISSION FACTORS FOR A LIME KILN WITH A VENTURI SCRUBBER[a]

EMISSION FACTOR RATING: C

Particulate Size (µm)	Cumulative Mass % ≤ Stated Size		Cumulative Emission Factor (kg/Mg of Air-Dried Pulp)	
	Uncontrolled	Controlled	Uncontrolled	Controlled
15	27.7	98.9	7.8	0.24
10	16.8	98.3	4.7	0.24
6	13.4	98.2	3.8	0.24
2.5	10.5	96.0	2.9	0.24
1.25	8.2	85.0	2.3	0.21
1.00	7.1	78.9	2.0	0.20
0.625	3.9	54.3	1.1	0.14
Total	100	100	28.0	0.25

[a] Reference 7.

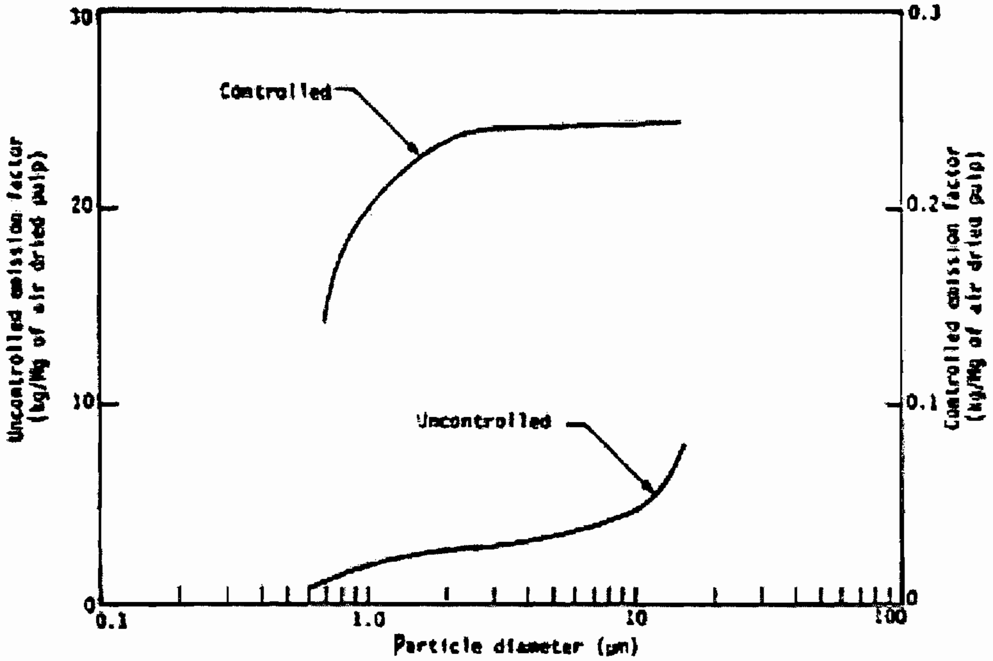

Figure 10.2-4. Cumulative particle size distribution and size-specific emission factors for lime kiln with venturi scrubber.

Table 10.2-7 (Metric Units). CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE-SPECIFIC EMISSION FACTORS FOR A SMELT DISSOLVING TANK WITH A VENTURI SCRUBBER[a]

EMISSION FACTOR RATING: C

Particulate Size (µm)	Cumulative Mass % ≤ Stated Size		Cumulative Emission Factor (kg/Mg of Air-Dried Pulp)	
	Uncontrolled	Controlled	Uncontrolled	Controlled
15	90.0	89.9	3.2	0.09
10	88.5	89.5	3.1	0.09
6	87.0	88.4	3.0	0.09
2.5	73.0	81.3	2.6	0.08
1.25	47.5	63.5	1.7	0.06
1.00	40.0	54.7	1.4	0.06
0.625	25.5	38.7	0.9	0.04
Total	100	100	3.5	0.09

[a] Reference 7.

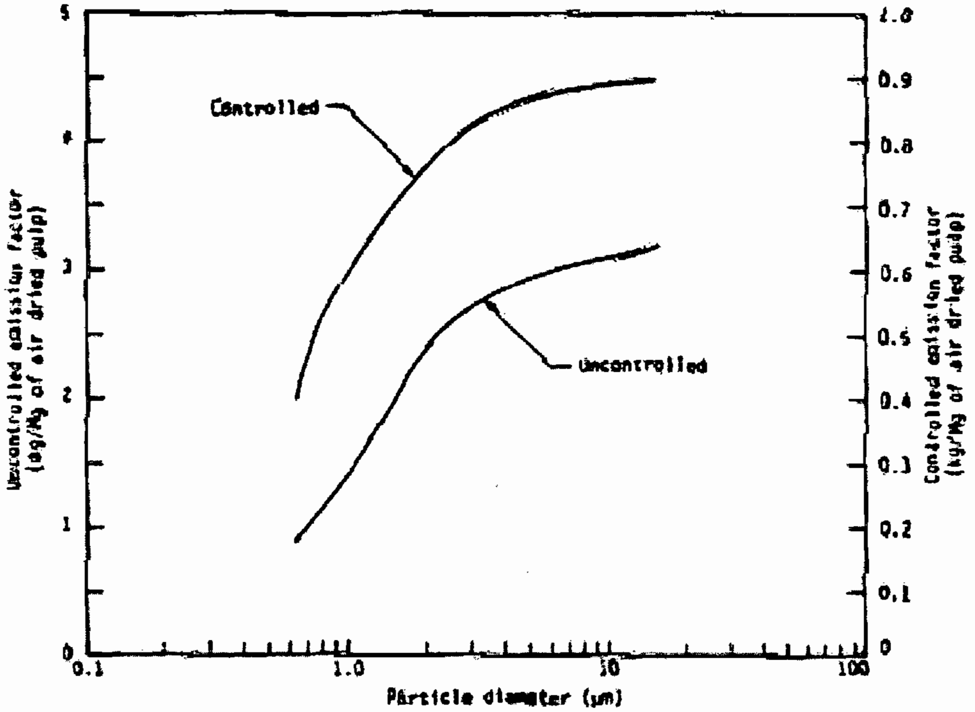

Figure 10.2-7. Cumulative particle size distribution and size-specific emission factors for smelt dissolving tank with venturi scrubber.

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

EMISSION FACTORS FOR NO_X, SO_2, AND VOLATILE ORGANIC COMPOUNDS FOR BOILERS, KRAFT PULP MILLS, AND BLEACH PLANTS

TECHNICAL BULLETIN NO. 646

FEBRUARY 1993

TABLE 13 LIME KILN SULFUR DIOXIDE EMISSIONS

MILL CODE	TEST DATE	CONTROL DEVICE	PULP ADTPD	LIME TPD	FUEL & PERCENT S	BURN NCG Y/N	INPUT NCG S[1] lb/ton CaO	INPUT tot S[2] lb/ton CaO	OUTPUT SO_2, ppm @ 10% O_2	OUTPUT lb SO_2/ ton CaO	OUTPUT lb/SO_2[3] 10^6 Btu	ESTIMATE OF % SULFUR CAPTURED
LIME KILNS WITH SCRUBBERS												
LA	1986-87	VEN SCBR	1375	344	NATURAL GAS	Y	4.4 to 14.0	4.4 to 14.0	13 to 15	0.33	0.037	96.3 to 98.8
LB	1988	VEN SCBR	800	220	OIL, 2.5% S	Y	5.8 to 20.0	16.4 to 30.5	10.0	0.18[6]	0.023	98.9 to 99.7
LC	1986	VEN SCBR	1090	300	OIL, 1.0% S	N	0.0	1.17	1.3	0.02	0.003	99.8
LE	1979	SCRUBBER[4]	495	136	OIL, 1.3% S	Y	18.5	28.7[5]	-	0.45	0.057	99.2
LF	1984	VEN SCBR	290	80	NATURAL GAS	NA	NA	NA	3.9[6]	0.07	0.009	-
LG	1984	VEN SCBR	240	60	NATURAL GAS	Y	NA	NA	<2.0[6]	<0.04	<0.005	-
LH1	1987	VEN SCBR	717	180	NATURAL GAS	N	0.0	small	0.4[6]	0.01	0.001	-
LH2	1987	VEN SCBR	717	180	COKE/GAS	N	0.0	18.8	4.8[6]	0.10	0.011	99.7
LJ	1977	SCRUBBER[4]	267	73	OIL, 2.8% S	NA	NA	12.0	1 to 7	0.07[6]	0.009	99.7
LK	-	SCRUBBER	400	110	NATURAL GAS	N	0.0	small	0 to 6	0.09	0.011	-
LL	1984	VEN SCBR	740	221	NATURAL GAS	N	0.0	small	26.0[6]	0.47	0.059	-
LO1	1991	VEN SCBR	422	155	NATURAL GAS	N	0.0	small	<1.0	<0.02	<0.003	-
LO2	1991	VEN SCBR	1056	260	NATURAL GAS	N	0.0	small	<1.0	<0.02	<0.002	-
LP1	1990	VEN SCBR	820	225	OIL, 1.8% S	Y	NA	7.73	37 to 61	1.63	0.204	87.3 to 92.1
LT	1991	VEN SCBR	830	311	NATURAL GAS	N	0.0	small	0.5 to 1	0.01	0.002	-
LU	1992	VEN SCBR	890	306	NATURAL GAS	Y	NA	NA	4 to 16	0.13	0.020	-
									Average of 16 Kilns	0.23	0.028	
LIME KILNS WITH ESPs												
LD	1988	ESP	1700	468	OIL, 2.5% S	N	0.0	8.15[7]	1.03	0.02[6]	0.002	>99.9
LM	1989	ESP	840	230	NATURAL GAS	N	0.0	small	1.80	0.03[6]	0.004	-
LN	1990	ESP	1375	330	OIL/COKE/NG	Y	2.2	14.04[8]	10 to 100	1.00[6]	0.125	88.8 to 98.9
LP2	1991	ESP	2050	565	OIL, 1.8% S	NA	NA	7.69	72 to 237	2.98	0.373	93.0
									Average of 4 Kilns	1.00	0.126	

Range - 0.01 to 1.63 lb/ton CaO or ≤0.002 to 0.204 lb/10^6 Btu (kilns with scrubbers)

range - 0.02 to 2.98 lb/ton CaO or 0.002 to 0.373 lb/10^6 Btu (kilns with ESPs)

Notes

NA - not available or not known; [1] estimated from NCASI Technical Bulletin No. 469; [2] sulfur input from oil firing estimated assuming 8.0×10^6 Btu/ton CaO and 18,750 Btu/lb oil; [3] lb/ton CaO converted to lb/10^6 Btu using conversion factor of 8.0×10^6 Btu/ton CaO; [4] dust chamber followed by Peabody scrubber; [5] sulfur input from oil, lime mud and NCG were 31.8, 26.7 and 104.3 lb/hr, respectively; [6] assumed 5.5 ppm SO_2 in vent equals 0.1 lb SO_2/ton CaO; [7] sulfur input from oil firing for this kiln estimated using 6.2×10^6 Btu/ton CaO and 18,750 Btu/lb oil; [8] 2 lime kilns firing gas/coke with NCG and fuel oil/coke with NCG; NCGs are first scrubbed with white liquor or NaOH.

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

VOLATILE ORGANIC EMISSIONS FROM PULP AND PAPER MILL SOURCES

PART II - LIME KILNS, SMELT DISSOLVING TANKS AND MISCELLANEOUS CAUSTICIZING AREA VENTS

TECHNICAL BULLETIN NO. 676

SEPTEMBER 1994

TABLE VII.A.5 SUMMARY OF EMISSION TEST RESULTS MILL M SLAKER AND CAUSTICIZER VENTS

ANALYTE	SLAKER SCRUBBER (MC3)	NO. 2 CAUSTICIZING TANK (MC4)
HEATED CANISTER	AVG (lb/T)	AVG (lb/T)
acetaldehyde (H)	5.3E-2	1.0E-3
methanol (H)	5.3E-2	5.5E-4
methyl mercaptan	< 1.6E-3	< 5.5E-6
acetone	1.9E-2	2.1E-4
dimethyl sulfide	< 2.1E-3	< 7.1E-6
methylene chloride (H)	< 5.1E-4	< 1.7E-6
1,2-dichloroethylene	7.8E-4	< 6.6E-7
methyl ethyl ketone (H)	1.2E-3	7.0E-6
n-hexane (H)	< 5.8E-5	< 2.0E-7
chloroform (H)	< 9.6E-4	< 3.3E-6
1,2-dichloroethane (H)	< 2.7E-4	< 9.0E-7
1,1,1-trichloroethane (H)	< 2.7E-4	< 9.1E-7
benzene (H)	1.3E-4	6.8E-7
carbon tetrachloride (H)	< 1.2E-3	< 4.2E-6
trichloroethylene (H)	< 2.7E-4	< 9.0E-7
methyl isobutyl ketone (H)	< 6.1E-5	1.6E-6
dimethyl disulfide	< 3.2E-3	< 1.1E-5
1,1,2-trichloroethane (H)	< 2.7E-4	< 9.1E-7
toluene (H)	3.1E-4	< 2.1E-7
tetrachloroethylene (H)	< 3.3E-4	U 6.6E-6
chlorobenzene (H)	< 7.6E-5	< 2.6E-7
m,p-xylene (H)	< 7.1E-5	1.2E-6
o-xylene (H)	< 7.1E-5	< 2.4E-7
xylenes (H)		
styrene (H)	1.1E-3	2.2E-5
alpha-pinene		
beta-pinene		
terpenes	8.2E-3	7.4E-5
1,2,4-trichlorobenzene (H)	< 1.2E-4	U 1.3E-6
acrolein (H)	< 1.1E-4	U 1.7E-5
IMPINGER		
methanol (H)		
acetone		
methyl ethyl ketone (H)		
acetaldehyde (H)		
acrolein (H)		
formaldehyde (H)	< 2.4E-3	< 5.4E-6
Total HAPs	1.1E-1	1.6E-3
THC (Method 25A)	4.1E-2	8.3E-4
Flow (DSCFM)	5117	15
PROD RATE, TCaO/D	549	549

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
TCaO/D = TONS OF CaO PER DAY
H = CAA HAP

TABLE VIII.A.1 SUMMARY OF EMISSION TEST RESULTS
MILL D LIME MUD WASHING AREA SOURCES

ANALYTE	NO. 2 PRECOAT FILTER VACUUM PUMP EXHAUST (DCA1)	LIME MUD PRESSURE FILTER VENT (DCA2)	LIME MUD DILUTION TANK VENT (DCA3)	LIME MUD MIX TANK VENT (DCA4)	PRECOAT FILTER VENT (DCA6)
HEATED CANISTER	**AVG (lb/T)**	**AVG (lb/T)**	**AVG (lb/T)**	**AVG (lb/T)**	**AVG (lb/T)**
acetaldehyde (H)					
methanol (H)	3.5E-2	9.0E-3	9.3E-2	1.8E-3	5.4E-2
methyl mercaptan	2.7E-4	< 3.6E-5	7.4E-4	< 1.0E-5	< 8.9E-4
acetone	2.2E-3	1.4E-4	1.9E-3	2.8E-5	8.5E-4
dimethyl sulfide	1.4E-3	< 4.6E-5	1.2E-3	< 1.3E-5	1.0E-3
methylene chloride (H)	< 6.5E-5	< 1.1E-5	< 4.0E-5	< 3.3E-6	< 2.8E-4
1,2-dichloroethylene	4.4E-5	U 5.9E-6	U 4.7E-5	U 1.5E-6	< 1.1E-4
methyl ethyl ketone (H)	9.8E-4	6.1E-5	2.6E-4	1.7E-6	1.5E-4
n-hexane (H)					
chloroform (H)	1.1E-4	< 2.1E-5	< 7.5E-5	< 6.1E-6	< 5.3E-4
1,2-dichloroethane (H)	< 1.9E-5	< 5.9E-6	< 2.1E-5	< 1.7E-6	< 1.5E-4
1,1,1-trichloroethane (H)	< 2.0E-5	< 6.0E-6	< 2.1E-5	< 1.7E-6	< 1.5E-4
benzene (H)	< 3.8E-6	< 1.2E-6	1.4E-5	< 3.3E-7	< 2.9E-5
carbon tetrachloride (H)	< 9.0E-5	< 2.7E-5	< 9.7E-5	< 7.9E-6	< 6.8E-4
trichloroethylene (H)	< 1.9E-5	< 5.9E-6	< 2.1E-5	< 1.7E-6	< 1.5E-4
methyl isobutyl ketone (H)	1.4E-4	< 1.3E-6	1.2E-5	4.8E-7	2.2E-4
dimethyl disulfide	3.4E-4	< 7.0E-5	< 2.5E-4	< 2.0E-5	< 1.7E-3
1,1,2-trichloroethane (H)	< 2.0E-5	< 6.0E-6	< 2.1E-5	< 1.7E-6	< 1.5E-4
toluene (H)	1.0E-5	3.6E-6	3.5E-5	5.7E-7	< 3.4E-5
tetrachloroethylene (H)	< 2.4E-5	U 2.6E-5	U 3.3E-5	U 2.9E-6	< 1.8E-4
chlorobenzene (H)	< 5.5E-6	< 1.7E-6	U 5.9E-5	< 4.8E-7	< 4.2E-5
m,p-xylene (H)	1.9E-5	9.4E-6	1.4E-5	2.1E-6	< 3.9E-5
o-xylene (H)	3.5E-5	2.0E-5	1.6E-5	5.0E-6	4.5E-5
xylenes (H)					
styrene (H)	4.2E-5	2.5E-5	9.9E-5	4.6E-7	3.9E-5
alpha-pinene					
beta-pinene					
terpenes	5.0E-3	2.2E-4	7.5E-3	9.1E-5	5.3E-3
1,2,4-trichlorobenzene (H)	U 6.6E-4	U 6.9E-5	U 1.9E-4	U 1.2E-5	< 6.7E-5
acrolein (H)					
IMPINGER					
methanol (H)					
acetone					
methyl ethyl ketone (H)					
acetaldehyde (H)	4.0E-4	< 3.6E-5	2.0E-4	< 1.0E-5	< 8.9E-4
acrolein (H)					
formaldehyde (H)					
Total HAPs	3.8E-2	9.3E-3	9.4E-2	1.9E-3	5.6E-2
THC (Method 25A)	3.5E-2	3.8E-3	8.5E-2	1.3E-3	3.0E-2
Flow (DSCFM)	279	120	392	29	1423
PROD RATE, TCaO/D	260	441	436	439	273

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
TCaO/D = TONS OF CaO PER DAY
H = CAA HAP

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC.
P.O. BOX 13318, RESEARCH TRIANGLE PARK, NC 27709-3318

COMPILATION OF 'AIR TOXIC' AND TOTAL HYDROCARBON EMISSIONS DATA FOR SOURCES AT CHEMICAL WOOD PULP MILLS

VOLUME 2

TECHNICAL BULLETIN NO. 701
OCTOBER 1995

TABLE 12C SUMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES

MILL CODE	TEST DATE	BLS MMPPD	SOURCE & CONTROL DEVICE	YEAR INSTALLED	YEAR REBUILT	MAKE	REFERENCE
RFC	1989	1.20	NDCE WITH DRY BOTTOM ESP	1973	NA	B&W	9
RFE	1991	2.30	NDCE WITH DRY BOTTOM ESP	1976	1990	B&W	9
RFL	1992	1.94	NDCE WITH DRY BOTTOM ESP	1962	1979	CE	3
RFN	1992	5.97	NDCE WITH DRY BOTTOM ESP	1991	NA	GOT	9
RFO	1992	1.90	NDCE WITH DRY BOTTOM ESP	1986	NONE	GOT	3
RFMC	1994	2.64	NDCE WITH DRY BOTTOM ESP	1975	NONE	B&W	17
RFMG	1994	2.69	NDCE WITH WET BOTTOM ESP	1981	1991	B&W	17
RFMH	1994	2.06	NDCE WITH WET BOTTOM ESP	1970	NA	CE	17
RFMJ	1994	2.10	NDCE WITH DRY BOTTOM ESP	NA	NA	CE	17
RFMK	1994	3.12	NDCE WITH DRY BOTTOM ESP	1985	1990	B&W	17
RFMM	1994	5.69	NDCE WITH DRY BOTTOM ESP	1993	NONE	B&W	17
RFIA	1993	4.2	2 NDCEs WITH DRY BOTTOM ESP	1965;1976	1986;1988	CE;B&W	9
RFIB	1993	2.3	NDCE WITH WET BOTTOM ESP	1970	1991	B&W	9
RFIF2	1993	3.4	NDCE WITH DRY BOTTOM ESP	1975	NA	CE	9
RFIH1	1993	1.9	NDCE WITH WET BOTTOM ESP	1967	1983	B&W	9
RFIH2	1993	2.4	NDCE WITH WET BOTTOM ESP	1982	NA	CE	9
RFIJ	1993	2.0	NDCE WITH DRY BOTTOM ESP	1969	1989	B&W	9
RFD	1990	2.11	NDCE WITH DB ESP & SCRUBBER	1980	1987	B&W	5

References

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9. Individual Mill Test Results for 'Air Toxics' - NCASI Mill File Information.
17. Volatile Organic Emissions from Pulp and Paper Mill Sources - Part VI - Kraft Recovery Furnaces and Black Liquor Oxidation Systems, NCASI Technical Bulletin No. 680, October 1994.

TABLE 12C SUMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

VOLATILE ORGANIC COMPOUND		MILL CODE	EMISSIONS RANGE lb/ton BLS	AVG lb/ton BLS	TEST METHOD	COMMENTS
ACETALDEHYDE		RFL		ND[0.009]	RTI DRAFT	
ACETALDEHYDE		RFD	0.0009 to 0.0011	1.0E-03	CARB 430	
ACETALDEHYDE		RFMC		ND[4.9E-2]	IMPINGER	NCASI METHOD
ACETALDEHYDE		RFMG		6.7E-03	HEATED CANISTER	FID
ACETALDEHYDE		RFMH		ND[1.4E-3]	HEATED CANISTER	FID
ACETALDEHYDE		RFMJ		5.0E-02	HEATED CANISTER	FID
ACETALDEHYDE		RFMK		7.6E-03	HEATED CANISTER	FID
ACETALDEHYDE		RFMM		3.7E-03	HEATED CANISTER	FID
ACETALDEHYDE		RFIA		ND[0.053]	HEATED CANISTER	FID
ACETALDEHYDE		RFIB		ND[0.019]	HEATED CANISTER	FID
ACETALDEHYDE		RFIH1		ND[0.024]	HEATED CANISTER	FID
ACETALDEHYDE		RFIH2		ND[0.032]	HEATED CANISTER	FID
ACETALDEHYDE		RFIJ		ND[0.0031]	IMPINGER	DNPH
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
13	5		ND to 5.0E-02	5.0E-04		
ACETONE		RFL		ND[1.4E-02]	M18	3.7 ppm (VOST) & 1.2 lb/hr (RTI DRAFT)
ACETONE		RFMC		3.7E-03	IMPINGER	NCASI METHOD
ACETONE		RFMG		6.3E-03	HEATED CANISTER	FID
ACETONE		RFMH		1.5E-02	HEATED CANISTER	FID
ACETONE		RFMJ		5.0E-03	HEATED CANISTER	FID
ACETONE		RFMK		3.4E-03	HEATED CANISTER	FID
ACETONE		RFMM		2.1E-03	HEATED CANISTER	FID
ACETONE		RFIA		ND[0.070]	HEATED CANISTER	FID
ACETONE		RFIB		ND[0.025]	HEATED CANISTER	FID
ACETONE		RFIH1		ND[0.032]	HEATED CANISTER	FID
ACETONE		RFIH2	ND[0.042] to 0.048	3.0E-02	HEATED CANISTER	FID
ACETONE		RFIJ		ND[0.013]	HEATED CANISTER	FID , [0.016] BY DNPH METH.
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
12	7		ND to 4.8E-02	2.8E-03		
ACETOPHENONE		RFL		ND[0.023]	RTI DRAFT	
ACETOPHENONE		RFIB		ND[0.052]	HEATED CANISTER	FID
ACETOPHENONE		RFIH1		ND[0.066]	HEATED CANISTER	FID
ACETOPHENONE		RFIH2		ND[0.087]	HEATED CANISTER	FID
ACETOPHENONE		RFIJ		ND[0.028]	HEATED CANISTER	FID, [0.008] BY DNPH METH.
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	0		ND	ND		
ACROLEIN		RFL		ND[1.1E-02]	RTI DRAFT	
ACROLEIN		RFMG		ND[6.3E-04]	HEATED CANISTER	FID
ACROLEIN		RFMH		ND[1.2E-03]	HEATED CANISTER	FID
ACROLEIN		RFMJ		ND[1.8E-03]	HEATED CANISTER	FID
ACROLEIN		RFMK		ND[5.7E-04]	HEATED CANISTER	FID
ACROLEIN		RFMM		ND[5.2E-04]	HEATED CANISTER	FID
ACROLEIN		RFIA		ND[6.8E-02]	HEATED CANISTER	FID
ACROLEIN		RFIB		ND[2.4E-02]	HEATED CANISTER	FID
ACROLEIN		RFIH1		ND[3.1E-02]	HEATED CANISTER	FID
ACROLEIN		RFIH2		ND[4.0E-02]	HEATED CANISTER	FID
ACROLEIN		RFIJ		ND[1.3E-02]	HEATED CANISTER	FID, [0.004] by DNPH METH.
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
11	0		ND	ND		
ALPHA-TERPINEOL		RFIJ		ND[3.6E-2]	HEATED CANISTER	FID
BENZALDEHYDE		RFL		ND[0.021]	RTI DRAFT	
BENZALDEHYDE		RFIJ		7.0E-03	IMPINGER	DNPH
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
2	1		ND to 7.0E-3	3.5E-03		
BENZENE		RFL		ND[0.018]	M18	10.6 ppm by the VOST METHOD
BENZENE		RFD	0.0015 to 0.009	5.8E-03	CARB 410A	
BENZENE		RFMC		9.4E-03	HEATED CANISTER	FID
BENZENE		RFMG		ND[2.9E-4]	HEATED CANISTER	FID

TABLE 12C UMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORG	IC	MILL	RANGE	AVG		
COMPOUND		CODE	lb/ton BLS	lb/ton BLS	TEST METHOD	COMMENTS
BENZENE		RFMH		5.6E-04	HEATED CANISTER	FID
BENZENE		RFMJ		2.5E-02	HEATED CANISTER	FID
BENZENE		RFMK		1.6E-02	HEATED CANISTER	FID
BENZENE		RFMM		ND[2.4E-4]	HEATED CANISTER	FID
BENZENE		RFIA		ND[9.4E-2]	HEATED CANISTER	FID
BENZENE		RFIB		ND[3.3E-2]	HEATED CANISTER	FID
BENZENE		RFIH1		ND[4.3E-2]	HEATED CANISTER	FID
BENZENE		RFIH2		ND[5.6E-2]	HEATED CANISTER	FID
BENZENE		RFIJ		ND[1.8E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
13	5		ND to 2.5E-02	6.3E-04		
BROMODICHLO	METHANE	RFL		ND[0.081]	M18	
CARBON DISUL	E	RFL		ND[0.014]	M18	
CARBON TETR	HLORIDE	RFD		ND[1.1E-3]	CARB 422	
CARBON TETR	HLORIDE	RFMC		ND[1.3E-2]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFMG		ND[6.9E-3]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFMH		ND[1.4E-2]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFMJ		ND[1.9E-2]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFMK		ND[6.3E-3]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFMM		ND[5.7E-3]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFIA		ND[1.9E-1]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFIB		ND[6.6E-2]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFIH1		ND[8.4E-2]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFIH2		ND[1.1E-1]	HEATED CANISTER	FID
CARBON TETR	HLORIDE	RFIJ		ND[3.6E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
12	0		ND	ND		
3-CARENE		RFL		ND[0.032]	M18	
CHLOROBENZE		RFMC		ND[8.2E-4]	HEATED CANISTER	FID
CHLOROBENZE		RFMG		ND[4.2E-4]	HEATED CANISTER	FID
CHLOROBENZE		RFMH		ND[8.3E-4]	HEATED CANISTER	FID
CHLOROBENZE		RFMJ		ND[1.2E-3]	HEATED CANISTER	FID
CHLOROBENZE		RFMK		ND[3.8E-4]	HEATED CANISTER	FID
CHLOROBENZE		RFMM		ND[3.5E-4]	HEATED CANISTER	FID
CHLOROBENZE		RFIA		ND[1.4E-1]	HEATED CANISTER	FID
CHLOROBENZE		RFIB		ND[4.8E-2]	HEATED CANISTER	FID
CHLOROBENZE		RFIH1		ND[6.1E-2]	HEATED CANISTER	FID
CHLOROBENZE		RFIH2		ND[8.1E-2]	HEATED CANISTER	FID
CHLOROBENZE		RFIJ		ND[2.6E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
11	0		ND	ND		
CHLOROFORM		RFC	1.2E-4 to 1.8E-3	5.3E-04		
CHLOROFORM		RFE		ND [1.5E-04]	IMPINGER	NCASI METHOD
CHLOROFORM		RFL		ND[6.3E-02]	M18	
CHLOROFORM		RFD		ND[1.9E-03]	IMPINGER	NCASI METHOD
CHLOROFORM		RFMC		ND[8.2E-3]	HEATED CANISTER	FID
CHLOROFORM		RFMG		ND[4.2E-3]	HEATED CANISTER	FID
CHLOROFORM		RFMH		ND[8.2E-3]	HEATED CANISTER	FID
CHLOROFORM		RFMJ		ND[1.2E-2]	HEATED CANISTER	FID
CHLOROFORM		RFMK		ND[3.8E-3]	HEATED CANISTER	FID
CHLOROFORM		RFMM		ND[3.5E-3]	HEATED CANISTER	FID
CHLOROFORM		RFIA		ND[2.9E-1]	HEATED CANISTER	FID
CHLOROFORM		RFIB		ND[1.0E-1]	HEATED CANISTER	FID
CHLOROFORM		RFIH1		ND[1.3E-1]	HEATED CANISTER	FID
CHLOROFORM		RFIH2		ND[1.7E-1]	HEATED CANISTER	FID
CHLOROFORM		RFIJ		ND[5.5E-2]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN**		
15	1		ND to 1.8E-03	3.9E-05		

TABLE 12C SUMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORGANIC		MILL	RANGE	AVG		
COMPOUND		CODE	lb/ton BLS	lb/ton BLS	TEST METHOD	COMMENTS
m-CRESOL		RFIJ		ND[2.5E-2]	HEATED CANISTER	FID
o-CRESOL		RFIA		ND[1.3E-1]	HEATED CANISTER	FID
o-CRESOL		RFIB		ND[4.6E-2]	HEATED CANISTER	FID
o-CRESOL		RFIH1		ND[5.9E-2]	HEATED CANISTER	FID
o-CRESOL		RFIH2		ND[7.8E-2]	HEATED CANISTER	FID
o-CRESOL		RFIJ		ND[2.5E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	0		ND	ND		
CUMENE		RFL		ND[3.0E-2]	M18	
CUMENE		RFIA		ND[1.5E-1]	HEATED CANISTER	FID
CUMENE		RFIB		ND[5.1E-2]	HEATED CANISTER	FID
CUMENE		RFIH1		ND[6.5E-2]	HEATED CANISTER	FID
CUMENE		RFIH2		ND[8.7E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	0		ND	ND		
p-CYMENE		RFL	30 ppb	1.2E-03	VOST	
1,2-DICHLOROETHANE		RFMC		ND[2.9E-3]	HEATED CANISTER	FID
1,2-DICHLOROETHANE		RFMG		ND[1.5E-3]	HEATED CANISTER	FID
1,2-DICHLOROETHANE		RFMH		ND[2.9E-3]	HEATED CANISTER	FID
1,2-DICHLOROETHANE		RFMJ		ND[4.1E-3]	HEATED CANISTER	FID
1,2-DICHLOROETHANE		RFMK		ND[1.4E-3]	HEATED CANISTER	FID
1,2-DICHLOROETHANE		RFMM		ND[1.2E-3]	HEATED CANISTER	FID
1,2-DICHLOROETHANE		RFIJ		ND[2.3E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	0		ND	ND		
1,2-DICHLOROETHYLENE		RFIJ		ND[2.2E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFL		ND[4.2E-2]	M16	
DIMETHYL DISULFIDE		RFMG		ND[1.8E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFMH		ND[3.2E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFMJ		ND[4.9E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFMK		ND[1.6E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFMM		ND[1.5E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFIA		ND[1.1E-1]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFIB		ND[4.0E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFIH1		ND[5.1E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFIH2		ND[6.8E-2]	HEATED CANISTER	FID
DIMETHYL DISULFIDE		RFIJ		ND[2.2E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
11	0		ND	ND		
DIMETHYL SULFIDE		RFL		ND[1.1E-2]	M16	
DIMETHYL SULFIDE		RFMG		ND[1.2E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFMH		ND[2.3E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFMJ		ND[3.2E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFMK		ND[1.1E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFMM		ND[9.6E-3]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFIA		ND[7.5E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFIB		ND[2.7E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFIH1	ND to 5.9E-02	3.2E-02	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFIH2		ND[4.5E-2]	HEATED CANISTER	FID
DIMETHYL SULFIDE		RFIJ		ND[1.4E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
11	1		ND to 5.9E-02	2.9E-03		
ETHANOL		RFL		ND[1.1E-2]	M18	
ETHANOL		RFIA		ND[6.7E-2]	HEATED CANISTER	FID
ETHANOL		RFIB		ND[2.0E-2]	HEATED CANISTER	FID

TABLE 12C UMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORGA	C	MILL	RANGE	AVG		
COMPOUND		CODE	lb/ton BLS	lb/ton BLS	TEST METHOD	COMMENTS
ETHANOL		RFIH1		ND[2.5E-2]	HEATED CANISTER	FID
ETHANOL		RFIH2		ND[3.3E-2]	HEATED CANISTER	FID
ETHANOL		RFIJ		ND[1.1E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
6	0		ND	ND		
ETHYL BENZENE		RFL		ND[2.6E-2]	M18	
ETHYL BENZENE		RFIA		ND[1.3E-1]	HEATED CANISTER	FID
ETHYL BENZENE		RFIB		ND[4.5E-2]	HEATED CANISTER	FID
ETHYL BENZENE		RFIH1		ND[5.8E-2]	HEATED CANISTER	FID
ETHYL BENZENE		RFIH2		ND[7.7E-2]	HEATED CANISTER	FID
ETHYL BENZENE		RFIJ		ND[2.5E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
6	0		ND	ND		
FORMALDEHYDE		RFC	0.012 to 0.044	2.4E-02	MOD NIOSH 3500	
FORMALDEHYDE		RFE	0.0025 to 0.017	7.8E-03	RTI DRAFT	
FORMALDEHYDE		RFL		ND[0.3 lb/hr]	RTI DRAFT	
FORMALDEHYDE		RFD	0.070 to 0.091	8.1E-02	CARB 430	
FORMALDEHYDE		RFMG		ND[6.7E-3]	HEATED CANISTER	FID
FORMALDEHYDE		RFMJ		8.5E-03	HEATED CANISTER	FID
FORMALDEHYDE		RFMK		1.2E-02	HEATED CANISTER	FID
FORMALDEHYDE		RFMM		ND[1.8E-2]	HEATED CANISTER	FID
FORMALDEHYDE		RFIJ	ND[.002] to 0.004	1.9E-03	IMPINGER	DNPH
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
9	6		ND to 9.1E-02	7.8E-03		
HEXACHLOROCY	LOPENTADIE	RFIJ		ND[6.3E-2]	HEATED CANISTER	FID
HEXACHLOROET	ANE	RFIJ		ND[5.5E-2]	HEATED CANISTER	FID
n-HEXANE		RFL	107 ppb	3.6E-03	VOST	
n-HEXANE		RFMG		ND[3.2E-4]	HEATED CANISTER	FID
n-HEXANE		RFMK		ND[2.9E-4]	HEATED CANISTER	FID
n-HEXANE		RFMM		ND[2.7E-4]	HEATED CANISTER	FID
n-HEXANE		RFIA		ND[1.0E-1]	HEATED CANISTER	FID
n-HEXANE		RFIB		ND[3.7E-2]	HEATED CANISTER	FID
n-HEXANE		RFIH1		ND[4.7E-2]	HEATED CANISTER	FID
n-HEXANE		RFIH2		ND[6.2E-2]	HEATED CANISTER	FID
n-HEXANE		RFIJ		ND[2.0E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
9	1		ND to 3.6E-03	3.8E-04		
HYDROGEN CHLC	IDE	AA1	0.57 to 0.72	6.6E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	BB4	0.00 to 0.02	1.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	CC2	0.30 to 0.72	4.7E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	CC3	0.60 to 0.84	7.2E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	D3	0.61 to 0.71	6.7E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	DD4	0.01 to 0.02	1.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	FF2	0.01 to 0.08	5.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	FF3		2.0E-03	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	FF4		8.0E-04	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	GG10	0.23 to 0.61	4.7E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	HH3	0.43 to 0.65	5.1E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	I	0.25 to 1.23	7.4E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	J	0.80 to 0.85	8.3E-01	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	L		4.9E-03	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	M	0.03 to 0.06	6.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	O	ND to 0.05	2.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	Q	ND to 0.01	1.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	R	0.02 to 0.03	3.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	S	0.02 to 0.03	3.0E-02	M26	See NCASI Tech. Bull. No. 674 for details
HYDROGEN CHLC	IDE	T	0.03 to 0.10	6.0E-02	M26	See NCASI Tech. Bull. No. 674 for details

TABLE 12C SU ARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORGANIC COMPOUND		MILL CODE	RANGE lb/ton BLS	AVG lb/ton BLS	TEST METHOD	COMMENTS
HYDROGEN CHLO	DE	U	0.13 to 0.18	1.5E-01	M26	See NCASI Tech. Bull. No. 674 for details
NO. OF TESTS	TECTS		RANGE	MEDIAN		
21	21		ND to 1.23	6.0E-02		
ISOPROPANOL		RFIA		ND[7.2E-2]	HEATED CANISTER	FID
ISOPROPANOL		RFIB		ND[2.6E-2]	HEATED CANISTER	FID
ISOPROPANOL		RFIH1		ND[3.3E-2]	HEATED CANISTER	FID
ISOPROPANOL		RFIH2		ND[4.3E-2]	HEATED CANISTER	FID
ISOPROPANOL		RFIJ		ND[1.4E-2]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN		
5	0		ND	ND		
METHANOL		RFL	ND to 0.034	2.1E-02	M18	
METHANOL		RFN		ND[0.022]		
METHANOL		RFD	ND to 0.0021	7.1E-04	MOD NIOSH S59	
METHANOL		RFMC		1.4E-01	HEATED CANISTER	FID
METHANOL		RFMG		2.3E-01	HEATED CANISTER	FID
METHANOL		RFMH		1.9E-01	HEATED CANISTER	FID
METHANOL		RFMJ		4.4E-02	HEATED CANISTER	FID
METHANOL		RFMK		5.8E-02	HEATED CANISTER	FID
METHANOL		RFMM		1.8E-02	HEATED CANISTER	FID
METHANOL		RFIA	ND to 0.112	6.3E-02	HEATED CANISTER	FID
METHANOL		RFIB	0.045 to 0.055	4.9E-02	HEATED CANISTER	FID
METHANOL		RFIH1	0.035 to 0.078	5.1E-02	HEATED CANISTER	FID
METHANOL		RFIH2	ND to 0.266	1.0E-01	HEATED CANISTER	FID
METHANOL		RFIJ		ND[0.015]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN		
14	12		ND to 0.266	5.0E-02		
METHYL ETHYL	TONE	RFL		ND[1.8E-2]	M18	0.3 ppm (VOST) & ND[0.6 lb/hr] (RTI DRAFT
METHYL ETHYL	TONE	RFMC		5.2E-03	HEATED CANISTER	
METHYL ETHYL	TONE	RFMG		2.7E-03	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFMH		3.8E-03	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFMJ		7.1E-03	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFMK		ND[9.8E-4]	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFMM		1.3E-03	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFIA		ND[8.7E-2]	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFIB		ND[3.1E-2]	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFIH1		ND[3.9E-2]	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFIH2		ND[5.2E-2]	HEATED CANISTER	FID
METHYL ETHYL	TONE	RFIJ		ND[1.7E-2]	HEATED CANISTER	FID, [0.005] by DNPH METH.
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
12	5		ND to 7.1E-03	1.2E-03		
METHYL ISOBUT	L KETONE	RFL		ND[2.1E-2]	RTI DRAFT	
METHYL ISOBUT	L KETONE	RFMC		5.1E-03	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFMG		4.7E-04	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFMH		ND[7.4E-4]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFMJ		ND[1.0E-3]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFMK		ND[3.4E-4]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFMM		5.3E-04	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFIA		ND[1.2E-1]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFIB		ND[4.3E-2]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFIH1		ND[5.5E-2]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFIH2		ND[7.2E-2]	HEATED CANISTER	FID
METHYL ISOBUT	L KETONE	RFIJ		ND[2.3E-2]	HEATED CANISTER	FID, [0.007] by DNPH METH.
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
11	3		ND to 5.1E-03	3.1E-05		
METHYL MERC	TAN	RFL	0.039 to 0.064	5.0E-02	M16	
METHYL MERC	TAN	RFMG		ND[9.0E-3]	HEATED CANISTER	FID
METHYL MERC	TAN	RFMH		ND[1.8E-3]	HEATED CANISTER	FID
METHYL MERC	TAN	RFMJ		ND[2.5E-2]	HEATED CANISTER	FID
METHYL MERC	TAN	RFMK		ND[8.2E-3]	HEATED CANISTER	FID

TABLE 12C . MMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORGA	C	MILL	RANGE	AVG		
COMPOUND		CODE	lb/ton BLS	lb/ton BLS	TEST METHOD	COMMENTS
METHYL MERCA	AN	RFMM		ND[7.5E-3]	HEATED CANISTER	FID
METHYL MERCA	AN	RFIA		ND[5.8E-2]	HEATED CANISTER	FID
METHYL MERCA	AN	RFIB		ND[2.1E-2]	HEATED CANISTER	FID
METHYL MERCA	AN	RFIH1	ND to 0.077	3.4E-02	HEATED CANISTER	FID
METHYL MERCA	AN	RFIH2		ND[3.5E-2]	HEATED CANISTER	FID
METHYL MERCA	AN	RFIJ		ND[1.1E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
11	2		ND to 7.7E-02	6.9E-03		
METHYLENE CHL	RIDE	RFL	116 ppb	3.8E-03	VOST	
METHYLENE CHL	RIDE	RFD	0.0033 to 0.011	6.3E-03	CARB 422	
METHYLENE CHL	RIDE	RFMC		ND[5.6E-3]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFMG		ND[2.9E-3]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFMH		ND[5.6E-3]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFMJ		ND[8.0E-3]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFMK		ND[2.6E-3]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFMM		ND[2.4E-3]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFIA		ND[1.0E-1]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFIB		ND[3.6E-2]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFIH1		ND[4.6E-2]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFIH2		ND[6.1E-2]	HEATED CANISTER	FID
METHYLENE CHL	RIDE	RFIJ		ND[2.0E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
11	2		ND to 1.1E-02	7.7E-04		
NAPHTHALENE		RFD	0.0003 to 0.0007	5.4E-04	CARB 429	
ALPHA-PINENE		RFL	45 ppb	1.5E-03	VOST	
ALPHA-PINENE		RFMC		2.0E-03	HEATED CANISTER	FID
ALPHA-PINENE		RFIJ		ND[3.2E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.0E-3	1.5E-03		
BETA-PINENE		RFL		ND[3.2E-2]	M18	
BETA-PINENE		RFMC		4.6E-03	HEATED CANISTER	FID
BETA-PINENE		RFIJ		ND[3.2E-2]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN**		
3	1		ND to 4.6E-3	1.2E-03		
PAH		RFC	7.9 - 15.9 ug/m3	9.7E-05		Note, PAHs include Naphthalene
PAH		RFD	3.0E-4 to 9.2E-4	6.5E-04	CARB 429	Note, PAHs include Naphthalene
NO. OF TESTS	ETECTS		RANGE	MEDIAN		
2	2		9.7E-5 to 9.2E-4	3.8E-04		
PHENOL		RFIA		ND[1.1E-1]	HEATED CANISTER	FID
PHENOL		RFIB		ND[4.0E-2]	HEATED CANISTER	FID
PHENOL		RFIH1		ND[5.1E-2]	HEATED CANISTER	FID
PHENOL		RFIH2		ND[6.8E-2]	HEATED CANISTER	FID
PHENOL		RFIJ		ND[2.2E-2]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN		
5	0		ND	ND		
2-PROPANOL		RFL		ND[0.014]	M18	
STYRENE		RFL	14 ppb	5.6E-04	VOST	
STYRENE		RFMC		1.6E-03	HEATED CANISTER	FID
STYRENE		RFMG		1.3E-03	HEATED CANISTER	FID
STYRENE		RFMH		ND[7.7E-4]	HEATED CANISTER	FID
STYRENE		RFMJ		2.0E-03	HEATED CANISTER	FID
STYRENE		RFMK		ND[3.6E-4]	HEATED CANISTER	FID

TABLE 12C SU IARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORGANIC COMPOUND		MILL CODE	RANGE lb/ton BLS	AVG lb/ton BLS	TEST METHOD	COMMENTS
STYRENE		RFMM		ND[3.2E-4]	HEATED CANISTER	FID
NO. OF TESTS	TECTS		RANGE	MEDIAN		
7	4		ND to 2.0E-03	5.6E-04		
SULFURIC ACID		C	0.21 to 0.91 ppm	3.3E-02	CONTROLLED COND.	See NCASI Tech. Bull. No. 106 for details
SULFURIC ACID		D	0.17 to 2.98 ppm	7.1E-02	CONTROLLED COND.	See NCASI Tech. Bull. No. 106 for details
SULFURIC ACID		E	0.49 to 1.71 ppm	5.1E-02	CONTROLLED COND.	See NCASI Tech. Bull. No. 106 for details
SULFURIC ACID		RFO		ND[1.3E-02]	CONTROLLED COND.	
NO. OF TESTS	ETECTS		RANGE	MEDIAN		
4	3		ND to 1.6E-01	4.2E-02		
TETRACHLOROET	YLENE	RFMC		3.0E-03	HEATED CANISTER	FID, U
TETRACHLOROET	YLENE	RFMG		ND[1.9E-3]	HEATED CANISTER	FID
TETRACHLOROET	YLENE	RFMH		ND[3.7E-3]	HEATED CANISTER	FID
TETRACHLOROET	YLENE	RFMJ		ND[5.2E-3]	HEATED CANISTER	FID
TETRACHLOROET	YLENE	RFMK		ND[1.7E-3]	HEATED CANISTER	FID
TETRACHLOROET	YLENE	RFMM		1.5E-03	HEATED CANISTER	FID, U
NO. OF TESTS	ETECTS		RANGE	MEDIAN**		
6	2		ND to 3.0E-3	5.7E-04		
TOLUENE		RFL		ND[2.3E-2]	M18	0.32 ppm by VOST METHOD
TOLUENE		RFMC		1.1E-03	HEATED CANISTER	FID
TOLUENE		RFMG		ND[2.5E-4]	HEATED CANISTER	FID
TOLUENE		RFMH		4.8E-04	HEATED CANISTER	FID
TOLUENE		RFMJ		1.1E-03	HEATED CANISTER	FID
TOLUENE		RFMK		ND[2.3E-4]	HEATED CANISTER	FID
TOLUENE		RFMM		ND[2.1E-4]	HEATED CANISTER	FID
TOLUENE		RFIA		ND[1.1E-1]	HEATED CANISTER	FID
TOLUENE		RFIB		ND[3.9E-2]	HEATED CANISTER	FID
TOLUENE		RFIH1		ND[2.9E-2]	HEATED CANISTER	FID
TOLUENE		RFIH2		ND[6.6E-2]	HEATED CANISTER	FID
TOLUENE		RFIJ		ND[2.1E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
12	3		ND to 1.1E-03	2.9E-04		
1,2,4-TRICHLOR	ENZENE	RFMC		ND[1.3E-3]	HEATED CANISTER	FID
1,2,4-TRICHLOR	ENZENE	RFMG		8.7E-03	HEATED CANISTER	FID
1,2,4-TRICHLOR	ENZENE	RFMH		ND[1.3E-3]	HEATED CANISTER	FID
1,2,4-TRICHLOR	ENZENE	RFMJ		ND[1.9E-3]	HEATED CANISTER	FID
1,2,4-TRICHLOR	ENZENE	RFMK		ND[6.2E-4]	HEATED CANISTER	FID
1,2,4-TRICHLOR	ENZENE	RFMM		ND[5.6E-4]	HEATED CANISTER	FID
1,2,4-TRICHLOR	ENZENE	RFIJ		ND[4.2E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
7	1		ND to 8.7E-03	1.1E-03		
1,1,1-TRICHLOR	THANE	RFD		ND[2.0E-3]	CARB 429	
1,1,1-TRICHLOR	THANE	RFMC		ND[2.9E-3]	HEATED CANISTER	FID
1,1,1-TRICHLOR	THANE	RFMG		ND[1.5E-3]	HEATED CANISTER	FID
1,1,1-TRICHLOR	THANE	RFMH		ND[2.9E-3]	HEATED CANISTER	FID
1,1,1-TRICHLOR	THANE	RFMJ		ND[4.2E-3]	HEATED CANISTER	FID
1,1,1-TRICHLOR	THANE	RFMK		ND[1.4E-3]	HEATED CANISTER	FID
1,1,1-TRICHLOR	THANE	RFMM		ND[1.2E-3]	HEATED CANISTER	FID
1,1,1-TRICHLOR	ETHANE	RFIA		ND[1.6E-1]	HEATED CANISTER	FID
1,1,1-TRICHLOR	ETHANE	RFIB		ND[5.7E-2]	HEATED CANISTER	FID
1,1,1-TRICHLOR	ETHANE	RFIH1		ND[7.3E-2]	HEATED CANISTER	FID
1,1,1-TRICHLOR	ETHANE	RFIH2		ND[9.6E-2]	HEATED CANISTER	FID
1,1,1-TRICHLOR	ETHANE	RFIJ		ND[6.2E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
12	0		ND	ND		
1,1,2-TRICHLOR	ETHANE	RFMC		ND[2.9E-3]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFMG		ND[1.5E-3]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFMH		ND[2.9E-3]	HEATED CANISTER	FID

TABLE 12C UMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORG	IC	MILL	RANGE	AVG		
COMPOUND		CODE	lb/ton BLS	lb/ton BLS	TEST METHOD	COMMENTS
1,1,2-TRICHLOR	ETHANE	RFMJ		ND[4.2E-3]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFMK		ND[1.4E-3]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFMM		ND[1.2E-3]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFIA		ND[1.6E-1]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFIB		ND[5.7E-2]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFIH1		ND[7.3E-2]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFIH2		ND[9.6E-2]	HEATED CANISTER	FID
1,1,2-TRICHLOR	ETHANE	RFIJ		ND[3.1E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
11	0		ND	ND		
TRICHLOROETH	ENE	RFD		ND[2.0E-3]	CARB 429	
TRICHLOROETH	ENE	RFMC		ND[2.8E-3]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFMG		ND[1.5E-3]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFMH		ND[2.8E-3]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFMJ		ND[4.1E-3]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFMK		ND[1.3E-3]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFMM		ND[1.2E-3]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFIA		ND[1.6E-1]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFIB		ND[5.6E-2]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFIH1		ND[7.2E-2]	HEATED CANISTER	FID
TRICHLOROETH	ENE	RFIH2		ND[9.5E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
11	0		ND	ND		
m,p-XYLENE		RFL	42 ppb	1.7E-03	VOST	
m,p-XYLENE		RFMG		ND[4.0E-4]	HEATED CANISTER	FID
m,p-XYLENE		RFMH		ND[7.8E-4]	HEATED CANISTER	FID
m,p-XYLENE		RFMJ		1.1E-03	HEATED CANISTER	FID
m,p-XYLENE		RFMK		ND[3.6E-4]	HEATED CANISTER	FID
m,p-XYLENE		RFMM		4.4E-04	HEATED CANISTER	FID
m,p-XYLENE		RFIA		ND[1.3E-1]	HEATED CANISTER	FID
m,p-XYLENE		RFIB		ND[4.5E-2]	HEATED CANISTER	FID
m,p-XYLENE		RFIH1		ND[5.8E-2]	HEATED CANISTER	FID
m,p-XYLENE		RFIH2		ND[7.6E-2]	HEATED CANISTER	FID
m,p-XYLENE		RFIJ		ND[2.5E-2]	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
11	3		ND to 1.7E-03	1.8E-04		
o-XYLENE		RFL	30 ppb	1.2E-03	VOST	
o-XYLENE		RFMG		5.0E-04	HEATED CANISTER	FID
o-XYLENE		RFMH		9.6E-04	HEATED CANISTER	FID
o-XYLENE		RFMJ		1.1E-03	HEATED CANISTER	FID
o-XYLENE		RFMK		ND[3.6E-4]	HEATED CANISTER	FID
o-XYLENE		RFMM		3.1E-04	HEATED CANISTER	FID
o-XYLENE		RFIA		ND[1.3E-1]	HEATED CANISTER	FID
o-XYLENE		RFIB		ND[4.5E-2]	HEATED CANISTER	FID
o-XYLENE		RFIH1		ND[5.8E-2]	HEATED CANISTER	FID
o-XYLENE		RFIH2		ND[7.6E-2]	HEATED CANISTER	FID
o-XYLENE		RFIJ		ND[2.5E-2]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN*		
11	5		ND to 1.2E-03	3.3E-04		
TERPENES		RFMG		9.2E-02	HEATED CANISTER	FID
TERPENES		RFMJ		1.8E-02	HEATED CANISTER	FID
TERPENES		RFMK		3.1E-02	HEATED CANISTER	FID
TERPENES		RFMM		4.5E-03	HEATED CANISTER	FID
TERPENES		RFIA		ND[1.6E-1]	HEATED CANISTER	FID
TERPENES		RFIB		ND[5.8E-2]	HEATED CANISTER	FID
TERPENES		RFIH1		ND[7.4E-2]	HEATED CANISTER	FID
TERPENES		RFIH2		ND[9.8E-2]	HEATED CANISTER	FID
NO. OF TESTS	ETECTS		RANGE	MEDIAN*		
8	4		ND to 9.2E-02	4.4E-03		

TABLE 12C SUMMARY OF 'AIR TOXIC' EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES, CONTD.

			EMISSIONS			
VOLATILE ORGANIC		MILL	RANGE	AVG		
COMPOUND		CODE	lb/ton BLS	lb/ton BLS	TEST METHOD	COMMENTS
TOTAL HYDROCARBONS		A	0.10 to 0.42	3.3E-01	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		B	0.06 to 0.64	3.1E-01	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		C	0.22 to 0.98	5.1E-01	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RA	-	3.7E-02	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RF	<0.012 to 0.60	2.1E-01	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RO	-	0.0E+00	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RP	0.006 to 0.012	1.2E-02	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RQ	0.00 to 0.02	1.2E-02	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RT	0.018 to 0.25	5.5E-02	M25	See NCASI Tech. Bull. No. 646 for details
TOTAL HYDROCARBONS		RFMG		1.0E-01	M25A	
TOTAL HYDROCARBONS		RFMH		9.3E-02	M25A	
TOTAL HYDROCARBONS		RFMJ		2.6E-01	M25A	
TOTAL HYDROCARBONS		RFMK		4.5E-01	M25A	
TOTAL HYDROCARBONS		RFMM		ND[3.8E-3]	M25A	
TOTAL HYDROCARBONS		RFIB	0.056 to 0.151	1.0E-01	M25A	
TOTAL HYDROCARBONS		RFIJ	0.061 to 0.078	7.0E-02	M25A	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
16	15		ND to 9.8E-01	9.7E-02		

Notes

(a) U - unidentified and unconfirmed by GC/MS

(b) For recovery furnaces with codes RFMX (X = A to Q) the heated canister gases were concentrated before analysis on the FID;

(c) For recovery furnaces with codes RFIX (X = A to J) the heated canister gases were not concentrated before analysis on the FID;

MEDIAN - empirical median; MEDIAN* - "NORPLOT" median; MEDIAN** - "SDln" median

TABLE 12D SUMMARY OF TRACE METAL EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES

			EMISSIONS			
TRACE METAL		MILL CODE	RANGE lb/1E+6 TON BLS	AVG	TEST METHOD	COMMENT
Chromium+6		RC		8.3E+00	CARB 425	
Chromium+6		RE		5.8E-01	NA	
Chromium+6		RF		3.3E+01	CARB 425	
Chromium+6		RG		2.7E+01	NA	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	4		0.58 to 33	1.7E+01		
Copper		RA		9.1E+00	NA	
Copper		RF		4.6E+01	CARB 436	
Copper		RG		2.0E+01	NA	
Copper		RH		3.2E+02	EPA DRAFT MM	
Copper		RFIF2	ND to 25	2.1E+01	METHOD 29	
Copper		RFIJ	ND to 24	1.7E+01	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
6	6		ND to 320	2.1E+01		
Cobalt		RFIF2		ND[10]	METHOD 29	
Cobalt		RFIJ		ND[42]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
2	0		ND	ND		
Lead		RB2		1.6E+01	NA	
Lead		RF		3.5E+01	CARB 436	
Lead		RG		3.1E+01	NA	
Lead		RH		2.1E+02	EPA DRAFT MM	
Lead		RI		ND[1.1E+02]	EPA DRAFT MM	
Lead		RFIF2	47 to 52	5.0E+01	METHOD 29	
Lead		RFIJ		ND[56]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	5		ND to 2.1E+02	3.1E+01		
Manganese		RA		1.2E+01	NA	
Manganese		RB2		7.9E+01	NA	
Manganese		RC		1.0E+01	EPA DRAFT MM	
Manganese		RE		1.2E+02	NA	
Manganese		RF		5.1E+01	CARB 436	
Manganese		RG		1.2E+01	NA	
Manganese		RH		8.8E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	7		10 to 120	5.1E+01		
Mercury		RA		2.0E+00	NA	
Mercury		RB2		2.8E+01	NA	
Mercury		RF		4.3E+01	CARB 436	
Mercury		RH		9.0E+01	EPA DRAFT MM	
Mercury		RI		5.7E+00	EPA DRAFT MM	
Mercury		RFIF2		ND[15]	METHOD 29	
Mercury		RFIJ	ND to 56	3.7E+01	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	6		ND to 90	2.8E+01		
Nickel		RA		4.4E+00	NA	

TABLE 14B SUMMARY OF TRACE METAL EMISSIONS FROM LIME KILNS, CONTD.

			EMISSIONS IN			
		MILL	lb/1E+6 TON CaO		TEST	
TRACE METAL		CODE	RANGE	AVG	METHOD	COMMENTS
Antimony		LB1		3.2E+02	NA	
Antimony		LB2		1.3E+01	EPA M0012	
Antimony		LD		ND[48]	EPA DRAFT MM	
Antimony		LKIC1	ND to 7.6E+00	5.7E+00	METHOD 29	
Antimony		LKID1		ND[4.7E+01]	METHOD 29	
Antimony		LKID2		ND[2.9E+00]	METHOD 29	
Antimony		LKIE		ND[5.8E+01]	METHOD 29	
Antimony		LKIF3	ND to 6.9E+00	5.1E+00	METHOD 29	
Antimony		LKIG		ND[3.0E+00]	METHOD 29	
Antimony		LKIJ	ND to 1.4E+01	9.0E+00	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
10	5		ND to 3.2E+02	2.0E+00		
Arsenic		LB1		ND[1000]	NA	
Arsenic		LB2		8.9E+00	EPA M0012	
Arsenic		LC		1.6E+00	CARB 436	
Arsenic		LD		3.9E+01	EPA DRAFT MM	
Arsenic		LE		ND[24]	CARB 436	
Arsenic		LKIC1		8.8E+00	METHOD 29	
Arsenic		LKID1		ND[1.1E+02]	METHOD 29	
Arsenic		LKID2		ND[6.5E+01]	METHOD 29	
Arsenic		LKIE		ND[8.3E+01]	METHOD 29	
Arsenic		LKIF3		ND[2.0E+01]	METHOD 29	
Arsenic		LKIG		ND[9.0E+00]	METHOD 29	
Arsenic		LKIJ		ND[5.6E+01]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
12	4		ND to 3.9E+01	6.0E-01		
Barium		LA		7.6E+01	NA	
Barium		LB2		1.8E+04	EPA M0012	
Barium		LD		ND[4E+4]	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 7.6E+01	7.6E+01		
Beryllium		LB1		1.0E+01	NA	
Beryllium		LB2		1.4E+00	EPA M0012	
Beryllium		LC		3.4E+01	CARB 436	
Beryllium		LD		2.3E+01	EPA DRAFT MM	
Beryllium		LE		ND[0.78]	CARB 436	
Beryllium		LKIC1		ND[2.8E+00]	METHOD 29	
Beryllium		LKID1		ND[3.1E+00]	METHOD 29	
Beryllium		LKID2		ND[2.2E+00]	METHOD 29	
Beryllium		LKIE		ND[5.3E+00]	METHOD 29	
Beryllium		LKIF3		ND[6.9E+00]	METHOD 29	
Beryllium		LKIG		ND[3.0E+00]	METHOD 29	
Beryllium		LKIJ		ND[3.4E+00]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
12	4		ND to 3.4E+01	5.2E-01		
Cadmium		LB1		ND[13]	NA	
Cadmium		LB2		1.1E+02	EPA M0012	
Cadmium		LC		9.7E+00	CARB 436	
Cadmium		LD		ND[46]	EPA DRAFT MM	
Cadmium		LE		2.2E+01	CARB 436	
Cadmium		LKIC1	1.3E+01 to 2.2E+01	1.7E+01	METHOD 29	
Cadmium		LKID1		ND[3.1E+01]	METHOD 29	
Cadmium		LKID2		ND[1.8E+01]	METHOD 29	
Cadmium		LKIE	ND to 7.8E+01	4.9E+01	METHOD 29	
Cadmium		LKIF3	ND to 2.1E+02	1.4E+02	METHOD 29	

TABLE 15B SUMMARY OF 'AIR TOXIC' METAL EMISSIONS FROM SMELT DISSOLVING TANK VENTS, CONTD.

			EMISSIONS IN lb/1E+6 ton BLS			
		MILL			TEST	
TRACE METAL		CODE	RANGE	AVG	METHOD	COMMENTS
Antimony		SDTB		8.7E+00	EPA DRAFT MM	
Antimony		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Antimony		SDTI		2.0E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.0E+01	8.7E+00		
Arsenic		SDTA		7.0E-01	EPA DRAFT MM	
Arsenic		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Arsenic		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Arsenic		SDTI		2.1E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 2.1E+01	3.0E+00		
Barium		SDTB	ND[5600]		EPA DRAFT MM	
Barium		SDTE	ND[3982]		EPA DRAFT MM	
Barium		SDTI		2.0E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	1		ND to 2.0E+01	2.0E+01		
Beryllium		SDTA		1.4E-01	EPA DRAFT MM	
Beryllium		SDTB	ND[7.0]		EPA DRAFT MM	
Beryllium		SDTE	ND[5.0]		EPA DRAFT MM	
Beryllium		SDTI		1.8E+00	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 1.8E+00	9.6E-01		
Cadmium		SDTA		1.1E-01	EPA DRAFT MM	
Cadmium		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Cadmium		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Cadmium		SDTI		3.8E+02	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 3.8E+02	3.0E+00		
Chromium		SDTA		2.3E+01	CARB 425	
Chromium		SDTB	ND[14.0]	7.0E+00	EPA DRAFT MM	
Chromium		SDTE	ND[10.0]	5.0E+00	EPA DRAFT MM	
Chromium		SDTI		2.5E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 2.5E+01	1.5E+01		
Chromium+6		SDTA		3.4E+00	CARB 425	
Copper		SDTA		6.0E+00	EPA DRAFT MM	
Copper		SDTB		1.6E+01	EPA DRAFT MM	
Copper		SDTE		8.2E+00	EPA DRAFT MM	
Copper		SDTI		2.1E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	4		ND to 2.1E+01	1.2E+01		
Lead		SDTA		1.2E+00	EPA DRAFT MM	
Lead		SDTB		4.5E+01	EPA DRAFT MM	
Lead		SDTE	ND[10.0]	5.0E+00	EPA DRAFT MM	

TABLE 15B SUMMARY OF 'AIR TOXIC' METAL EMISSIONS FROM SMELT DISSOLVING TANK VENTS, CONTD.

			EMISSIONS IN lb/1E+6 ton BLS			
TRACE METAL		MILL CODE	RANGE	AVG	TEST METHOD	COMMENTS
Lead		SDTI		1.1E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	3		ND to 4.5E+01	8.2E+00		
Manganese		SDTA		3.1E+01	EPA DRAFT MM	
Manganese		SDTB		2.3E+01	EPA DRAFT MM	
Manganese		SDTE		4.4E+01	EPA DRAFT MM	
Manganese		SDTI		2.2E+02	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	4		2.3E+01 to 2.2E+02	3.8E+01		
Mercury		SDTA		1.8E-01	EPA DRAFT MM	
Mercury		SDTB	ND[7.0]		EPA DRAFT MM	
Mercury		SDTE	ND[5.0]		EPA DRAFT MM	
Mercury		SDTI	ND[14.3]		EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	1		ND to 1.8E-01	1.8E-01		
Nickel		SDTA		6.8E-01	EPA DRAFT MM	
Nickel		SDTB	ND[7.0]	4.0E+00	EPA DRAFT MM	
Nickel		SDTE		8.0E+00	EPA DRAFT MM	
Nickel		SDTI		2.5E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	3		ND to 2.5E+01	6.0E+00		
Phosphorus		SDTB	ND[14]	7.0E+00	EPA DRAFT MM	P is a non-metal
Phosphorus		SDTE		1.2E+02	EPA DRAFT MM	P is a non-metal
Phosphorus		SDTI		2.4E+02	EPA DRAFT MM	P is a non-metal
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.4E+02	1.2E+02		
Selenium		SDTA		8.6E-01	EPA DRAFT MM	
Selenium		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Selenium		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Selenium		SDTI		1.2E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 1.2E+01	3.0E+00		
Silver		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Silver		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Silver		SDTI		7.3E+00	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	1		ND to 7.3E+00	3.5E+00		
Thallium		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Thallium		SDTE		3.0E+00	EPA DRAFT MM	
Thallium		SDTI		5.4E+00	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 5.4E+00	3.5E+00		
Zinc		SDTA		4.4E+01	EPA DRAFT MM	

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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

COMPILATION OF SPECIATED REDUCED SULFUR COMPOUND AND TOTAL REDUCED SULFUR EMISSIONS DATA FOR KRAFT MILL SOURCES

TECHNICAL BULLETIN NO. 849
AUGUST 2002

by
Arun V. Someshwar, Ph.D.
National Council for Air and Stream Improvement
Southern Regional Center, Gainesville, Florida

Table 24. TRS Data Summary – Slakers & Causticizers

	Gas Flow Rate		Vent Gas Properties			Prod.		Reduced Sulfur Compounds					TRS[1] as S
	acfm	dscfm	Temp °F	% H_2O	% O_2	tCaO/day	dscfm/tpd	Units	H_2S	MM	DMS	DMDS	
I. Slakers													
TRS and Vent Gas Properties for 4 Slaker Vents (2 tested for speciated reduced sulfur compounds and 2 for TRS only)								TRS as S					
										ppmd	lb/tCaO		
mean	16,738[2]	4,904	168.1	65.2	20.8	333.3	16.4			19.0	4.5E-02		
minimum		49	127.0	35.6	20.8	196.2	0.2			1.9	3.8E-04		
maximum		8,586	210.0	96.0	20.8	549.0	29.9			54.4	1.7E-01		
number of sources	3	4	3	3	1	4	4			4	4		
II. Causticizers													
TRS and Vent Gas Properties for 3 Causticizer Vents (2 tested for speciated reduced sulfur compounds and 1 for TRS only)								TRS as S					
										ppmd	lb/tCaO		
mean	2,410[2]	641	354.3	59.0	20.8	422.8	1.7			422.8	1.9E-02		
minimum		15	193.7	28.0	20.8	330.0	0.0			1.4	7.4E-06		
maximum		1,795	515.0	90.0	20.8	549.0	4.6			1,265	5.5E-02		
number of sources	2	3	2	2	1	3	3			3	3		
III. Combined Slaker & Causticizer Vents													
mean[a]	7,528[2]	2,646	164.8	58.4		432.3	6.0	ppmd		*0.41*	*0.41*	0.66	2.14
minimum		574	128.1	48.6		301.0	1.3	ppmd		*0.28*	*0.28*	*0.29*	*1.14*
maximum		5,132	189.0	64.0		549.0	9.3	ppmd		*0.48*	*0.49*	1.20	3.34
mean[a]								lb/tCaO		*4.3E-04*	*5.6E-04*	9.6E-04	1.2E-03
minimum								lb/tCaO		*1.1E-04*	*1.4E-04*	5.4E-04	5.1E-04
maximum								lb/tCaO		*8.0E-04*	*1.0E-03*	*1.6E-03*	*2.2E-03*
number of sources tested	3	3	3	3		3	3			3	3	3	3

[a] computed treating ND as ½ DL

[1] Note: For total reduced sulfur or TRS, the mean and median are estimated from the means and medians of the individual reduced sulfur compounds, respectively. However, the minimum and maximum correspond to the actual minimum and maximum TRS concentration estimated among all sources.

[2] estimated from dscfm, T and % H_2O

All data in italics correspond to non-detects shown at one-half detection limit

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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

COMPILATION OF 'AIR TOXIC' AND TOTAL HYDROCARBON EMISSIONS DATA FOR SOURCES AT KRAFT, SULFITE AND NON-CHEMICAL PULP MILLS – AN UPDATE

TECHNICAL BULLETIN NO. 858
FEBRUARY 2003

by
Arun Someshwar, Ph.D.
National Council for Air and Stream Improvement
Southern Regional Center
Gainesville, Florida

Table 14B. Summary of Trace Metal Emissions from Kraft NDCE Recovery Furnaces

Trace Metal	Reference No.	No. of Sources	Detects	Emissions, lb/ton BLS					
						NDs > 50%	NDs ≤ 50%		
				Min	Max	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2]	Mean[2]
								using ND = ½ DL	
PM	1	11	11	0.02	3.50		0.32	0.32	0.57
Sb	1	11	3	*4.3E-07*	4.5E-06	1.5E-06[b]			
As	1	11	3	*1.0E-06*	5.4E-04	1.3E-08[b]			
Be	1	9	3	5.9E-08	1.2E-06	1.3E-08[b]			
Cd	1	11	9	*9.7E-07*	4.8E-05		7.1E-06	7.1E-06	1.2E-05[a]
Cr	1	9	9	2.7E-06	3.8E-05		1.9E-05	1.9E-05	1.7E-05
Co	1	11	6	*1.1E-06*	7.7E-06		1.6E-06	2.8E-06	3.2E-06[a]
Pb	1	11	9	1.1E-06	7.0E-05		1.2E-05	1.2E-05	2.3E-05[a]
Mn	1	10	10	5.4E-06	1.7E-04		5.2E-05	5.2E-05	5.9E-05
Hg	1	10	5	*1.0E-07*	7.0E-06		1.8E-07	2.0E-06	2.0E-06[a]
Ni	1	9	8	8.8E-06	6.2E-05		3.3E-05	3.2E-05	2.8E-05
Se	1	11	5	*1.1E-06*	2.2E-04	8.0E-07[b]			
P	1	8	8	6.4E-05	5.5E-04		2.0E-04	2.0E-04	2.2E-04
Ba	1	6	4	1.5E-05	5.6E-05		1.7E-05	4.1E-05	3.8E-05
Cu	1	5	5	1.5E-05	4.3E-05		2.1E-05	2.1E-05	2.6E-05
Zn	1	5	5	6.6E-06	8.0E-04		5.8E-05	5.8E-05	2.8E-04
Ag	1	3	2	*9.2E-07*	4.7E-06		4.1E-06	4.1E-06	3.2E-06
Th	1	2	0				*4.3E-07*	*4.3E-07*	*4.3E-07*[d]
Cr^{+6}	1,2	5	4	*5.8E-07*	3.3E-05		1.4E-05	1.4E-05	1.6E-05

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[1] median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b] NOR-PLOT Average; [c] SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with >50% NDs; [d] when more than 1 source is tested and all observations are ND, averages shown correspond to ½ of the lowest detection limit.

PM – simultaneous total particulate matter emissions

References: 1 (NCASI 2002b); 2 (NCASI 1995a)

Non-detects are shown in italics at ½ the detection limit

Table 16C. Summary of Trace Metal Emissions from Kraft Lime Kilns with Wet Scrubbers

Trace Metal	Reference No.	No. of Sources	Detects	Emissions, lb/ton CaO					
						NDs > 50%	NDs ≤ 50%		
				Min	Max	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2] using ND = ½ DL	Mean[2] using ND = ½ DL
PM	1	12	12	0.00	5.34		0.78	0.78	1.52
Sb	1	10	6	*1.5E-06*	1.0E-05		2.1E-06	3.1E-06	3.7E-06[a]
As	1	12	5	1.1E-06	1.2E-04	6.1E-07[b]			
Be	1	13	4	*1.6E-07*	1.0E-05	2.4E-08[b]			
Cd	1	10	9	1.8E-06	3.3E-05		5.8E-06	1.3E-05	1.4E-05
Cr	1	13	12	5.8E-06	9.6E-04		2.0E-04	2.0E-04	2.7E-04
Co	1	11	8	1.9E-06	3.6E-05		2.3E-06	1.0E-05	1.0E-05[a]
Pb	1	12	9	9.0E-06	1.7E-02		2.1E-04	1.6E-04	3.2E-03[a]
Mn	1	13	13	1.0E-04	8.3E-03		3.0E-04	3.0E-04	1.7E-03
Hg	1	6	1	*7.7E-09*	5.2E-06	6.2E-07[c]			
Ni	1	13	12	1.5E-05	1.3E-03		9.5E-05	9.5E-05	3.1E-04
Se	1	12	4	*4.7E-07*	1.2E-04	2.6E-06[b]			
P	1	7	7	2.5E-05	2.9E-03		1.7E-03	1.7E-03	1.5E-03
Ba	1	3	3	3.4E-04	1.2E-03		5.3E-04	5.3E-04	6.8E-04
Cu	1	2	2	2.2E-05	1.8E-04		1.0E-04	1.0E-04	1.0E-04
Zn	1	2	2	6.7E-05	1.0E-04		8.4E-05	8.4E-05	8.4E-05
Ag	1	1	0				*7.8E-07*	*7.8E-07*	*7.8E-07*
Th	2	2	1	*2.3E-05*	7.8E-06		7.8E-06	7.8E-06	2.8E-06
Cr^{+6}	1,2	3	1	*9.1E-06*	7.6E-05	1.8E-05[c]			

[1] median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b] NOR-PLOT Average; [c] SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with >50% NDs.

PM – simultaneous total particulate matter emissions

References: 1 (NCASI 2002b); 2 (NCASI 1995a)

Non-detects are shown in italics at ½ the detection limit

Table A-17. Summary of 'Air Toxic' Emissions from Causticizing Area Vents

Mill Code	Test Date	Source Description	Pulp Type	Other Information	Capacity/Day	Ref.
CSTMJ	1994	Combined Causticizer/Slaker Vents	SW	574 SCFM	447 ton CaO/d	13
CSTMK	1994	Combined Causticizer/Slaker Vents	HW	2223 DSCFM	301 ton CaO/d	13
CSTMM	1994	Combined Causticizer/Slaker Vents	SW/HW	5161 DSCFM	549 ton CaO/d	13
Several	1993	Causticizer & Slaker Vents	-	-	-	9
LMPCFMD	1994	Lime Mud Precoat Filter Vent	SW	1423 SCFM	273 ton CaO/d	13
LMPCFMJ	1994	Lime Mud Precoat Filter Vent	SW	1239 DSCFM	169 ton CaO/d	13
LMPCFMM	1994	Lime Mud Precoat Filter Vent	SW/HW	1185 DSCFM	568 ton CaO/d	13
PCFVPMD	1994	Precoat Filter Vacuum Pump Exhaust	SW	279 SCFM	260 ton CaO/d	13
PCFVPMJ	1994	Precoat Filter Vacuum Pump Exhaust	SW	72 DSCFM	145 ton CaO/d	13
GLCVMD	1994	Green Liquor Clarifier Tank Vent	SW	1579 SCFM	274 ton CaO/d	13
GLSTMO	1994	Green Liquor Surge Tank Vent	SW	72 DSCFM	2988 ton CaO/d	13
WLPFMF	1994	White Liquor Pressure Filter Vent	SW	1624 SCFM	279 ton CaO/d	13
WLPFMJ	1994	White Liq/ Weak Wash Press. Filt. Vent	SW/HW	2210 DSCFM	377 ton CaO/d	13

References

9. Individual Mill Tests Results for 'Air Toxics' - NCASI Mill File Information - 1993
13. Volatile Organic Emissions from Pulp and Paper Mill Sources - Part II - Lime Kilns, Smelt Dissolving Tanks and Miscellaneous Causticizing Area Vents, NCASI Technical Bulletin No. 675, September 1994.

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

Table A-17 (Cont'd). Summary of 'Air Toxic' Emissions from Causticizing Area Vents

Volatile Organic Compound	No. of Sources	No. of Detects	Emissions, lb/ton CaO					Test Method	Comments
			Range	Median	Mean	SDln	701 Median[1]		
Source: Causticizer and Slaker Vents Emissions									
Acetaldehyde	3	3	1.5E-03 to 5.6E-02	6.8E-03	2.1E-02		6.8E-03	Heated Canister	FID with Concentrator
Acetone	3	3	8.8E-04 to 1.9E-02	8.0E-03	9.4E-03		8.0E-03	Heated Canister	FID with Concentrator
Acrolein	3	1	ND to 1.1E-04	2.7E-05	4.7E-05	1.4E-05 (c)		Heated Canister	FID with Concentrator, U
Ammonia	8/12*	8/12*	0.14 to 1.53	4.4E-01	5.4E-01		4.4E-01		See NCASI TB 789 for details
Benzene	3	1	ND to 1.4E-04	1.2E-05	5.0E-05	1.8E-05 (c)		Heated Canister	FID with Concentrator
Carbon Tetrachloride	3	0		*3.4E-04*	*3.4E-04*		*3.4E-04*	Heated Canister	FID with Concentrator
Chlorobenzene	3	0		*2.1E-05*	*2.1E-05*		*2.1E-05*	Heated Canister	FID with Concentrator
Chloroform	3	0		*2.6E-04*	*2.6E-04*		*2.6E-04*	Heated Canister	FID with Concentrator
1,2-Dichloroethane	3	0		*7.0E-05*	*7.0E-05*		*7.0E-05*	Heated Canister	FID with Concentrator
1,2-Dichloroethylene	3	2	ND to 7.8E-04	3.6E-04	3.8E-04		3.6E-04	Heated Canister	FID with Concentrator, U
Dimethyl Disulfide	3	0		*2.6E-03*	*2.6E-03*		*2.6E-03*	Heated Canister	FID with Concentrator
Dimethyl Sulfide	3	0		*5.5E-04*	*5.5E-04*		*5.5E-04*	Heated Canister	FID with Concentrator
Formaldehyde	3	0		*5.0E-04*	*5.0E-04*		*5.0E-04*	NMIT	NCASI Impinger Method
n-Hexane	3	0		*2.2E-05*	*2.2E-05*		*2.2E-05*	Heated Canister	FID with Concentrator
Methanol	3	3	9.1E-03 to 2.4E-01	5.4E-02	1.0E-01		5.4E-02	Heated Canister	FID with Concentrator
Methyl Ethyl Ketone	3	3	1.5E-04 to 1.4E-03	1.2E-03	9.0E-04		1.2E-03	Heated Canister	FID with Concentrator
Methyl Isobutyl Ketone	3	2	ND to 1.1E-4	3.5E-05	4.9E-05		3.5E-05	Heated Canister	FID with Concentrator
Methyl Mercaptan	3	0		*4.4E-04*	*4.4E-04*		*4.4E-04*	Heated Canister	FID with Concentrator
Methylene Chloride	3	0		*1.4E-04*	*1.4E-04*		*1.4E-04*	Heated Canister	FID with Concentrator
Styrene	3	2	ND to 1.2E-03	1.9E-05	4.0E-04		1.9E-05	Heated Canister	FID with Concentrator
Terpenes	3	3	2.7E-03 to 1.8E-02	8.4E-03	7.0E-03		8.4E-03	Heated Canister	FID with Concentrator
Tetrachloroethylene	3	1	ND to 1.9E-04	8.0E-05	9.6E-05	2.4E-05 (c)		Heated Canister	FID with Concentrator, U
Toluene	3	2	ND to 3.1E-04	1.8E-04	1.7E-04		1.8E-04	Heated Canister	FID with Concentrator
Trichloroethylene	3	0		*7.0E-05*	*7.0E-05*		*7.0E-05*	Heated Canister	FID with Concentrator
1,1,1-Trichloroethane	3	0		*7.0E-05*	*7.0E-05*		*7.0E-05*	Heated Canister	FID with Concentrator
1,1,2-Trichloroethane	3	0		*7.0E-05*	*7.0E-05*		*7.0E-05*	Heated Canister	FID with Concentrator
1,2,4-Trichlorobenzene	3	2	ND to 6.5E-05	2.2E-05	3.9E-05		2.2E-05	Heated Canister	FID with Concentrator, U
o-Xylene	3	1	ND to 5.0E-05	3.6E-05	3.4E-05	6.4E-06 (c)		Heated Canister	FID with Concentrator
m,p-Xylene	3	2	ND to 6.6E-05	3.9E-05	4.1E-05		3.9E-05	Heated Canister	FID with Concentrator
THCs, lb C/ton CaO	3	3	1.1E-02 to 5.7E-02	4.4E-02	3.7E-02		4.4E-02	M25A	

*8 mills w/causticizers & 12 mills w/slaker vents; [1]for data with < 50% NDs, median based upon assuming all NDs are = 0 as in NCASI Technical Bulletin No. 701

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

Table A-17 (Cont'd). Summary of 'Air Toxic' Emissions from Causticizing Area Vents

Volatile Organic Compound	No. of Sources	No. of Detects	Emissions, lb/ton CaO					Test Method	Comments
			Range	Median	Mean	SDln	701 Median[1]		
Source: Lime Mud Precoat Filter Vents									
Acetaldehyde	3	2	ND to 2.9E-03	4.5E-04	1.1E-03		6.7E-05	Canister/NMIT	FID with Concentrator
Acetone	3	3	1.2E-05 to 1.1E-03	8.5E-04	6.5E-04		8.5E-04	Heated Canister	FID with Concentrator
Acrolein	2	1	ND to 1.0E-04	5.3E-05	5.3E-05		5.0E-05	Heated Canister	FID with Concentrator
Benzene	3	1	ND to 4.1E-05	1.5E-05	1.9E-05	5.2E-06		Heated Canister	FID with Concentrator
Carbon Tetrachloride	3	0		*2.2E-04*	*2.2E-04*		*2.2E-04*	Heated Canister	FID with Concentrator
Chlorobenzene	3	1	ND to 1.5E-04	2.1E-05	6.2E-05	1.9E-05		Heated Canister	FID with Concentrator, U
Chloroform	3	0		*1.7E-04*	*1.7E-04*		*1.7E-04*	Heated Canister	FID with Concentrator
1,2-Dichloroethane	3	0		*4.6E-05*	*4.6E-05*		*4.6E-05*	Heated Canister	FID with Concentrator
1,2-Dichloroethylene	3	0		*3.4E-05*	*3.4E-05*		*3.4E-05*	Heated Canister	FID with Concentrator
Dimethyl Disulfide	3	0		*5.5E-04*	*5.5E-04*		*5.5E-04*	Heated Canister	FID with Concentrator
Dimethyl Sulfide	3	1	ND to 1.0E-03	3.9E-04	5.0E-04	1.3E-04		Heated Canister	FID with Concentrator
Formaldehyde	2	1	ND to 2.0E-04	2.1E-04	2.1E-04		1.0E-04	NMIT	NCASI INMPINGER METHOD
n-Hexane	1	0		*3.4E-06*	*3.4E-06*		*3.4E-06*	Heated Canister	FID with Concentrator
Methanol	3	3	1.5E-04 to 1.2E-02	1.2E-02	1.1E-02		1.2E-02	Heated Canister	FID with Concentrator
Methyl Mercaptan	3	0		*2.8E-04*	*2.8E-04*		*2.8E-04*	Heated Canister	FID with Concentrator
Methylene Chloride	3	0		*9.0E-05*	*9.0E-05*		*9.0E-05*	Heated Canister	FID with Concentrator
Methyl Ethyl Ketone	3	3	2.0E-05 to 3.0E-04	1.5E-04	1.5E-04		1.5E-04	Heated Canister	FID with Concentrator
Methyl Isobutyl Ketone	3	2	ND to 2.2E-4	5.7E-05	9.2E-05		5.7E-05	Heated Canister	FID with Concentrator
Styrene	3	2	ND to 6.9E-05	3.9E-05	3.7E-05		3.9E-05	Heated Canister	FID with Concentrator
Terpenes	3	3	7.7E-05 to 5.3E-03	2.6E-03	2.7E-03		2.6E-03	Heated Canister	FID with Concentrator
Tetrachloroethylene	3	1	ND to 3.7E-05	6.0E-05	6.3E-05	4.7E-06		Heated Canister	FID with Concentrator, U
1,1,1-Trichloroethane	3	1	ND to 1.7E-04	7.5E-05	8.5E-05	2.2E-05		Heated Canister	FID with Concentrator, U
Toluene	3	1	ND to 5.4E-04	1.7E-05	1.9E-04	6.9E-05		Heated Canister	FID with Concentrator
Trichloroethylene	3	0		*4.6E-05*	*4.6E-05*		*4.6E-05*	Heated Canister	FID with Concentrator
1,2,4-Trichlorobenzene	3	0		*2.1E-05*	*2.1E-05*		*2.1E-05*	Heated Canister	FID with Concentrator
1,1,2-Trichloroethane	3	0		*4.7E-05*	*4.7E-05*		*4.7E-05*	Heated Canister	FID with Concentrator
m,p-Xylene	3	1	ND to 2.2E-04	2.0E-05	8.2E-05	2.8E-05		Heated Canister	FID with Concentrator
o-Xylene	3	3	1.0E-05 to 9.5E-05	4.5E-05	5.0E-05		4.5E-05	Heated Canister	FID with Concentrator
THCs, lb C/ton CaO	3	3	1.0E-03 to 3.0E-02	4.1E-03	1.2E-02		4.1E-03	M25A	

[1] for data with < 50% NDs, median based upon assuming all NDs are = 0 as in NCASI Technical Bulletin No. 701

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

Table A-17 (Cont'd). Summary of 'Air Toxic' Emissions from Causticizing Area Vents

Volatile Organic Compound	No. of Sources	No. of Detects	Emissions, lb/ton CaO					Test Method	Comments
			Range	Median	Mean	SDln	701 Median[1]		
Source: Precoat Filter Vacuum Pump Exhausts									
Acetaldehyde	2	2	ND to 4.0E-04	2.0E-04	2.0E-04		2.0E-04	Canister/NMIT	FID with Concentrator
Acetone	2	1	ND to 2.2E-03	1.1E-03	1.1E-03		1.1E-03	Heated Canister	FID with Concentrator
Acrolein	1	0		*4.4E-06*	*4.4E-06*		*4.4E-06*	Heated Canister	FID with Concentrator
Benzene	2	0		*4.6E-06*	*4.6E-06*		*4.6E-06*	Heated Canister	FID with Concentrator
Carbon Tetrachloride	2	0		*3.7E-05*	*3.7E-05*		*3.7E-05*	Heated Canister	FID with Concentrator
Chlorobenzene	2	0		*6.5E-06*	*6.5E-06*		*6.5E-06*	Heated Canister	FID with Concentrator
Chloroform	2	1	ND to 1.1E-04	7.1E-05	7.1E-05		5.5E-05	Heated Canister	FID with Concentrator
1,2-Dichloroethane	2	0		*1.0E-05*	*1.0E-05*		*1.0E-05*	Heated Canister	FID with Concentrator
1,2-Dichloroethylene	2	1	ND to 4.4E-05	2.8E-05	2.8E-05		2.2E-05	Heated Canister	FID with Concentrator
Dimethyl Disulfide	2	1	ND to 3.4E-4	2.1E-04	2.1E-04		1.7E-04	Heated Canister	FID with Concentrator
Dimethyl Sulfide	2	1	ND to 1.4E-03	7.5E-04	7.5E-04		7.0E-04	Heated Canister	FID with Concentrator
Formaldehyde	1	0		*1.4E-05*	*1.4E-05*		*1.4E-05*	NMIT	NCASI Impinger Method
Methanol	2	2	5.1E-04 to 3.5E-02	1.8E-02	1.8E-02		1.8E-02	Heated Canister	FID with Concentrator
Methyl Ethyl Ketone	2	1	ND to 9.8E-04	4.9E-04	4.9E-04		4.9E-04	Heated Canister	FID with Concentrator
Methyl Isobutyl Ketone	2	1	ND to 1.4E-4	7.6E-05	7.6E-05		7.0E-05	Heated Canister	FID with Concentrator
Methyl Mercaptan	2	1	ND to 2.7E-04	1.5E-04	1.5E-04		1.4E-04	Heated Canister	FID with Concentrator
Methylene Chloride	2	0		*2.8E-05*	*2.8E-05*		*2.8E-05*	Heated Canister	FID with Concentrator
Styrene	2	1	ND to 4.2E-05	2.4E-05	2.4E-05		2.1E-05	Heated Canister	FID with Concentrator
Terpenes	1	1		5.0E-03	5.0E-03		5.0E-03	Heated Canister	FID with Concentrator
Tetrachloroethylene	2	0		*4.9E-05*	*4.9E-05*		*4.9E-05*	Heated Canister	FID with Concentrator
Toluene	2	1	ND to 1.0E-05	8.1E-06	8.1E-06		5.0E-06	Heated Canister	FID with Concentrator
1,2,4-Trichlorobenzene	2	1	ND to 6.6E-04	3.3E-04	3.3E-04		3.3E-04	Heated Canister	FID with Concentrator, U
1,1,1-Trichloroethane	2	0		*1.0E-05*	*1.0E-05*		*1.0E-05*	Heated Canister	FID with Concentrator
1,1,2-Trichloroethane	2	0		*1.0E-05*	*1.0E-05*		*1.0E-05*	Heated Canister	FID with Concentrator
Trichloroethylene	2	0		*1.1E-05*	*1.1E-05*		*1.1E-05*	Heated Canister	FID with Concentrator
m,p-Xylene	2	1	ND to 1.9E-05	1.5E-05	1.5E-05		9.5E-06	Heated Canister	FID with Concentrator
o-Xylene	2	1	ND to 3.5E-05	2.3E-05	2.3E-05		1.8E-05	Heated Canister	FID with Concentrator
THCs, lb C/ton CaO	2	2	1.7E-04 to 3.5E-02	1.8E-02	1.8E-02		1.8E-02	M25A	

[1] for data with < 50% NDs, median based upon assuming all NDs are = 0 as in NCASI Technical Bulletin No. 701

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

Table A-17 (Cont'd). Summary of 'Air Toxic' Emissions from Causticizing Area Vents

Source: Green Liquor Clarifier and Surge Tank Vents					
Volatile Organic Compound	No. of Sources	Clarifier Vent	Surge Tank Vent	Test Method	Comments
		Emissions, lb/ton CaO			
		Average	Average		
Acetaldehyde	1	1.00E-04	5.8E-05	Canister/NMIT	FID with Concentrator
Acetone	1	1.50E-03	6.6E-05	Heated Canister	FID with Concentrator
Acrolein	1		ND[1.5E-07]	Heated Canister	FID with Concentrator
Benzene	1	2.80E-05	4.7E-06	Heated Canister	FID with Concentrator
Carbon Tetrachloride	1	ND[7.3E-05]	ND[1.6E-06]	Heated Canister	FID with Concentrator
Chlorobenzene	1	ND[4.4E-06]	1.9E-07	Heated Canister	FID with Concentrator, U
Chloroform	1	ND[5.6E-05]	2.0E-06	Heated Canister	FID with Concentrator, U
1,2-Dichloroethane	1	ND[1.6E-05]	1.2E-06	Heated Canister	FID with Concentrator, U
1,2-Dichloroethylene	1	1.00E-04	ND[2.5E-07]	Heated Canister	FID with Concentrator, U
Dimethyl Disulfide	1	2.00E-04	3.1E-05	Heated Canister	FID with Concentrator
Dimethyl Sulfide	1	ND[1.2E-04]	4.8E-05	Heated Canister	FID with Concentrator
Formaldehyde	1		ND[1.5E-06]	NMIT	NCASI Impinger Method
n-Hexane			1.1E-06	Heated Canister	FID with Concentrator
Methanol	1	1.30E-01	1.1E-03	Heated Canister	FID with Concentrator
Methyl Ethyl Ketone	1	2.00E-04	2.0E-05	Heated Canister	FID with Concentrator
Methyl Isobutyl Ketone	1	1.10E-05	2.9E-06	Heated Canister	FID with Concentrator
Methyl Mercaptan	1	4.20E-04	2.1E-06	Heated Canister	FID with Concentrator
Methylene Chloride	1	ND[3.0E-05]	ND[6.7E-05]	Heated Canister	FID with Concentrator
Styrene	1	1.10E-04	ND[9.1E-08]	Heated Canister	FID with Concentrator
Terpenes	1	6.30E-03	1.2E-03	Heated Canister	FID with Concentrator
Tetrachloroethylene	1	ND[2.0E-05]	1.4E-06	Heated Canister	FID with Concentrator, U
Toluene	1	1.00E-05	3.2E-06	Heated Canister	FID with Concentrator
1,2,4-Trichlorobenzene	1	ND[7.2E-06]	ND[1.6E-07]	Heated Canister	FID with Concentrator
1,1,1-Trichloroethane	1	ND[1.6E-05]	8.9E-07	Heated Canister	FID with Concentrator, U
1,1,2-Trichloroethane	1	ND[1.6E-05]	6.5E-06	Heated Canister	FID with Concentrator, U
Trichloroethylene	1	ND[1.6E-05]	ND[3.4E-07]	Heated Canister	FID with Concentrator
m,p-Xylene	1	1.90E-04	ND[9.3E-08]	Heated Canister	FID with Concentrator
o-Xylene	1	1.00E-05	3.4E-07	Heated Canister	FID with Concentrator
THCs, lb C/ton CaO	1	6.60E-02	1.4E-03	M25A	

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

Table A-17 (Cont'd). Summary of 'Air Toxic' Emissions from Causticizing Area Vents

Source: White Liquor and Weak Wash Pressure Filter Vent					
Volatile Organic Compound	No. of Sources	White Liquor & Weak Wash	White Liquor	Test Method	Comments
		Emissions, lb/ton CaO			
		Average	Average		
Acetaldehyde	1	1.80E-03	ND[7.1E-05]	Heated Canister	FID with Concentrator
Acetone	1	1.40E-03	5.3E-04	Heated Canister	FID with Concentrator
Acrolein	1	5.90E-05	ND[6.8E-05]	Heated Canister	FID with Concentrator
Benzene	1	6.10E-05	2.9E-05	Heated Canister	FID with Concentrator
Carbon Tetrachloride	1	ND[7.6E-04]	ND[7.4E-04]	Heated Canister	FID with Concentrator
Chlorobenzene	1	ND[4.6E-05]	ND[4.5E-04]	Heated Canister	FID with Concentrator
Chloroform	1	ND[5.9E-04]	ND[5.8E-04]	Heated Canister	FID with Concentrator
1,2-Dichloroethane	1	ND[1.6E-04]	ND[1.6E-04]	Heated Canister	FID with Concentrator
1,2-Dichloroethylene	1	1.00E-04	ND[1.2E-04]	Heated Canister	FID with Concentrator, U
Dimethyl Disulfide	1	ND[1.9E-03]	ND[1.9E-03]	Heated Canister	FID with Concentrator
Dimethyl Sulfide	1	ND[1.3E-03]	ND[1.3E-03]	Heated Canister	FID with Concentrator
Formaldehyde	1	ND[3.7E-04]	2.2E-03	NMIT	NCASI Impinger Method
Methanol	1	3.30E-02	1.5E-02	Heated Canister	FID with Concentrator
Methyl Ethyl Ketone	1	1.90E-04	1.6E-04	Heated Canister	FID with Concentrator
Methyl Isobutyl Ketone	1	3.90E-05	ND[3.6E-05]	Heated Canister	FID with Concentrator
Methyl Mercaptan	1	ND[9.9E-04]	ND[9.7E-04]	Heated Canister	FID with Concentrator
Methylene Chloride	1	ND[3.1E-04]	ND[3.1E-04]	Heated Canister	FID with Concentrator
Styrene	1	4.20E-05	4.9E-05	Heated Canister	FID with Concentrator
Terpenes	1	1.40E-02	3.3E-03	Heated Canister	FID with Concentrator
Tetrachloroethylene	1	ND[2.0E-04]	ND[2.0E-04]	Heated Canister	FID with Concentrator
Toluene	1	1.50E-05	ND[3.7E-05]	Heated Canister	FID with Concentrator
1,2,4-Trichlorobenzene	1	ND[7.4E-05]	ND[7.3E-05]	Heated Canister	FID with Concentrator
1,1,1-Trichloroethane	1	ND[1.6E-04]	ND[1.6E-04]	Heated Canister	FID with Concentrator
1,1,2-Trichloroethane	1	ND[1.6E-04]	ND[1.6E-04]	Heated Canister	FID with Concentrator
Trichloroethylene	1	ND[1.6E-04]	ND[1.6E-04]	Heated Canister	FID with Concentrator
m,p-Xylene	1	4.60E-05	ND[4.3E-04]	Heated Canister	FID with Concentrator
o-Xylene	1	3.90E-05	6.2E-05	Heated Canister	FID with Concentrator
THCs, lb C/ton CaO	1	7.50E-03	5.6E-03	M25A	

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

Table A-24. Summary of 'Air Toxic' Emissions from Salt Cake Mix Tanks, ClO_2 Generator Scrubbers & UNOX System Vents)

Mill Code	Test Date	Source Description	DSCFM	Capacity/day	Ref.
SCMTL1	1994	Mill L, No. 2 Salt Cake Mix Tank Vent	482	1,883 t bls/day	13
SCMTL2	1994	Mill L, No. 3 Salt Cake Mix Tank Vent	114	1,982 t bls/day	13
SCMTN	1994	Mill N Salt Cake Mix Tank Vent	482	1,883 t bls/day	13
SCMTG	1999	No. 4 RF Wet Saltcake Tank	75	1,350 t bls/day	9
EV28	1994	Mill E ClO_2 Generator Scrubber Vent	415	22 t ClO_2/day	13
KCLGV	1994	Mill K ClO_2 Generator Scrubber Vent	1121	14 t ClO_2/day	13
NCLO	1994	Mill N ClO_2 Generator Scrubber Vent	484	39 t ClO_2/day	13
UNOXJ	1994	Mill J UNOX System Tank Vent	24	655 ODTP/day	13

References

9. Individual Mill Tests Results for 'Air Toxics' - NCASI Mill File Information - 1999

13. Volatile Organic Emissions from Pulp and Paper Mill Sources - Part III – Miscellaneous Sources at Kraft and TMP Mills, NCASI Technical Bulletin No. 677, September 1994.

Note: *All italicized entries correspond to non-detect values at one-half the detection limit*

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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

COMPILATION OF CRITERIA AIR POLLUTANT EMISSIONS DATA FOR SOURCES AT PULP AND PAPER MILLS INCLUDING BOILERS

TECHNICAL BULLETIN NO. 884
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by
Arun V. Someshwar, Ph.D.
NCASI Southern Regional Center
Gainesville, Florida

Table 4.14 VOC and TPM Emissions from Causticizing Area Vents

Type of Vent(s)		No.[b]	Range	Median	Mean
			lb/ton CaO		
Causticizer & Slaker – Combined	VOC[a]	5	0.011 to 0.27	0.0570	0.1026
Slaker Vents	TPM[c]	4	0.004 to 0.076	0.022	0.031
Lime Mud Precoat Filter	VOC[a]	3	0.001 – 0.030	0.0041	0.012
Precoat Filter Vac. Pump Exhaust	VOC[a]	2	2E-04 – 0.035	0.018	0.018
Green Liquor Clarifier	VOC[a]	1		0.066	0.066
Green Liquor Surge Tank	VOC[a]	1		0.0014	0.0014
Pressure Filter – WL & Wk Wash	VOC[a]	1		0.0075	0.0075
Pressure Filter – White Liquor	VOC[a]	1		0.0056	0.0056

[a] lb C/ton CaO as measured by EPA Method 25A; [2b] number of sources tested; [c] total (filterable) particulate matter – all TPM was <10μm (PM_{10}) in one slaker vent

4.14 Smelt Dissolving Tank Vents

The significant criteria pollutant emissions from a dissolving tank vent are particulate matter. VOC emissions are generally very low, unless process condensates containing significant VOCs are used to either dissolve the smelt or for scrubbing the vent gases.

4.14.1 *Particulate Emissions*

As with the recovery furnace, particulates are comprised of mainly sodium compounds with much lesser amounts of potassium compounds and some other trace metal compounds. The dominant compound is sodium carbonate, followed by sodium sulfate. Roughly 90% (by weight) of the particles have equivalent aerodynamic diameters under 10 μm, and 50% have diameters under 1 μm (Pinkerton and Blosser 1981; NCASI 1978a).

4.14.2 *VOC Emissions*

Volatile organic compounds such as methanol can be released from the weak wash in both the dissolving tank and the wet scrubber particulate control device.

4.14.3 *NO_x, CO and SO_2 Emissions*

Some mills have made measurements for NO_x, CO, and SO_2 in smelt dissolving tank vents. However, since no combustion takes place in smelt tanks, and smelt-water explosions are not known to result in NO_x, the low level of NO_x sometimes measured is believed to be an artifact caused by oxidation of a portion of the ammonia (NH_3) emissions from such tanks to NO within the NO_x analyzer (NCASI 2003c). Small amounts of CO and SO_2 at times measured in smelt tank vents could potentially result from oxidation of the carbon and sulfur in the smelt, respectively, during the smelt-water explosions.

Table 4.15 provides estimates of emissions for VOC, SO_2, NO_x, CO, total PM (TPM), condensible particulate emissions (CPM), PM_{10}, and $PM_{2.5}$ from smelt dissolving tanks. The data on PM_{10} and $PM_{2.5}$ emissions generated using a dilution tunnel sampler (O'Connor and Genest 2003a, 2003b) for eight smelt dissolving tanks equipped with wet scrubbers are also shown summarized in this table. Detailed data including descriptions for each smelt dissolving tank are provided in Appendix A, Tables A15a, A15b, A15c, A15d, and A15e.

Table 4.15 VOC[a], SO_2, NO_x, TPM, PM_{10} and $PM_{2.5}$ Emissions from Smelt Dissolving Tank Vents

	No.[b]	Range	Median	Mean
		lb/ton BLS		
VOC[a]	13	ND – 0.25	0.010	0.066
SO_2	20	ND – 0.073	0.005	0.015
NO_x[d]	10	ND – 0.151	0.020	0.033
CO	3	ND to 0.025	0.008	0.013
TPM[c]	36	0.04 – 0.64	0.15	0.16
CPM[e]	8		See table note e	
PM_{10}[f]	8	as % of TPM[c]	108.8%	103.7%
$PM_{2.5}$[f]	7	as % of TPM[c]	89.3%	89.6%

[a] lb C/ton BLS as measured by EPA Method 25A; [b] number of smelt tanks tested; [c] total (filterable) particulate matter; [d] most likely ammonia emissions reported as NO_x; [e] condensible particulate matter – for estimating CPM, use 19% of TPM for smelt dissolving tanks (see footnote 6); [f] primary + condensible PM_{10} and $PM_{2.5}$; if only primary PM_{10} and $PM_{2.5}$ is desired, subtract 19% for average CPM contribution

4.15 Paper Machine Vents

Vent or exhaust gases from the paper machine area consist mainly of air and water vapor; little or no particulate matter is emitted from the dryers (USEPA 1995). Paper machines and pulp dryers can, however, be a source of volatile organic compound emissions (VOCs). Typically, the wet-end and the dry-end speciated and total VOC emissions are approximately equal. VOCs present in the water carrying the pulp to the paper machine or dryer can be released as the water is removed from the sheet. Volatile organic compounds are sometimes present in paper machine additives (defoamers, slimicides, retention aids, wet strength agents, wire and felt cleaners, etc.), and these can also be released during the papermaking process. On some paper machines, especially machines used for tissue production, direct-fired dryers burning natural gas, distillate oil, or propane are used for additional drying capacity, and these dryers are a source of combustion byproducts such as NO_x and CO. Application of coatings to the paper can also be a source of volatile organic compound emissions, although this activity may take place either on the paper machine or in a separate coating operation.

Studies of paper machine VOC emissions have been performed by NCASI (NCASI 1994b, 1997b). Results indicate volatile organic compounds present in the pulp slurry being fed to the machine will be found in the roof vent and vacuum system exhaust gases. The most often detected compound is methanol, a byproduct of chemical and mechanical pulping and bleaching processes. However, methanol is also found in recycled fiber slurries, presumably as a result of residual lignin breakdown.

Trace amounts of particulate matter may be present in paper machine vents. However, measurement data for pulp mill paper machine TPM, PM_{10}, or $PM_{2.5}$ emissions are scarce. TPM emission data for five paper machines, two making linerboard and three making newsprint, are provided in Section 8.1.

Table 4.16 provides estimates of emissions for VOCs from two bleached and two unbleached kraft pulp mill paper machines. Detailed data including descriptions for each machine are provided in Appendix A, Table A16.

Table 4.16 VOC[a] Emissions from Kraft Mill Paper Machine Vents

Type of Paper Machine	No.	Range	Median	Mean
		lb/ADTFP		
VOC[a], Unbleached Linerboard	2	0.42 – 0.60	0.51	0.51
VOC[a], Bleached Paper & Pulp	2	0.038 – 0.10	0.069	0.069

[a] lb C/ADTFP (air dry ton of finished product) as measured by EPA Method 25A

4.16 Miscellaneous Kraft Mill Sources

VOCs may be emitted from various other point sources in a kraft pulp mill. Table 4.17 provides estimates of VOC emissions from three salt cake mix tanks, one UNOX system vent, and one cooling tower. It should be noted that cooling tower VOC emissions are expected to be extremely mill-specific, depending mainly on the type of condensate reuse practices and level of VOCs present in the water sent to the cooling tower. Detailed data including descriptions for each source are provided in Appendix A, Table A17. Several other sources of VOC emissions potentially exist in a pulp and paper mill. These include wastewater treatment systems, both primary and secondary, open sewers, landfills, etc. No data are available for such sources. However, the VOC emissions from these sources (except perhaps wastewater treatment systems) are expected to be small compared with those from various process vents and boiler stacks at a mill.

Table 4.17 VOC Emissions from Miscellaneous Kraft Mill Sources

	Units[a]	No.[b]	Range	Median	Mean
Salt Cake Mix Tank Vent	lb/ton bls	3	3.9E-05 – 0.0076	0.0013	0.003
UNOX System Vent	lb/ODTUBP	1		0.019	0.019
Cooling Tower[c]	lb/ADTP	1		0.79	0.79

[a] lb C as measured by EPA Method 25A; [b] number of sources tested; [c] mill with steam stripper – tower treats entire mill effluent and discharges to a high rate activated sludge system

5.0 SULFITE PULP MILL SOURCES

In a sulfite pulp mill, VOC and SO_2 emissions can arise from uncontrolled digester and relief gases, pulp washing and bleaching sources, and recovery area sources. Just as for kraft pulp mill sources, fugitive VOC emissions from wastewater treatment area sources, such as primary clarifiers and secondary treatment systems, surface impoundments, flow-through basins, lagoons, and open sewers are not included in this report. CO is expected to be present in emissions from all vents where some form of combustion, either of spent liquor or fuel, takes place. CO is also expected from bleach plant vents (no data available). Particulate matter is expected to be present in emissions from the sulfite recovery furnaces, boilers burning fuels, wood preparation activities and to a lesser extent, paper machines. Limited data on particulate matter emissions from paper machines and wood preparation activities are presented in Section 8.0. Oxides of nitrogen (or NO_x) are expected to be present in all combustion-related source vents.

ENVIRONMENTAL CONSIDERATIONS AND PERMITTING

USE OF PETROLEUM COKE AS SUPPLEMENTAL FUEL IN LIME KILNS

December 4, 2003
Revised

ARCADIS
Infrastructure, buildings, environment, communications

ARCADIS

Environmental Considerations and Permitting

Use of Petroleum Coke as Supplemental Fuel in Lime Kilns

Marjorie Collins

Marjorie Collins, PE, CHMM
Senior Engineer

Amy G Hagen

Amy Hagen
Business Practice Manager

Marty Jones
Senior Project Manager

Prepared for:
DTE Energy Services

Prepared by:
ARCADIS G&M of Michigan, LLC
25200 Telegraph Road
Southfield
Michigan 48034
Tel 248 936 8000
Fax 248 936 8111

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A EPA Green Book

Introduction

The pulp and paper industry continues to come under pressure to improve financial performance in the face of increasing energy costs for fuel oil and natural gas. Fuel is the primary cost in the operation of a lime kiln. Presently, for a 1,000-ton-per-day (tpd) bleached pulp mill, the fuel cost for a lime kiln can be $2.6 million per year. At current natural gas and oil prices, there are economic benefits for using petroleum coke (pet coke) for part of the fuel requirements in lime kilns.

Pet coke is a by-product of the upgrading of the heaviest petroleum fractions (e.g., residual fuel oil) to more valuable lighter products in coking units. Pet coke is used as a raw material in metals manufacturing, is commonly burned in cement kilns around the world, and is currently being fired in three lime kilns at pulp mills in the southeastern U. S. It is a solid fuel requiring pulverization prior to combustion. It has a sulfur content higher than natural gas and fuel oil and burns more intensely than natural gas and oil.

A bleached pulp mill can realize potential savings by utilizing alternative fuel sources at the lime kiln. For example, using pet coke in a lime kiln could save a 1,000-tpd bleached pulp mill more than $800,000 per year in fuel costs. The Parton Group identified these cost savings, as well as considered the economic and process implications for burning pet coke in a lime kiln in their report *Considerations in the Use of Petroleum Coke as a Supplemental Fuel in Lime Reburning Kilns*. Although, economic gains can be realized by using pet coke, an increase in air emissions may be the environmental tradeoff. This paper considers whether the increased air emissions would trigger additional permitting and environmental regulations.

The pulp and paper industry is currently subject to many environmental regulations to control air emissions from the facility, and the use of pet coke in the lime kiln combustion process does have the potential to trigger additional air quality regulations. Based on the emission estimates in this report, switching from 100% natural gas to 75% pet coke and 25% natural gas as a fuel in a lime kiln would result in the following:

- Prevention of Significant Deterioration (PSD) regulations would not be triggered for a 1,000-tpd bleached pulp mill (based on actual operations of 350 days and using AP-42 factors for actual emissions). The net emissions increase for each of the criteria pollutants, when modifying the lime kiln to combust 75% pet coke and 25% natural gas, is below the significant net emissions increase threshold level for attainment areas.

- The National Emission Standards for Hazardous Air Pollutants (NESHAPs) requirement for a new source would not be triggered because modifying a lime kiln to burn pet coke is not considered a modification or a new source under the NESHAPs requirements.
- The NESHAPs requirements (effective March 2004) for existing sources would apply, but these requirements will apply regardless if a fuel switch occurs.
- New Source Performance Standards (NSPS) may be triggered if the hourly emission rates of particulate matter (PM) or total reduced sulfur (TRS) increases. This paper is based on the assumption that the existing lime kilns (1) have the necessary control equipment to achieve the NSPS PM emission standards (as there is an existing PM standard under the NESHAPs requirements) and (2) will most likely be able to meet the NSPS TRS requirements using existing current operational controls. If NSPS for TRS is triggered, then continuous emission monitoring (CEM) and monitoring of percent oxygen (0_2) discharged would be required.
- State permitting would require air toxic modeling, but the air toxics from a pet coke lime kiln are insignificant (less than one ton) and, therefore, should not cause any issues with permitting.
- Some areas may be reclassified as nonattainment in the near future, which would affect permit applications that have not been approved or finalized prior to the reclassification.

This report has been prepared assuming the following conditions: 75% pet coke and 25% natural gas burned at a lime kiln to support a 1,000-tpd bleached pulp mill. The particulate emissions would be controlled with a wet scrubber or an electrostatic precipitator (ESP) with a control efficiency of 99%, and the sulfur removal of the system would be 99.5%. Pet coke has a heating value of 28 million British thermal units (MMBtu) per ton of pet coke and a sulfur content of 6%.

Background

The production of kraft paper products from wood can be divided into three process areas: (1) pulping of wood chips, (2) chemical recovery, and (3) product forming (including bleaching).

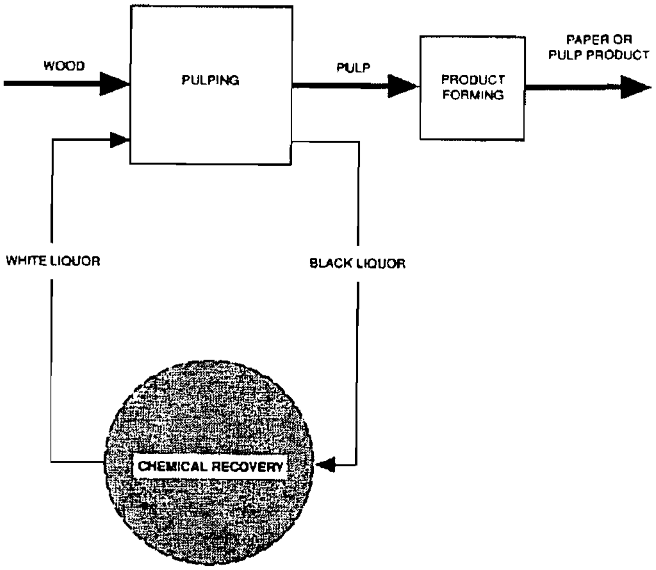


Figure 1. Pulp and Paper Process

As described in the Parton Group report, spent black liquor from the pulp mill is concentrated in multiple effect evaporators and is burned in the recovery boiler. The dissolved organics combust while the inorganic chemicals in the black liquor melt and form a pool of smelt in the bottom of the boiler. The smelt flows out into an agitated smelt-dissolving tank where the inorganic chemicals are dissolved to form green liquor.

Staged combustion in the recovery boiler keeps the lower portion of the furnace under reducing conditions, converting the sodium-sulfur compounds to sodium sulfide, one of the active cooking chemicals. The remainder of sodium is converted to sodium carbonate. To reuse the liquor for cooking, the sodium carbonate must be converted to sodium hydroxide, the other active cooking chemical.

To convert the sodium carbonate, calcium oxide is introduced into the green liquor in the slaker. The products of this chemical process are sodium hydroxide (caustic) and calcium carbonate (lime mud). The product solution is called white liquor.

The lime mud is separated from the white liquor by decantation or filtration, and the mud is washed to remove the residual white liquor. The lime mud is then heated (reburned) in the lime kiln, and the calcium carbonate is reconverted to calcium oxide.

Both the cooking liquor and the lime circulate within the pulp mill. Any elements introduced from the use of pet coke will circulate in either the liquor or solids circuits until purged or would be emitted from the lime kiln exhaust stack.

Air Quality Regulatory Requirements

Air permitting is the means through which regulatory agencies combine all applicable state, federal, and local requirements associated with a source of air pollution into one legal and enforceable document. When a new source is constructed or a facility needs to make a modification to its existing source, thereby potentially increasing impacts to air quality, air permitting is typically necessary. In the case of converting a lime kiln to burn pet coke (a modification), an air permit is required because the kiln was not originally designed to burn pet coke. The following sections discuss the potential air quality permitting issues related to converting from burning 100% natural gas to burning 75% pet coke and 25% natural gas at a 1,000-tpd bleached pulp mill's lime kiln.

Federal Regulations and Permitting Requirements

Modifying the lime kiln at a pulp mill to burn pet coke may trigger the following federal rules:

- PSD requirements under Title 40 Code of Federal Regulations (CFR) 52;
- NSPS under Title 40 CFR 60; and
- NESHAPs under Title 40 CFR 63.

Nonattainment new source review (NSR) may also be triggered if a facility is located in an area that exceeds the National Ambient Air Quality Standards (NAAQS) set by the United States Environmental Protection Agency (USEPA).

New Source Review

Major stationary sources of air pollution and major modifications to major stationary sources are required by the Clean Air Act to obtain an NSR air pollution permit before commencing construction. The NSR process is required whether the major source or modification is planned for an area where the NAAQS are exceeded (nonattainment areas) for one or more criteria pollutants or an area where air quality is acceptable (attainment and unclassifiable areas). PSD permits are required for sources in attainment areas, while nonattainment NSR permits are required for sources located in nonattainment areas. A source may have to meet both PSD and nonattainment NSR permitting requirements if the source is in an area classified as attainment for some pollutants and nonattainment for others. The PSD and nonattainment NSR requirements are pollutant specific. Only those pollutants that exceed PSD or nonattainment NSR emission thresholds are subject to PSD or nonattainment NSR permitting requirements.

Prevention of Significant Deterioration

No source or modification subject to PSD review may be constructed without a permit. To obtain a PSD permit, an applicant must:

- Apply the best available control technology (BACT);
- Conduct an ambient air quality analysis;
- Analyze impacts to soils, vegetation, and visibility;
- Not adversely impact a Class I area (Class I areas include national parks, national wilderness areas, and tribal areas); and
- Undergo adequate public participation.

A PSD permit is necessary for a major modification to an existing major source. A major modification is generally a physical change or a change in the method of operation of a major stationary source that would result in a significant net emissions increase of any regulated pollutant. In determining if a proposed increase would result in a significant net increase, several detailed calculations must be performed. The significant emissions net increase number is pollutant specific, as shown in the table below:

Pollutant	Significant Emissions Net Increase Threshold level (tons per year)
Carbon monoxide	100 tpy
Nitrogen oxides	40 tpy
Sulfur dioxide	40 tpy
PM	25 tpy
PM_{10}	15 tpy
Ozone	40 tpy of volatile organic compounds (VOCs)
Hydrogen Sulfide (H_2S)	10 tpy
TRS (including H_2S)	10 tpy
Reduced sulfur compounds (including H_2S)	10 tpy

To determine whether a net emissions increase will result, the following equation is used:

$$\text{Net Emissions Change} = \text{Emissions increases associated with the proposed modification} - \text{Source-wide creditable contemporaneous emissions decreases} + \text{Source-wide creditable contemporaneous emissions increases}$$

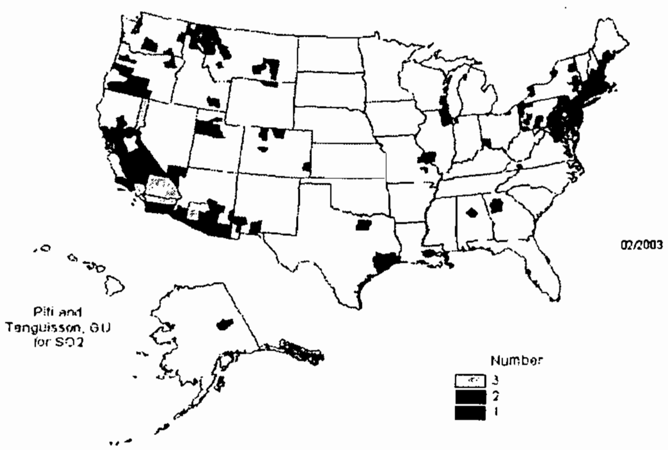
The net emissions change is based on the potential emissions increase from the proposed modification (combustion of pet coke) minus any actual emissions that would be decreased (in this case, the reduction of actual emissions from the natural gas burned at the lime kiln), plus any emissions increases (such as an increase in production that would increase the potential emissions from other processes).

The emissions estimates associated with modifying a natural gas fired lime kiln at a 1,000-tpd bleached pulp mill to combust 75% pet coke and 25% natural gas indicate the net emissions increase for each of the criteria pollutants are below the significant emissions net increase threshold levels for attainment areas (see page 15). Thus, no PSD permits are required; however, a minor source (state-only construction) permit would be required.

Nonattainment New Source Review

The permitting requirements for major new sources or major modifications located in nonattainment areas differ from the PSD permitting requirements for attainment areas. The significant emissions net increase threshold level for pollutants in nonattainment areas is lower than the levels established for attainment areas (projects with emission increases above the threshold levels are defined as major modifications). The emissions control requirement for a major modification in a nonattainment area is the lowest achievable emission rate (LAER), which is more stringent than the BACT emission control requirement required for attainment areas. The facility must also obtain emissions reductions (offsets) of the nonattainment pollutant from other sources that impact the same area as the proposed source. Facilities typically purchase emission offsets from other companies that have curtailed production or have shut down operations. The applicant must also certify that all other sources owned by the applicant in the State are complying with all applicable requirements of the Clean Air Act. Areas that are considered nonattainment for one or more pollutants are shaded in the map below[1]. Current nonattainment areas are identified in Appendix A.

Number of Pollutants By County Designated Nonattainment



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[1] The NAAQS for ozone are currently being lowered, and there is a new standard being developed for PM under 2.5 microns ($PM_{2.5}$). Therefore, some current attainment areas may be reclassified as nonattainment areas in the near future.

A facility located in one of these nonattainment areas needs to assess whether converting to pet coke is a feasible option based on the permitting requirements for that area. For example, a mill located in Atlanta will have area-specific requirements that are different from the requirements for a mill located in Dallas, even though both mills are located in non-attainment areas.

New Source Performance Standards

Title 40 CFR 60, Subpart BB - *Standards of Performance for Kraft Pulp Mills* applies to kraft pulp mills constructed or modified after September 24, 1976 and includes the following sources: digester system, brown stock washer system, multiple-effect evaporator system, recovery furnace, smelt-dissolving tank, lime kiln, and condensate stripper system. If the lime kiln was being modified to burn pet coke, then the NSPS requirements would only be triggered for the lime kiln process, not for other processes at the facility.

The NSPS includes standards for both PM and TRS. The standards for PM include the following for the lime kiln:

- For natural gas use: 0.15 grams per dry standard cubic meter (g/dscm) (0.066 grains per dry standard cubic foot [gr/dscf]) corrected to 10% O_2, when gaseous fossil fuel is burned.
- For fuel oil and pet coke usage: 0.30 g/dscm (0.13 gr/dscf) corrected to 10% O_2, when liquid fossil fuel is burned.

When petroleum coke and gaseous fossil fuel are fired simultaneously in any combination, some states may allow a particulate emissions limit (in gr/dscf at 10% O_2) to be determined by prorating the natural gas and pet coke emission limits. This is an alternative to the more restrictive limit of 0.066 gr/dscf that is required when natural gas is burned. The prorated emission rate can be determined by the following equation:

$$PS_{PM} = \frac{Y(0.066) + Z(0.13)}{Y + Z}$$

Where: PS_{PM} is the prorated standard for PM when firing natural gas and pet coke simultaneously, in gr/dscf at 10% oxygen;

Y is the percentage of total heat input from natural gas; and

Z is the percentage of total heat input derived from pet coke.

Using the assumption of 75% total heat input from pet coke and 25% total heat input from natural gas, the PS_{PM} would be 0.114 gr/dscf.

The TRS standard for the lime kiln is 8 parts per million (ppm) by volume on a dry basis, corrected to 10% O_2. For a lime kiln that is modified, CEM systems are required to monitor and record the concentration of TRS emissions on a dry basis and the percent O_2 by volume on a dry basis in the gases discharged into the atmosphere from any lime kiln.

NSPS is triggered if a modification occurs where the hourly emission rates of PM or TRS increase. If the hourly emission rate (kilograms per hour [kg/hour]) for PM or TRS does not increase, then that standard does not apply. In other words, if only the hourly PM emission rate increases and not the TRS emission rate, then the mill is subject only to the NSPS PM emission standard and not the TRS emission standard.

National Emission Standards of Hazardous Air Pollutants

National Emission Standards for Hazardous Air Pollutants for Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills (Title 40 CFR 63 Subpart MM) requires that existing kraft or soda pulp mills comply with the requirements shown in the following table.

Summary of Promulgated Standards[a]

Subcategory	Emission point	HAP metals standard		Alternate HAP metals standard ("bubble")		Gaseous organic HAP standard	
		Existing	New	Existing	New	Existing	New
Kraft and soda	Recovery furnaces	PM ≤ 0.10 g/dscm (0.044 gr/dscf) at 8% oxygen	PM ≤ 0.034 g/dscm (0.015 gr/dscf) at 8% oxygen	Mill-specific PM emission limit (kg/Mg (lb/ton) BLS) based on calculated value of the sum of the individual emissions limits for recovery furnaces, SDT, and lime kilns. See equation 1 in §63.865(a)(1) of the final rule.	No "bubble" alternate standard for new sources	No standard	Gaseous organic HAP ≤ 0.012 kg/Mg (0.025 lb/ton) BLS (as measured by methanol)
	SDT	PM ≤ 0.10 g/dscm (0.20 lb/ton) BLS	PM ≤ 0.06 g/dscm (0.012 lb/ton) BLS			No standard[b]	No standard[b]
	Lime kilns	PM ≤ 0.15 g/dscm (0.064 gr/dscf) at 10% oxygen	PM ≤ 0.023 g/dscm (0.01 gr/dscf) at 10% oxygen			No standard[b]	No standard[b]
Sulfite	Sulfite combustion units	PM ≤ 0.092 g/dscm (0.040 gr/dscf) at 8% oxygen	PM ≤ 0.046 g/dscm (0.020 gr/dscf) at 8% oxygen	Not applicable	Not applicable	No standard[b]	No standard[b]
Stand-alone semi-chemical	Semi-chemical combustion units	No standard	No standard	Not applicable	Not applicable	Gaseous organic HAP ≤ 1.49 kg/Mg (2.97 lb/ton) BLS (as measured by THC) or 90% reduction	Gaseous organic HAP ≤ 1.49 kg/Mg (2.97 lb/ton) BLS (as measured by THC) or 90% reduction

[a] g/dscm= grams per standard cubic meter, gr/dscf = grains per standard cubic foot, kg/Mg = kilograms per megagram, lb/ton = pounds per ton, BLS = black liquor solids, and THC = total hydrocarbons

[b] Emissions of gaseous organic HAP from these sources are regulated as part of the NESHAP for noncombustion sources at pulp and paper mills.

Source: Federal Register, Vol. 66, No. 9, Friday, January 12, 2001

As the table indicates, an existing mill must comply with the following individual limits:

- Non direct contact evaporator (NDCE) recovery furnace/direct contact evaporator (DCE) recovery furnace - Reduce outlet PM emissions to 0.044 gr/dscf at 8% O_2
- Smelt Dissolving Tank (SDT) - Reduce outlet PM emissions to 0.20 pounds per ton (lb/ton) black liquor solids (BLS)
- Lime kiln- Reduce outlet PM emissions to 0.15 g/dscm (0.064 gr/dscf) at 10% O_2

Under the NESHAPs regulations for existing mills, all lime kilns equipped with an ESP must install, calibrate, maintain, and operate a continuous opacity monitoring system. All lime kilns equipped with a wet scrubber must install, calibrate, maintain, and operate a continuous monitoring system that can be used to determine and record the pressure drop across the scrubber and the scrubbing liquid flow to meet the NESHAPs monitoring requirements.

The NESHAPs regulations for existing mills allow a mill to comply with a PM bubble compliance alternative that is a mill-specific PM limit (lb/ton BLS) based on the calculated value of the sum of the individual emission limits for recovery furnaces, SDTs, and lime kilns. This mill-specific bubble limit is calculated based on the proposed emission limits for each affected source and mill-specific gas flow rates and process rates.

Mills that choose to comply with the NESHAPs standard using the proposed bubble compliance alternative are required to submit preliminary emission limits to the applicable permitting authority for approval for each existing recovery furnace, SDT, and lime kiln at the mill. Before the preliminary PM emission limits are approved, the mill is required to submit documentation demonstrating that if the preliminary emission limits for each emission source are met, the entire group of affected sources would be in compliance with the mill-wide allowable emission level. The allowable emission level would be determined from the applicable bubble equation using the reference concentrations and reference emission rates for each emission source and source-specific factors for exhaust gas flow rates and process rates. When approved by the applicable permitting authority, the emission limits would be incorporated into the operating permit for the mill. The PM emission limits from the mill-specific bubble limit would need to be modified to include the conversion of a lime kiln to burning pet coke.

The proposed bubble compliance alternative would not be applicable to new sources. All new affected sources at kraft pulp mills would be required to meet the individual emission limitations set for those sources. Also, mills subject to the NSPS requirements for kraft pulp mills would be required to continue to meet the PM emission limits of NSPS, regardless of which option they choose for complying with the NESHAP standard.

The conversion of a lime kiln to burning pet coke is not considered a "new source" under the NESHAPs regulations. Under Subpart A of Title 40 CFR 63, "new source" means "any affected source the construction or reconstruction of which is commenced after the Administrator first proposes a relevant emission standard under this part establishing an emission standard applicable to such source." As the lime kiln would not be newly constructed, because it would be constructed before the applicable NESHAPs standard was proposed, it is considered a reconstruction. The definition for Reconstruction, in Title 40 CFR 63 Subpart A is as follows:

> "Unless otherwise defined in a relevant standard, means the replacement of components of an affected or a previously nonaffected source to such an extent that:
>
> (1) The **fixed capital cost of the new components exceeds 50 percent** of the fixed capital cost that would be required to construct a comparable new source; and
>
> (2) It is technologically and economically feasible for the reconstructed source to meet the relevant standard(s) established by the Administrator (or a State) pursuant to section 112 of the Act. Upon reconstruction, an affected source, or a stationary source that becomes an affected source, is subject to relevant standards for new sources, including compliance dates, irrespective of any change in emissions of hazardous air pollutants from that source."

The estimated cost of a burner plus a fan, silo, and associated loading and unloading equipment required to facilitate the transportation and combustion of pet coke would be about $2.5 million, and the estimated cost of a new lime kiln is $30 million[2].

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[2] Costs are based on an estimate from the DTE Energy Services Development Department.

As the capital costs of the burner reconstruction is less than 50% of a new lime kiln, this modification would not be considered a reconstruction and, therefore, not be regulated under the new source requirements under the NESHAPs regulations. Thus, conversion of the lime kiln to burn pet coke does not introduce new NESHAPs regulations or alter a mill's requirement to comply with NESHAPs as an existing source. The mill will be regulated under the existing source NESHAPs requirements of either the source-specific limit or can continue under the PM bubble compliance alternative.

Potential Emission Increases Using Pet Coke

To determine if a source will trigger PSD permitting, the potential to emit for the source must be calculated. The potential to emit is the maximum capacity of a stationary source given its physical and operational design to emit a pollutant. Potential to emit is an emission estimation method used to determine future emissions, which are then compared to actual emissions. The difference between potential and actual emissions is used to determine if a significant net increase in emissions will occur.

As detailed in the Parton's Group paper, 285 tpd of reburned lime are required for a 1,000-tpd bleached pulp mill. The fuel requirement for the lime kiln is approximately 6 million MMBtu per ton of lime. The resulting fuel demand for the kiln that serves the 1,000-tpd pulp mill is

285 tpd lime x 6 MMBtu/ton = 1,710 MMBtu/day

The following calculations identify the fuel requirements for a lime kiln burning 75% pet coke and 25% natural gas at a 1,000-tpd bleached pulp mill, given a heating value of 28 MMBtu per ton of pet coke:

1,710 MMBtu/day x 1 ton pet coke/28 MMBtu x 75% = 45 tpd pet coke

1,710 MMBtu/day x 1 ft^3 natural gas/1,000 Btu x 25% = 427,000 cubic feet per day (ft^3/day) natural gas

Using these fuel requirements and the following assumptions and emission factors, we are able to calculate potential emission increases.

- The particulate emissions would be controlled with a wet scrubber or an ESP with a control efficiency of 99%.

- The sulfur removal of the system would be 99.5%.
- Pet coke has a sulfur content of 6%.
- Calculations in this paper for actual emissions from a lime kiln are based on an actual operating schedule of 350 days per year and the potential to emit is based on 365 days per year[3]. Actual emissions from current operating lime kilns can vary from these calculations based on several factors such as process differences, operating schedule, and add-on control removal efficiency.

Emissions were calculated using emissions factors described below:

- Lime kiln emission factors are from the United States Environmental Protection Agency's (USEPA's) *AP-42, Fifth Edition, Wood Products Industry, Chapter 10.2, Chemical Wood Pulping*. These emission factors are used to estimate the emissions associated with a lime kiln burning natural gas and include emissions generated by the lime kiln process, as well as those generated by the combustion of natural gas.
- Pet coke emission factors are from the USEPA's *Emission Inventory Improvement Program* (EIIP)*; Volume II: Chapter 14, Uncontrolled Emission Factor Listing for Criteria Air Pollutants, July, 2001.* These emission factors are fuel specific for commercial and institutional external combustion boilers; however, in the absence of available lime kiln-specific data, they are appropriate for use in this comparison. The EIIP emissions factors are used to calculate the emissions of sulfer dioxide (SO_2) and PM generated by the combustion of pet coke. The combustion of natural gas generates a negligible amount of SO_2 and PM. Therefore, to estimate the total potential to emit emissions, SO_2 and PM emissions from combusting pet coke in a lime kiln are added to the AP-42 factors for lime kilns.

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[3] Under the PSD regulations, current actual emissions are compared to the proposed potential emissions to determine an emissions increase. On December 31, 2002, the USEPA reformed the PSD program. Under the reformed program, the proposed emissions increases can be calculated using other methods such as comparing current actual emissions to proposed actual emissions. However, most states have not yet implemented the reformed PSD program and continue to operate under the old program. In this paper, PSD applicability is based on the comparison of actual emissions to potential emissions because it is the most conservative method of comparison.

- The emissions factors for carbon monoxide (CO) and nitrous oxides (NOx) from a lime kiln burning a combination of pet coke/natural gas were obtained from a burner manufacturer. These emission factors are based on 80% pet coke being combusted with 20% natural gas. These factors are considered appropriate for this comparison because they take into account flame temperature and size, which are different in a lime kiln than in a boiler. In addition, the emissions from combustion vary greatly depending on flame temperature and size. CO and NOx are not emitted from the lime kiln process; they are only emitted during the combustion of fuels (natural gas or pet coke). Therefore, the addition of AP-42 factors and EIIP factors is not required to estimate the total potential-to-emit emissions.
- VOC emissions from a pet coke lime kiln are calculated by adding the VOC emissions from the lime kiln process and the VOC emissions from the combustions of pet coke and natural gas. The VOC emissions from a lime kiln burning a combination of pet coke/natural gas were calculated using an emission factor from a burner manufacturer and the AP-42 emission factor for the lime kiln process burning 100% natural gas. VOC emissions are produced from the lime kiln process and natural gas and pet coke combustion. There is no method to accurately determine the percentage of VOCs from natural gas combustion in the lime kiln, so the potential to emit from a pet coke lime kiln is very conservative.

PSD Netting Analysis for a Pet Coke Lime Kiln[1]

Pollutant	Natural Gas Lime Kiln[2] Estimated Actual Emissions (Tons per Year)	Pet Coke Lime Kiln[1] Estimated Potential to Emit (Tons per Year)	Net Increase (Tons per Year)	PSD Significance Threshold (Tons per Year)	PSD Triggered?
TRS as S	5.25	5.48	0.23	10	No
SO_2	52.5	64.4	11.9	40	No
PM	87.5	91.8	4.3	15	No
NOx	175	202.8	27.8	40	No
CO	17.5	18.7	1.2	100	No
VOCs (Total Hydrocarbons)	5.25	9.18	3.93	40	No
CO_2	35,192	57,788	22,596	---	--

[1] Pet coke lime kiln refers to a lime kiln burning 75% pet coke and 25% natural gas.

[2] Natural gas lime kiln refers to a lime kiln burning 100% natural gas.

Total Reduced Sulfur Emissions

The USEPA's AP-42 factor for total reduced sulfur from a lime kiln burning natural gas is 0.03 pounds of TRS per ton of lime. The actual emissions from a lime kiln burning natural gas are calculated in the following equation:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.03\text{ lbs TRS}}{\text{ton pulp}} \times \frac{350\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 5.25\text{ tpy of TRS}$$

To determine the potential to emit of TRS from a lime kiln burning pet coke and natural gas together, the same emission factor of 0.03 lbs TRS/ton of lime is used because the additional sulfur from the pet coke will be converted to SO_2 or anhydrite ($CaSO_4$)[4]. The emission factor for TRS is multiplied by the maximum number of days to determine the potential to emit, as shown in the equation below:

Potential to Emit from a Pet Coke Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.03\text{ lbs TRS}}{\text{ton pulp}} \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 5.48\text{ tpy of TRS}$$

Based on these estimations, the net increase in TRS (the difference in the potential to emit from a pet coke lime kiln minus actual emissions estimate from a natural gas lime kiln for PSD purposes) is 0.23 tpy and is the shown in the equation below:

Net Increase

5.48 tpy of TRS – 5.25 tpy of TRS = 0.23 tpy of TRS

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[4] When burning pet coke in the kiln, the sulfur in the pet coke is converted to SO_2. Most of the SO_2 is absorbed by the lime in the kiln forming $CaSO_4$. Anhydrite is a solid and will not be emitted to the air. Therefore, any additional sulfur generated from combusting pet coke in the lime kiln will be converted to SO_2 or $CaSO_4$.

The net increase is below the significant emissions net increase threshold level of 10 tpy, and therefore, the PSD permitting requirements will not be triggered.

Sulfur Dioxide Emissions

The estimated actual emissions of SO_2 from an existing lime kiln burning natural gas is 52.5 tons per year. This is using the USEPA's AP-42 lime kiln emissions factor of 0.3 pounds SO_2/ton pulp and would be calculated as follows:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}}\times\frac{0.3\text{ lbs SO}_2}{\text{ton pulp}}\times\frac{350\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=52.5\text{ tpy of SO}_2$$

Based on process knowledge, the SO_2 emissions from the combustion of natural gas are negligible. Additional SO_2 emissions are introduced from the burning of pet coke and were calculated using the EIIP's emission factor for pet coke combustion, assuming 6% pet coke sulfur content and 99.5% removal efficiency. The EIIP's pet coke combustion emission factor of 39S lb/ton pet coke (where S is % sulfur) was used in this calculation.

Potential to Emit from Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}}\times\frac{0.3\text{ lbs SO}_2}{\text{ton pulp}}\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=54.8\text{ tpy of SO}_2$$

Potential to Emit from Pet Coke Combustion

$$\frac{45\text{ tons pet coke}}{\text{day}}\times\frac{(39\text{ x }6)\text{ lbs SO}_2}{\text{ton pet coke}}\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}\times(1-0.995)=9.6\text{ tpy of SO}_2$$

The potential to emit for SO_2 from a lime kiln burning pet coke would be:

Potential to Emit from Pet Coke Lime Kiln

$$54.8\text{ tpy SO}_{2\,(\text{emissions from lime kiln})}+9.6\text{ tpy SO}_{2\,(\text{emissions from pet coke combustion})}=64.4\text{ tpy of SO}_2$$

Based on these estimations, the net increase in SO_2 would be 11.9 tpy, as expressed below:

Net Increase

64.4 tpy of SO_2 – 52.5 tpy of SO_2 = 11.9 tpy of SO_2

The net increase is below the significant emissions net increase threshold level of 40 tpy, and therefore, PSD permitting requirements will not be triggered.

Particulate Matter Emissions

The PM emissions calculations assume (1) PM control of 99% with add-on controls of either a wet scrubber or an ESP, and (2) the additional PM from the burning of pet coke would be adequately controlled by a wet scrubber or ESP and would remain below the NSPS and NESHAPs for existing sources.

The PM emissions for a natural gas fired lime kiln were calculated using the USEPA's AP-42 emission factor for a lime kiln with a wet scrubber or ESP.

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}}\times\frac{0.5\text{ lbs PM}}{\text{ton pulp}}\times\frac{350\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=87.5\text{ tpy of PM}$$

Natural gas combustion produces negligible PM emissions, so the potential to emit from a pet coke lime kiln is the potential to emit from the lime kiln process and the potential to emit from pet coke combustion. Additional PM emissions generated during the burning of pet coke were calculated using the EIIP's emission factor for pet coke combustion.

Potential to Emit from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}}\times\frac{0.5\text{ lbs PM}}{\text{ton pulp}}\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=91.3\text{ tpy of PM}$$

Potential to Emit from Pet Coke Combustion

$$\frac{45\text{ tons pet coke}}{\text{day}}\times\frac{3.5\text{ lbs PM}}{\text{ton pet coke}}\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}\times(1-99\%)=0.3\text{ tpy of PM}$$

Potential to Emit from Pet Coke Lime Kiln

$$91.3 \text{ tpy } PM_{(\text{emissions from natural gas lime kiln})} + 0.3 \text{ tpy } PM_{(\text{emissions from pet coke combustion})} = 91.6 \text{ tpy of PM}$$

Additional PM emissions generated from using pet coke at the facility occur from the delivery and storage of pet coke. The delivery of pet coke to the facility by trucks would result in additional PM emissions due to unpaved roads inside facility boundaries. Potential PM emissions from unpaved roads were calculated using the USEPA's AP-42 emissions factor for PM_{10}. Assuming four delivery trucks daily driving a total of 0.5 mile per round trip and 95% control efficiency (from watering); the estimated emissions are 0.11 tpy PM.

Storage of pet coke at the facility has the potential to increase PM emissions. Potential PM emissions were calculated using the USEPA's AP-42 PM emission factor (for coke handling/ production) of 0.006 lb PM/ton coke (0.003 kilograms per megagram [kg/Mg] coke).

Potential to Emit from Pet Coke Handling/Storage

$$\frac{45 \text{ tons pet coke}}{\text{day}} \times \frac{0.006 \text{ lbs PM}}{\text{ton pet coke}} \times \frac{365 \text{ days}}{\text{year}} \times \frac{1 \text{ ton}}{2{,}000 \text{ lbs}} = 0.05 \text{ tpy PM}$$

Therefore, the total PM emissions for a pet coke lime kiln are calculated as follows:

$$0.3_{\text{petcoke}} + 91.3_{\text{process}} + 0.05_{\text{handling/storage}} + 0.11_{\text{roads}} = 91.8 \text{ tpy of PM}$$

Based on these estimations, the net increase in PM would be 4.3 tpy and is expressed below:

Net Increase

91.8 tpy of PM – 87.5 tpy of PM = 4.3 tpy of PM

The net increase is below the significant emissions net increase threshold level of 15 tpy; therefore, PSD permitting requirements will not be triggered.

Nitrous Oxides, Carbon Monoxide and Volatile Organic Compounds Emissions

NOx, CO, and VOC emissions factors for pet coke combustion in a lime kiln were obtained from a burner manufacturer. The burner manufacturer's emission factors are based on 80% pet coke being combusted with 20% natural gas. This information was uses a slightly different fuel split ratio (80% pet coke, 20% natural gas) than our assumption of 75% pet coke and 25% natural gas. However, we believe (1) the burner manufacturer data to be appropriate and (2) the 5% difference in fuel use assumption will not make a material difference in our estimates. Therefore, the potential to emit calculations from these factors will be higher than 75% pet coke being combusted with 25% natural gas. Emission factors for NOx, CO, and VOCs are shown in the table below:

Expected Emissions, Pet Coke Firing Lime Recovery Kiln Burners [1,2]

Constituent	80% Pet Coke[3]/20% Natural Gas
NOx	0.65 lb/MMBtu
CO	0.06 lb/MMBtu
VOC	0.012 lb/MMBtu

1. The above are the contribution from the burner.
2. Secondary air temperature of 750 F.
3. Pet coke with heating value of 14,800 Btu/lb and nitrogen content of 1.5% by weight, dry.

NOx Emissions

Typical NOx from a lime kiln at a 1,000-tpd pulp mill burning natural gas is 175 tpy. This is using the USEPA's AP-42 emission factor of 1 pound NOx/ton pulp and is calculated below:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{1\text{ lbs NOx}}{\text{ton pulp}} \times \frac{350\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 175\text{ tpy NOx}$$

The majority of the NOx emissions is from the combustion of natural gas, not the lime kiln process itself. For example, NOx emissions from lime kilns used in cement manufacturing are higher when burning natural gas than when burning coal or oil. According to the AP-42, Chapter 11.6 on lime kilns at cement manufacturing, "Oxides of nitrogen are generated during fuel combustion by oxidation of chemically-bound nitrogen in the fuel and by thermal fixation of nitrogen in the combustion air. As flame temperature increases, the amount of thermally generated NOx increases. Fuel use affects the quantity and type of NOx generated. For example, in the kiln, natural gas combustion with a high flame temperature and low fuel nitrogen generates a larger quantity of NOx than does oil or coal, which have higher fuel nitrogen but which burn with lower flame temperatures." Conversely, NOx emissions from natural gas combustion in boilers are much lower than NOx emissions from combustion in lime kilns due to the lower flame temperatures.

Potential NOx emissions from a lime kiln burning a pet coke/natural gas mix of 80% pet coke and 20% would be 202.8 tpy and expressed as follows:

Potential to Emit from Pet Coke Lime Kiln

$$\frac{1{,}710\text{ MMBtu}}{\text{day}} \times \frac{0.65\text{ lbs NOx}}{\text{MMBtu}} \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 202.8\text{ tpy NOx}$$

Based on these estimations, the net increase in NOx would be 27.8 tpy and is expressed below:

Net Increase

202.8 tpy of NOx – 175.0 tpy of NOx = 27.8 tpy of NOx

Because the increase in NOx emissions are below the significant emissions net increase threshold level of 40 tpy, PSD permitting requirements will not be triggered.

Carbon Monoxide Emissions

Typical CO from a lime kiln burning natural gas is 17.5 tpy. This is using the USEPA's AP-42 emission factor of 0.1 pound CO/ton pulp and is calculated:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.1\text{ lbs CO}}{\text{ton pulp}} \times \frac{350\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 17.5\text{ tpy CO}$$

The majority of the CO emissions is from the combustion of natural gas, not the lime kiln process itself. Potential CO emissions from a lime kiln burning 80% pet coke and 20% natural gas would be 18.7 tpy. The emissions are calculated as follows:

Potential to Emit from Pet Coke Lime Kiln

$$\frac{1{,}710\text{MMBtu}}{\text{day}} \times \frac{0.06\text{ lbs CO}}{\text{MMBtu}} \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 18.7\text{ tpy CO}$$

Based on these estimations, the net increase in CO would be 1.2 tpy and is expressed below:

Net Increase

18.7 tpy of CO – 17.5 tpy of CO = 1.2 tpy of CO

Because the increase in CO emissions is below the significant emissions net increase threshold level of 100 tpy, PSD permitting requirements will not be triggered.

Volatile Organic Compound Emissions

The USEPA's AP-42 emission factor for a typical natural gas burning lime kiln is 0.03 pounds VOC/ton pulp (using the USEPA's AP-42 factors for methyl mercaptan, dimethyl sulfide, and dimethyl disulfide with efficient mud washing, optimal kiln operation, and added caustic in scrubbing water). The emissions are calculated as follows:

Actual Emissions Estimate from Natural Gas Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.03\text{ lbs VOC}}{\text{ton pulp}} \times \frac{350\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 5.25\text{ tpy of VOC}$$

To calculate the VOC emissions from a lime kiln burning 80% pet coke and 20% natural gas, the emission factor for VOCs from a burner manufacturer is used and then added to the VOCs from the process.

Potential to Emit from Lime Kiln

$$\frac{1{,}000\text{ tons pulp}}{\text{day}} \times \frac{0.03\text{ lbs VOC}}{\text{ton pulp}} \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 5.48\text{ tpy of VOC}$$

Potential to Emit from Pet Coke Combustion

$$\frac{0.012\text{ lb VOC}}{\text{MMBtu}}\times\frac{1{,}710\text{MMBtu}}{\text{day}}\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=3.7\text{ tpy of VOC}$$

Potential to Emit from a Pet Coke Lime Kiln

$$5.48\text{ tpy of VOC}_{\text{Lime Kiln Process}}+3.7\text{ tpy of VOC}_{\text{Pet Coke Combustion}}=9.18\text{ tpy of VOC}$$

Based on these estimations, the total potential to emit from the pet coke lime kiln would be 9.18 tpy of VOCs. The net increase of VOC emissions is 3.93 tpy and is expressed below:

Net Increase

$$9.18\text{ tpy of VOC}-5.48\text{ tpy of VOC}=3.93\text{ tpy of VOC}$$

Because the increase in VOC emissions is below the significant emissions net increase threshold level of 40 tpy, PSD permitting requirements will not be triggered.

Carbon Dioxide Emissions

A CO_2 emission factor for both natural gas and pet coke was calculated based on the heating value and carbon content weight percent of the fuel. The calculated emission factors for natural gas and pet coke are 117.6 pounds CO_2/MMBtu and 207.7 pounds CO_2/MMBtu, respectively. Using the calculated emission factors, CO_2 emissions were calculated. Based on these calculations, the typical CO_2 emissions from a lime kiln burning natural gas are 35,192 tpy. The emissions are calculated as follows:

Estimated Actual Emissions from Natural Gas Lime Kiln

$$\frac{117.6\text{ lb CO}_2}{\text{MMBtu}}\times\frac{1{,}710\text{MMBtu}}{\text{day}}\times\frac{350\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=35{,}192\text{ tpy of CO}_2$$

The CO_2 emissions from a lime kiln burning 75% pet coke and 25% natural gas would be 57,788 tpy CO_2 and is expressed in the following equations:

Potential to Emit from Pet Coke Combustion

$$\frac{207.7\text{ lb CO}_2}{\text{MMBtu}}\times\left(75\%\times\frac{1{,}710\text{MMBtu}}{\text{day}}\right)\times\frac{365\text{ days}}{\text{year}}\times\frac{1\text{ ton}}{2{,}000\text{ lbs}}=48{,}613\text{ tpy of CO}_2$$

$\frac{3.64e6\ Btu}{hr} \times \frac{\cancel{\#}\ cf}{1000\ Btu} = \frac{3640\ cf}{hr} \times \frac{1}{1e6}$

Potential to Emit from Natural Gas Combustion

$$\frac{117.6\text{ lb CO}_2}{\text{MMBtu}} \times \left(25\% \times \frac{1{,}710\text{MMBtu}}{\text{day}}\right) \times \frac{365\text{ days}}{\text{year}} \times \frac{1\text{ ton}}{2{,}000\text{ lbs}} = 9{,}175\text{ tpy of CO}_2$$

Potential to Emit from Pet Coke Lime Kiln

$$48{,}613\text{ tpy of CO}_2\text{ (pet coke)} + 9{,}175\text{ tpy CO}_2\text{ (natural gas)} = 57{,}788\text{ tpy of CO}_2$$

Based on these calculations, the net increase in CO_2 is 22,596 tpy CO_2. This is a net increase of 64%; however, CO_2 emissions are not currently regulated.

Trace Elements

Trace elements will also be emitted from a lime kiln burning pet coke. The estimated potential to emit values from burning pet coke shown in the table below are based on concentrations of trace metals provided in the "PPM" column. The controlled emissions are based on 99% removal efficiency. This removal efficiency is achieved through a combination of trace elements being removed during the lime kiln process itself and the use of PM control devices.

LRPO $\frac{49\text{ tpd}}{67.8\text{ lb/min coke}}$

Potential to Emit of Trace Elements from a Pet Coke Lime Kiln

Pet Coke Analysis	PPM	Uncontrolled Potential to Emit (lbs/year)	Controlled Potential to Emit (lbs/year)
Arsenic	0.3	9.9 10.7	0.10
Beryllium	1.5	49.5	0.50
Cadmium	0.1	3.3	0.03
Chromium	-	-	-
Copper	3.5	115	1.15
Fluorine	11	361	3.62
Iron	425	13,961	139.62
Lead	0.6	19.7	0.20
Manganese	2.4	78.8	0.79
Mercury	0.001	0.03	-

Pet Coke Analysis	PPM	Uncontrolled Potential to Emit (lbs/year)	Controlled Potential to Emit (lbs/year)
Nickel	350	11,498	114.98
Selenium	2.0	66	0.66
Silica	300	9,855	98.55
Sodium	200	6,570	65.70
Vanadium	700	22,995	229.95

State Requirements

States typically have additional requirements for PM, SO_2, and TRS emissions for new, modified, and reconstructed lime kilns. Most states also regulate air toxic emissions from pulp mills as well.

Air Quality Regulations for Selected States

For the purpose of this paper and based on DTE's request, air quality regulations of Louisiana, Arkansas, Mississippi, and Texas were selected for review and a permitting process comparison. The following table summarizes the air quality requirements for these four states; the state requirements are in addition to the applicable federal requirements.

State	PM Requirements	SO2 Requirements	TRS/H2S Requirements	Permitting Process Time
Louisiana	1 pound PM/ton pulp	No additional state applicable requirement	20 ppm TRS	6 to 9 months
Arkansas	No additional state applicable requirement	No additional state applicable requirement	No additional state applicable requirement	2 to 3 months
Mississippi	No additional state applicable requirement	No additional state applicable requirement	No additional state applicable requirement	6 to 9 months
Texas	No additional state applicable requirement	3.0 lb SO2/MMBtu	20 ppm H_2S	6 to 9 months

These states also have varying levels of air toxics regulations. The regulations, however, tend to limit the concentration of air toxics at the pulp mill fence line and, thus, do not directly regulate emissions from specific equipment in the chemical recovery area of the mill. Each of the four states' air quality requirements are further discussed in the following paragraphs.

Louisiana Air Quality Regulations

Louisiana regulates wood pulping in Title 33, Part III, Chapter 23, Subchapter A § 2301 *Control of Emissions from the Chemical Wood Pulping Industry.*

> "1. Particulate Emissions. Emission of particulate matter shall not exceed the following limits.
>
> c. For lime kilns, not more than 1.0 pound per equivalent pulp ton, (0.5 kilograms per equivalent pulp metric ton).
>
> 3. Total Reduced Sulfur Emissions. Emissions of Total Reduced Sulfur (TRS) from existing sources specified below shall not exceed the following limits:
>
> d. lime kilns, corrected to 10 percent oxygen by volume, 20 ppm"

Arkansas Air Quality Regulations

Arkansas currently does not have any applicable air quality regulations for PM, SO2, or TRS.

Mississippi Air Quality Regulations

Mississippi also regulates new kraft pulping mills as follows: "Kraft Pulping Mills. All sources shall minimize gaseous and particulate emission by use of modern equipment, devices, maintenance, and operating practices in accordance with best current technology. In no case shall emissions exceed the limits set forth in any applicable Federal Standard of Performance for New Stationary Sources."

Texas Air Quality Regulations

Texas regulates emissions of TRS under Title 30 Texas Administrative Code Chapter 112 (30 TAC Chapter §112.51)

> "3. For lime kilns: 20 ppm TRS, as H2S on a dry basis, corrected to 10% oxygen"

Sulfur dioxide emissions are regulated under 30 TAC Chapter 112, § 112.8 - Control of Sulfur Dioxide.

> "a. Except as provided in subsection (b) of this section, no person may cause, suffer, allow, or permit emissions of sulfur dioxide (SO_2) from any solid fossil fuel-fired steam generator to exceed 3.0 pounds per million Btu (MMBtu) heat input averaged over a three-hour period.
>
> b. No person may cause, suffer, allow, or permit emissions of SO_2 from any solid fossil fuel-fired steam generator located in Milam County, which began operation prior to January 1, 1955, to exceed 4.0 pounds per MMBtu heat input averaged over a three-hour period.
>
> c. Except as provided in subsection (d) of this section, beginning September 30, 1994, solid fossil fuel-fired steam generators of greater than 250 MMBtu heat input per hour which are equipped with SO_2 control equipment shall be equipped with a continuous emissions monitoring system (CEMS) for SO_2. The CEMS shall be installed, calibrated, and operated as specified in 40 Code of Federal Regulations Part 51, Appendix P, hereby incorporated by reference."

Permitting Timelines and Expediting Methods

In general, the time required to obtain a non-PSD (minor source) permit modification from Louisiana, Mississippi, and Texas is approximately six to nine months, with Arkansas' current turnaround time being less than six months. Arkansas permit engineers indicated their typical turnaround for non-PSD permits currently is approximately 60 to 90 days (two to three months).

A description of the permit review time frames and methods to expedite permit reviews are listed below for Louisiana, Arkansas, Mississippi, and Texas.

Louisiana

Agency:	Louisiana Department of Environmental Quality (LDEQ)
Contact:	Kermit Whittenburg, Permit Engineer (225-765-0195)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately 6 to 9 months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels. The LDEQ has a general operating permit (GOP) program that, if applicable, can reduce the review time by 30 days because no public notice period is required. However, based on the level of emissions increase expected, it does not appear that this modification will fit under the GOP program. The LDEQ has an internal expediting system that utilizes a series of red flags to track these permits. To expedite review of a permit application, the company must initially request this expedited review from the LDEQ permit engineer.

Arkansas

Agency:	Arkansas Department of Environmental Quality (ADEQ)
Contact:	Tom Rheaume (501-682-0762)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately two to three months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels.

Based on a conversation with Cecil Harrell, Permit Engineer, several permit engineers are available to review permit applications on an expedited schedule. The ADEQ can also authorize pilot testing without the full permit application being approved and the permit issued to the company. A pilot test can be authorized based on submitting general permit and emission information.

Mississippi

Agency:	Mississippi Department of Environmental Quality (MDEQ)
Contact:	Sharon Vinson (601-961-5693)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately six to nine months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels.

To expedite review of a permit application in Mississippi, the MDEQ recommends a pre-application meeting to discuss the project schedule and importance to the company and community and to request an expedited review. The MDEQ did indicate that permit modifications take priority over general permit renewal applications.

Texas

Agency:	Texas Commission on Environmental Quality (TCEQ)
Contact:	Wesley Smith (512-239-6143)

The typical permit turnaround time from the time the permit application is deemed technically complete to permit issuance is approximately six to nine months. This turnaround time is based on the assumption that the emissions do not exceed the PSD significance levels.

To expedite review of a permit application in Texas, the TCEQ recommends a pre-application meeting to discuss the project schedule, expected emissions, and importance to the company and community and to request an expedited review. The TCEQ has a GOP program and Permit By Rule (PBR); however, based on the level of emissions increase expected, it does not appear that this modification will fit under either of these programs. The GOP program can reduce review time by eliminating the 30-day public notice period. The PBR regulation consists of the standard exemptions previously utilized by this agency and its predecessor agencies (i.e., TACB, TNRCC).

Conclusions

The following conclusions were reached as result of this study:

- For sources located in attainment areas, the permitting requirements and potential air quality regulations that may be triggered by modifying an existing lime kiln to combust pet coke rather that natural gas are minimal and should not be considered a roadblock when considering alternative fuels. Based on the calculations performed for this paper, the increased emissions of TRS, SO2, PM, NOx, CO, VOCs, and CO2 resulting from a switch to a 75% pet coke and 25% natural gas fuel source would remain below the significant emissions net increase threshold level and, therefore, would trigger state-only and possibly NSPS regulations.
- PSD permitting requirements will likely not be triggered from the potential emission increases associated with the fuel switch.
- The NESHAPs for a new source would not be triggered because modifying a lime kiln to burn pet coke is not considered a modification or a new source under the

NESHAPs requirements. The NESHAPs requirements for existing sources that will become effective March 2004 would apply, but these requirements would apply regardless if a fuel switch occurs.

- NSPS may be triggered if the hourly PM or TRS emission rate increases. This paper is based on the assumption that the existing lime kilns (1) have the necessary control equipment to achieve the NSPS PM emission standards (as there is an existing PM standard under the NESHAPs requirements) and (2) will most likely be able to meet the NSPS TRS requirements using existing current operational controls. Continuous emission monitoring of TRS emissions and monitoring of percent O_2 discharged would also be required if NSPS is triggered.
- State permitting may require air toxic modeling, but the air toxics from a pet coke lime kiln are insignificant and, therefore, should not cause any issues with permitting. Some areas may be reclassified as nonattainment in the near future, which would affect permit applications that have not been approved or finalized prior to the reclassification.
- The use of pet coke fuel should be considered in light of each mill's current operating conditions, actual emissions, and local requirements (especially in an non attainment area). However, based on the emission calculations in this paper, the cost advantages of converting to pet coke outweigh the minor permitting requirements needed for the conversion.

Appendix A

EPA Green Book

U.S. Environmental Protection Agency

Green Book

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Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name *Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
AK: Anchorage				
CO	Anchorage, AK	255	1	Serious
PM-10	Eagle River, AK	195	1	Moderate
AK: Fairbanks				
CO	Fairbanks, AK	39	1	Serious
AK: Juneau				
PM-10	Juneau, AK	14	1	Moderate
AL: Birmingham				
Ozone	Birmingham, AL	805	2	Marginal
AZ: Ajo				
PM-10	Ajo (Pima County), AZ	8	1	Moderate
SO2	Ajo (Pima County), AZ	8	1	Primary
AZ: Douglas (Cochise County)				
PM-10	Douglas (Cochise County), AZ	16	1	Moderate
SO2	Douglas (Cochise County), AZ	16	1	Primary
AZ: Hayden/Miami				
PM-10	Hayden/Miami, AZ	4	2	Moderate
SO2	Hayden (Pinal County), AZ	2	1	Primary
SO2	Miami (Gila County), AZ	2	1	Primary
AZ: Morenci				
SO2	Morenci (Greenlee County), AZ	9	1	Primary
AZ: Nogales				

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name	*Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
	PM-10	Nogales, AZ	25	1	Moderate
AZ: Paul Spur (Cochise County)					
	PM-10	Paul Spur, AZ	1	1	Moderate
AZ: Phoenix					
	CO	Phoenix, AZ	3,029	1	Serious
	Ozone	Phoenix, AZ	3,029	1	Serious
	PM-10	Phoenix, AZ	3,112	2	Serious
AZ: Rillito (Pima County)					
	PM-10	Rillito, AZ	1	1	Moderate
AZ: San Manuel					
	SO2	San Manual (Pinal County), AZ	8	1	Primary
AZ: Yuma					
	PM-10	Yuma, AZ	82	1	Moderate
CA: Chico					
	Ozone	Chico, CA	203	1	Section 185A
CA: Imperial County					
	Ozone	Imperial Co, CA	142	1	Section 185A
	PM-10	Imperial Valley, CA	120	1	Moderate
CA: Los Angeles-South Coast Air Basin					
	CO	Los Angeles South Coast Air Basin, CA	14,551	4	Serious
	Ozone	Los Angeles South Coast Air Basin, CA	14,551	4	Extreme
	PM-10	Los Angeles South Coast Air Basin, CA	14,551	4	Serious
CA: Mono County					
	PM-10	Mono Basin, CA	0	1	Moderate
CA: Owens Valley					
	PM-10	Owens Valley, CA	7	1	Serious
CA: Sacramento Metro					
	Ozone	Sacramento Metro, CA	1,978	6	Severe-15
	PM-10	Sacramento Co, CA	1,223	1	Moderate
CA: San Francisco-Bay Area					
	Ozone	San Francisco Bay Area, CA	6,542	9	Other
CA: San Joaquin Valley					
	Ozone	East Kern Co, CA	111	1	Serious
	Ozone	San Joaquin Valley, CA	3,191	8	Severe-15
	PM-10	San Joaquin Valley, CA	3,080	7	Serious
CA: Searles Valley					
	PM-10	Coso Junction, CA	7	1	Moderate
	PM-10	Trona, CA	4	1	Moderate

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name *Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
CA: Southeast Desert Modified AQMA				
Ozone	Southeast Desert Modified AQMA, CA	1,024	3	Severe-17
PM-10	Coachella Valley, CA	225	1	Serious
PM-10	San Bernardino Co, CA	199	1	Moderate
CA: Ventura County				
Ozone	Ventura Co, CA	753	1	Severe-15*
CA: Yuba City				
Ozone	Yuba City, CA	114	2	Section 185A
CO: Fort Collins				
CO	Fort Collins, CO	143	1	Moderate <= 12.7ppm
CO: Lamar				
PM-10	Lamar, CO	9	1	Moderate
CO: Steamboat Springs				
PM-10	Steamboat Springs	10	1	Moderate
CT: Greater Connecticut				
Ozone	Greater Connecticut, CT	2,532	8	Serious
PM-10	New Haven Co, CT	124	1	Moderate
DC-MD-VA: Washington				
Ozone	Washington, DC-MD-VA	4,545	16	Severe-15
DE: Sussex County				
Ozone	Sussex Co, DE	157	1	Marginal
GA: Atlanta				
Ozone	Atlanta, GA	3,699	13	Serious
GU: Piti Power Plant				
SO2	Piti, GU	1	1	Primary
GU: Tanguisson Power Plant				
SO2	Tanguisson, GU	1	1	Primary
ID: Bonner County (Sandpoint)				
PM-10	Bonner Co (Sandpoint), ID	37	1	Moderate
ID: Pocatello				
PM-10	Portneuf Valley, ID	66	2	Moderate
PM-10	Fort Hall Reservation, ID	1	2	Moderate
ID: Shoshone County				
PM-10	Shoshone Co, ID	10	1	Moderate
PM-10	Pinehurst, ID	2	1	Moderate
IL-IN: Chicago-Gary-Lake County				
Ozone	Chicago-Gary-Lake County, IL-IN	8,758	10	Severe-17
PM-10	Lyons Twsp., IL	109	1	Moderate

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name *Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
PM-10	Southeast Chicago, IL	3	1	Moderate
SO2	Lake County, IN	485	1	Primary
LA: Baton Rouge				
Ozone	Baton Rouge, LA	636	5	Severe-15
MA: Springfield (W. Mass)				
Ozone	Springfield (Western MA), MA	815	4	Serious
MA-NH: Boston-Lawrence-Worcester (E. Mass)				
Ozone	Boston-Lawrence-Worcester (E. MA), MA-NH	5,883	12	Serious
MD: Baltimore				
Ozone	Baltimore, MD	2,512	6	Severe-15
MD: Kent County and Queen Anne's County				
Ozone	Kent & Queen Anne's Co.s, MD	60	2	Marginal
ME: Knox County and Lincoln County				
Ozone	Knox & Lincoln Co.s, ME	73	2	Moderate*
ME: Lewiston-Auburn				
Ozone	Lewiston-Auburn, ME	221	2	Moderate*
ME: Portland				
Ozone	Portland, ME	488	3	Moderate
MO: Liberty and Arcadia (Iron County)				
Lead	Iron County (part); Liberty and Arcadia, MO	6	1	
MO-IL: St. Louis				
Lead	Jefferson County (part); Herculaneum, MO	2	1	
MT: Billings/Laurel				
SO2	Laurel Area (Yellowstone County), MT	6	1	Primary
MT: Butte				
PM-10	Butte, MT	35	1	Moderate
MT: Columbia Falls (Flathead County)				
PM-10	Columbia Falls, MT	4	1	Moderate
MT: East Helena				
Lead	East Helena Area (Lewis and Clark Co.), MT	2	1	
SO2	East Helena Area (Lewis and Clark Co.), MT	2	1	Primary, Secondary
MT: Kalispell (Flathead County)				
PM-10	Kalispell, MT	15	1	Moderate
MT: Lame Deer				
PM-10	Lame Deer, MT	1	1	Moderate
MT: Libby				
PM-10	Libby, MT	3	1	Moderate
MT: Missoula				

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name *Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
CO	Missoula, MT	52	1	Moderate <= 12.7ppm
PM-10	Missoula, MT	52	1	Moderate
MT: Polson (Lake County)				
PM-10	Polson, MT	4	1	Moderate
MT: Ronan (Lake County)				
PM-10	Ronan, MT	3	1	Moderate
MT: Thompson Falls				
PM-10	Sanders County (part);Thompson Falls and vicinity,MT	1	1	Moderate
MT: Whitefish (Flathead County)				
PM-10	Flathead County; Whitefish and vicinity, MT	5	1	Moderate
NH: Cheshire County				
Ozone	Cheshire Co, NH	74	1	Incomplete Data
NH: Manchester				
Ozone	Manchester, NH	365	3	Marginal
NH: Portsmouth-Dover-Rochester				
Ozone	Portsmouth-Dover-Rochester, NH	192	2	Serious
NJ: Atlantic City				
Ozone	Atlantic City, NJ	355	2	Moderate
NM: Anthony				
PM-10	Anthony, NM	3	1	Moderate
NM: Grant County				
SO2	Grant Co, NM	31	1	Primary
NM: Sunland Park				
Ozone	Sunland Park, NM (New Area 1995)	10	1	Marginal
NV: Lake Tahoe Nevada				
CO	Lake Tahoe, NV	29	3	Not Classified
NV: Las Vegas				
CO	Las Vegas, NV	479	1	Serious
PM-10	Clark Co, NV	1,376	1	Serious
NV: Reno				
CO	Reno, NV	179	1	Moderate <= 12.7ppm
Ozone	Reno, NV	339	1	Marginal
PM-10	Washoe Co, NV	339	1	Serious
NY: Albany-Schenectady-Troy				
Ozone	Albany-Schenectady-Troy, NY	892	6	Marginal
NY: Buffalo-Niagara Falls				
Ozone	Buffalo-Niagara Falls, NY	1,170	2	Marginal

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name *Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
NY: Essex County; Whiteface Mountain				
Ozone	Essex Co, NY	0	1	Marginal RT
NY: Jefferson County				
Ozone	Jefferson Co, NY	112	1	Marginal*
NY: Poughkeepsie				
Ozone	Poughkeepsie, NY	600	3	Moderate
NY-NJ-CT: New York-N. New Jersey-Long Island				
Ozone	New York-N. New Jersey-Long Island, NY-NJ-CT	19,171	24	Severe-17
PM-10	New York Co, NY	1,537	1	Moderate
OH: Cleveland-Akron-Lorain				
SO2	Cuyahoga Co, OH	1,095	1	Primary
OH: Toledo				
SO2	Lucas Co, OH	455	1	Primary
OH-KY: Cincinnati-Hamilton				
Ozone	Cincinnati-Hamilton, OH-KY (OH Portion)	1,514	4	Moderate
OH-PA: Youngstown-Warren-Sharon				
Ozone	Youngstown-Warren-Sharon, PA portion	120	1	Marginal
OR: Eugene-Springfield				
PM-10	Eugene-Springfield, OR	179	1	Moderate
OR: Grants Pass				
PM-10	Grants Pass, OR	21	1	Moderate
OR: Klamath Falls				
PM-10	Klamath Falls, OR	20	1	Moderate
OR: LaGrande				
PM-10	LaGrande, OR	12	1	Moderate
OR: Lakeview				
PM-10	Lake Co, OR	3	1	Moderate
OR: Medford				
PM-10	Medford-Ashland, OR	78	1	Moderate
OR: Oakridge				
PM-10	Lane Co, OR	3	1	Moderate
OR: Salem				
CO	Salem, OR	135	2	Not Classified
Ozone	Salem, OR	345	2	Incomplete Data
PA: Altoona				
Ozone	Altoona, PA	129	1	Marginal
PA: Crawford County				
Ozone	Crawford Co, PA	90	1	Incomplete Data

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name		*Population*	*Number of*	
Pollutant	*Nonattainment Area Name*	*(1000s)*	*Counties*	*Classification*
PA: Erie				
Ozone	Erie, PA	281	1	Marginal
PA: Franklin County				
Ozone	Franklin Co, PA	129	1	Incomplete Data
PA: Greene County				
Ozone	Greene Co, PA	41	1	Incomplete Data
PA: Harrisburg-Lebanon-Carlisle				
Ozone	Harrisburg-Lebanon-Carlisle, PA	629	4	Marginal
PA: Johnstown				
Ozone	Johnstown, PA	233	2	Marginal
PA: Juniata County				
Ozone	Juniata Co, PA	23	1	Incomplete Data
PA: Lancaster				
Ozone	Lancaster, PA	471	1	Marginal
PA: Lawrence County				
Ozone	Lawrence Co, PA	95	1	Incomplete Data
PA: Northumberland County				
Ozone	Northumberland Co, PA	95	1	Incomplete Data
PA: Pike County				
Ozone	Pike Co, PA	46	1	Incomplete Data
PA: Pittsburgh-Beaver Valley				
PM-10	Clairton & 4 Boroughs, PA	22	1	Moderate
SO2	Hazelwood, PA	406	1	Primary
SO2	Armstrong Co, PA	5	1	Primary
PA: Schuylkill County				
Ozone	Schuylkill Co, PA	150	1	Incomplete Data
PA: Scranton-Wilkes-Barre				
Ozone	Scranton-Wilkes-Barre, PA	763	5	Marginal
PA: Snyder County				
Ozone	Snyder Co, PA	38	1	Incomplete Data
PA: Susquehanna County				
Ozone	Susquehanna Co, PA	42	1	Incomplete Data
PA: Warren County				
Ozone	Warren Co, PA	44	1	Incomplete Data
SO2	Warren Co, PA	17	1	Primary, Secondary
SO2	Conewango Township (Warren County), PA	4	1	Primary
PA: Wayne County				
Ozone	Wayne Co, PA	48	1	Incomplete Data

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name Pollutant	Nonattainment Area Name	Population (1000s)	Number of Counties	Classification
PA: York				
Ozone	York, PA	473	2	Marginal
PA-DE-NJ-MD: Philadelphia-Wilmington-Trenton				
Ozone	Philadelphia-Wilmington-Trenton, PA-NJ-DE-MD	6,311	14	Severe-15
PA-NJ: Allentown-Bethlehem-Easton				
Ozone	Allentown-Bethlehem-Easton, PA-NJ	740	4	Marginal
SO2	Warren Co, NJ	102	1	Primary, Secondary
PR: Guaynabo County				
PM-10	Mun. of Guaynabo, PR	92	1	Moderate
RI: Providence (all of RI)				
Ozone	Providence (All RI), RI	1,048	5	Serious
TX: Beaumont-Port Arthur				
Ozone	Beaumont-Port Arthur, TX	385	3	Moderate
TX: Dallas-Fort Worth				
Ozone	Dallas-Fort Worth, TX	4,590	4	Serious
TX: El Paso				
CO	El Paso, TX	62	1	Moderate <= 12.7ppm
Ozone	El Paso, TX	680	1	Serious
PM-10	El Paso Co, TX	564	1	Moderate
TX: Houston-Galveston-Brazoria				
Ozone	Houston-Galveston-Brazoria, TX	4,670	8	Severe-17
UT: Ogden				
PM-10	Ogden, UT	77	1	Moderate
UT: Provo				
CO	Provo, UT	119	1	Moderate > 12.7ppm
PM-10	Utah Co, UT	369	1	Moderate
UT: Salt Lake City				
PM-10	Salt Lake Co, UT	898	1	Moderate
SO2	Salt Lake Co, UT	898	1	Primary, Secondary
UT: Tooele County				
SO2	Tooele Co, UT	41	1	Primary, Secondary
VA: Smyth County; White Top Mountain				
Ozone	Smyth Co, VA (White Top Mtn)	0	1	Marginal RT
WA: Spokane				
CO	Spokane, WA	323	1	Serious
PM-10	Spokane Co, WA	205	1	Moderate
WA: Wallula				
PM-10	Wallula, WA	0	1	Serious

Criteria Pollutant Area Summary Report

As of August 27, 2003

State: Simple Name *Pollutant*	*Nonattainment Area Name*	*Population (1000s)*	*Number of Counties*	*Classification*
WA: Yakima				
PM-10	Yakima Co, WA	64	1	Moderate
WI: Milwaukee-Racine				
Ozone	Milwaukee-Racine, WI	1,839	6	Severe-17
WV: Follansbee (Brooke County)				
PM-10	Follansbee, WV	3	1	Moderate
WV: New Manchester-Grant Mag. Dis (Hancock County)				
SO2	New Manchester-Grant Mag. Dis (Hancock), WV	9	1	Primary
WV: Weirton				
PM-10	Weirton, WV	15	2	Moderate
SO2	Weirton, WV	17	1	Primary, Secondary
WV-KY: Huntington-Ashland				
SO2	Boyd County (part), KY	50	1	Primary
WY: Sheridan				
PM-10	Sheridan, WY	16	1	Moderate

Note: The attainment status of Ada County (Boise), Idaho area for PM-10 is on hold pending the approval of a concent de

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ATTACHMENT F

COPIES OF RESULTS OF STACK TESTS FOR VARIOUS PIECES OF PROCESS EQUIPMENT AT PALATKA MILL

Table 1.3-1. CRITERIA POLLUTANT EMISSION FACTORS FOR FUEL OIL COMBUSTION[a]

Firing Configuration (SCC)[a]	SO_2[b]		SO_3[c]		NO_x[d]		CO[e]		Filterable PM[f]	
	Emission Factor (lb/10^3 gal)	EMISSION FACTOR RATING	Emission Factor (lb/10^3 gal)	EMISSION FACTOR RATING	Emission Factor (lb/10^3 gal)	EMISSION FACTOR RATING	Emission Factor (lb/10^3 gal)	EMISSION FACTOR RATING	Emission Factor (lb/10^3 gal)	EMISSION FACTOR RATING
Boilers > 100 Million Btu/hr										
No. 6 oil fired, normal firing (1-01-004-01), (1-02-004-01), (1-03-004-01)	157S	A	5.7S	C	47	A	5	A	9.19(S)+3.22	A
No. 6 oil fired, normal firing, low NO_x burner (1-01-004-01), (1-02-004-01)	157S	A	5.7S	C	40	B	5	A	9.19(S)+3.22	A
No. 6 oil fired, tangential firing, (1-01-004-04)	157S	A	5.7S	C	32	A	5	A	9.19(S)+3.22	A
No. 6 oil fired, tangential firing, low NO_x burner (1-01-004-04)	157S	A	5.7S	C	26	E	5	A	9.19(S)+3.22	A
No. 5 oil fired, normal firing (1-01-004-05), (1-02-004-04)	157S	A	5.7S	C	47	B	5	A	10	B
No. 5 oil fired, tangential firing (1-01-004-06)	157S	A	5.7S	C	32	B	5	A	10	B
No. 4 oil fired, normal firing (1-01-005-04), (1-02-005-04)	150S	A	5.7S	C	47	B	5	A	7	B
No. 4 oil fired, tangential firing (1-01-005-05)	150S	A	5.7S	C	32	B	5	A	7	B
No. 2 oil fired (1-01-005-01), (1-02-005-01), (1-03-005-01)	157S	A	5.7S	C	24	D	5	A	2	A
No.2 oil fired, LNB/FGR, (1-01-005-01), (1-02-005-01), (1-03-005-01)	157S	A	5.7S	A	10	D	5	A	2	A

Table 1.3-1. (cont.)

Firing Configuration (SCC)[a]	SO_2[b]		SO_3[c]		NO_x[d]		CO[e]		Filterable PM[f]	
	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING
Boilers < 100 Million Btu/hr										
No. 6 oil fired (1-02-004-02/03) (1-03-004-02/03)	157S	A	2S	A	55	A	5	A	10	B
No. 5 oil fired (1-03-004-04)	157S	A	2S	A	55	A	5	A	9.19(S)+3.22	A
No. 4 oil fired (1-03-005-04)	150S	A	2S	A	20	A	5	A	7	B
Distillate oil fired (1-02-005-02/03) (1-03-005-02/03)	142S	A	2S	A	20	A	5	A	2	A
Residential furnace (A2104004/A2104011)	142S	A	2S	A	18	A	5	A	0.4[g]	B

[a] To convert from $lb/10^3$ gal to $kg/10^3$ L, multiply by 0.120. SCC = Source Classification Code.

[b] References 1-2,6-9,14,56-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.

[c] References 1-2,6-8,16,57-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.

[d] References 6-7,15,19,22,56-62. Expressed as NO_2. Test results indicate that at least 95% by weight of NO_x is NO for all boiler types except residential furnaces, where about 75% is NO. For utility vertical fired boilers use 105 $lb/10^3$ gal at full load and normal (>15%) excess air. Nitrogen oxides emissions from residual oil combustion in industrial and commercial boilers are related to fuel nitrogen content, estimated by the following empirical relationship: lb $NO_2/10^3$ gal = 20.54 + 104.39(N), where N is the weight % of nitrogen in the oil. For example, if the fuel is 1% nitrogen, then N = 1.

[e] References 6-8,14,17-19,56-61. CO emissions may increase by factors of 10 to 100 if the unit is improperly operated or not well maintained.

[f] References 6-8,10,13-15,56-60,62-63. Filterable PM is that particulate collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Particulate emission factors for residual oil combustion are, on average, a function of fuel oil sulfur content where S is the weight % of sulfur in oil. For example, if fuel oil is 1% sulfur, then S = 1.

[g] Based on data from new burner designs. Pre-1970's burner designs may emit filterable PM as high as 3.0 $lb/10^3$ gal.

Table 1.3-3. EMISSION FACTORS FOR TOTAL ORGANIC COMPOUNDS (TOC), METHANE, AND NONMETHANE TOC (NMTOC) FROM UNCONTROLLED FUEL OIL COMBUSTION[a]

EMISSION FACTOR RATING: A

Firing Configuration (SCC)	TOC[b] Emission Factor (lb/10^3 gal)	Methane[b] Emission Factor (lb/10^3 gal)	NMTOC[b] Emission Factor (lb/10^3 gal)
Utility boilers			
No. 6 oil fired, normal firing (1-01-004-01)	1.04	0.28	0.76
No. 6 oil fired, tangential firing (1-01-004-04)	1.04	0.28	0.76
No. 5 oil fired, normal firing (1-01-004-05)	1.04	0.28	0.76
No. 5 oil fired, tangential firing (1-01-004-06)	1.04	0.28	0.76
No. 4 oil fired, normal firing (1-01-005-04)	1.04	0.28	0.76
No. 4 oil fired, tangential firing (1-01-005-05)	1.04	0.28	0.76
Industrial boilers			
No. 6 oil fired (1-02-004-01/02/03)	1.28	1.00	0.28
No. 5 oil fired (1-02-004-04)	1.28	1.00	0.28
Distillate oil fired (1-02-005-01/02/03)	0.252	0.052	0.2
No. 4 oil fired (1-02-005-04)	0.252	0.052	0.2
Commercial/institutional/residential combustors			
No. 6 oil fired (1-03-004-01/02/03)	1.605	0.475	1.13
No. 5 oil fired (1-03-004-04)	1.605	0.475	1.13
Distillate oil fired (1-03-005-01/02/03)	0.556	0.216	0.34
No. 4 oil fired (1-03-005-04)	0.556	0.216	0.34
Residential furnace (A2104004/A2104011)	2.493	1.78	0.713

[a] To convert from lb/10^3 gal to kg/10^3 L, multiply by 0.12. SCC = Source Classification Code.

[b] References 29-32. Volatile organic compound emissions can increase by several orders of magnitude if the boiler is improperly operated or is not well maintained.

Table 1.3-4. CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE-SPECIFIC EMISSION FACTORS FOR UTILITY BOILERS FIRING RESIDUAL OIL[a]

Particle Size[b] (□m)	Cumulative Mass % □ Stated Size			Cumulative Emission Factor lb/10^3 gal)					
	Uncon-trolled	Controlled		Uncontrolled[c]		ESP Controlled[d]		Scrubber Controlled[e]	
		ESP	Scrubber	Emission Factor	EMISSION FACTOR RATING	Emission Factor	EMISSION FACTOR RATING	Emission Factor	EMISSION FACTOR RATING
15	80	75	100	6.7A	C	0.05A	E	0.50A	D
10	71	63	100	5.9A	C	0.042A	E	0.50A	D
6	58	52	100	4.8A	C	0.035A	E	0.50A	D
2.5	52	41	97	4.3A	C	0.028A	E	0.48A	D
1.25	43	31	91	3.6A	C	0.021A	E	0.46A	D
1.00	39	28	84	3.3A	C	0.018A	E	0.42A	D
0.625	20	20	64	1.7A	C	0.007A	E	0.32A	D
TOTAL	100	100	100	8.3A	C	0.067A	E	0.50A	D

[a] Reference 26. Source Classification Codes 1-01-004-01/04/05/06 and 1-01-005-04/05. To convert from lb/10^3 gal to kg/m^3, multiply by 0.120. ESP = electrostatic precipitator.

[b] Expressed as aerodynamic equivalent diameter.

[c] Particulate emission factors for residual oil combustion without emission controls are, on average, a function of fuel oil grade and sulfur content where S is the weight % of sulfur in the oil. For example, if the fuel is 1.00% sulfur, then S = 1.
No. 6 oil: $A = 1.12(S) + 0.37$
No. 5 oil: $A = 1.2$
No. 4 oil: $A = 0.84$

[d] Estimated control efficiency for ESP is 99.2%.

[e] Estimated control efficiency for scrubber is 94%

Table 1.3-11. EMISSION FACTORS FOR METALS FROM UNCONTROLLED NO. 6 FUEL OIL COMBUSTION[a]

Metal	Average Emission Factor[b, d] (lb/10^3 Gal)	EMISSION FACTOR RATING
Antimony	5.25E-03[c]	E
Arsenic	1.32E-03	C
Barium	2.57E-03	D
Beryllium	2.78E-05	C
Cadmium	3.98E-04	C
Chloride	3.47E-01	D
Chromium	8.45E-04	C
Chromium VI	2.48E-04	C
Cobalt	6.02E-03	D
Copper	1.76E-03	C
Fluoride	3.73E-02	D
Lead	1.51E-03	C
Manganese	3.00E-03	C
Mercury	1.13E-04	C
Molybdenum	7.87E-04	D
Nickel	8.45E-02	C
Phosphorous	9.46E-03	D
Selenium	6.83E-04	C
Vanadium	3.18E-02	D
Zinc	2.91E-02	D

[a] Data are for residual oil fired boilers, Source Classification Codes (SCCs) 1-01-004-01/04.

[b] References 64-72. 18 of 19 sources were uncontrolled and 1 source was controlled with low efficiency ESP. To convert from lb/10^3 gal to kg/10^3 L, multiply by 0.12.

[c] References 29-32,40-44.

[d] For oil/water mixture, reduce factors in proportion to water content of the fuel (due to dilution). To adjust the listed values for water content, multiply the listed value by 1-decimal fraction of water (ex: For fuel with 9 percent water by volume, multiply by 1-0.9=.91).

Table 1.4-1. EMISSION FACTORS FOR NITROGEN OXIDES (NO_x) AND CARBON MONOXIDE (CO) FROM NATURAL GAS COMBUSTION[a]

Combustor Type (MMBtu/hr Heat Input) [SCC]	NO_x[b] Emission Factor ($lb/10^6$ scf)	NO_x[b] Emission Factor Rating	CO Emission Factor ($lb/10^6$ scf)	CO Emission Factor Rating
Large Wall-Fired Boilers (>100) [1-01-006-01, 1-02-006-01, 1-03-006-01]				
Uncontrolled (Pre-NSPS)[c]	280	A	84	B
Uncontrolled (Post-NSPS)[c]	190	A	84	B
Controlled - Low NO_x burners	140	A	84	B
Controlled - Flue gas recirculation	100	D	84	B
Small Boilers (<100) [1-01-006-02, 1-02-006-02, 1-03-006-02, 1-03-006-03]				
Uncontrolled	100	B	84	B
Controlled - Low NO_x burners	50	D	84	B
Controlled - Low NO_x burners/Flue gas recirculation	32	C	84	B
Tangential-Fired Boilers (All Sizes) [1-01-006-04]				
Uncontrolled	170	A	24	C
Controlled - Flue gas recirculation	76	D	98	D
Residential Furnaces (<0.3) [No SCC]				
Uncontrolled	94	B	40	B

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. To convert from $lb/10^6$ scf to $kg/10^6\ m^3$, multiply by 16. Emission factors are based on an average natural gas higher heating value of 1,020 Btu/scf. To convert from $lb/10^6$ scf to lb/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. SCC = Source Classification Code. ND = no data. NA = not applicable.

[b] Expressed as NO_2. For large and small wall fired boilers with SNCR control, apply a 24 percent reduction to the appropriate NO_x emission factor. For tangential-fired boilers with SNCR control, apply a 13 percent reduction to the appropriate NO_x emission factor.

[c] NSPS=New Source Performance Standard as defined in 40 CFR 60 Subparts D and Db. Post-NSPS units are boilers with greater than 250 MMBtu/hr of heat input that commenced construction modification, or reconstruction after August 17, 1971, and units with heat input capacities between 100 and 250 MMBtu/hr that commenced construction modification, or reconstruction after June 19, 1984.

TABLE 1.4-2. EMISSION FACTORS FOR CRITERIA POLLUTANTS AND GREENHOUSE GASES FROM NATURAL GAS COMBUSTION[a]

Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
CO_2[b]	120,000	A
Lead	0.0005	D
N_2O (Uncontrolled)	2.2	E
N_2O (Controlled-low-NO_X burner)	0.64	E
PM (Total)[c]	7.6	D
PM (Condensable)[c]	5.7	D
PM (Filterable)[c]	1.9	B
SO_2[d]	0.6	A
TOC	11	B
Methane	2.3	B
VOC	5.5	C

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. To convert from $lb/10^6$ scf to 1b/MMBtu, divide by 1,020. The emission factors in this table may be converted to other natural gas heating values by multiplying the given emission factor by the ratio of the specified heating value to this average heating value. TOC = Total Organic Compounds. VOC = Volatile Organic Compounds.

[b] Based on approximately 100% conversion of fuel carbon to CO_2. $CO_2[lb/10^6 \text{ scf}] = (3.67)(CON)(C)(D)$, where CON = fractional conversion of fuel carbon to CO_2, C = carbon content of fuel by weight (0.76), and D = density of fuel, $4.2x10^4$ $lb/10^6$ scf.

[c] All PM (total, condensible, and filterable) is assumed to be less than 1.0 micrometer in diameter. Therefore, the PM emission factors presented here may be used to estimate PM_{10}, $PM_{2.5}$ or PM_1 emissions. Total PM is the sum of the filterable PM and condensible PM. Condensible PM is the particulate matter collected using EPA Method 202 (or equivalent). Filterable PM is the particulate matter collected on, or prior to, the filter of an EPA Method 5 (or equivalent) sampling train.

[d] Based on 100% conversion of fuel sulfur to SO_2. Assumes sulfur content is natural gas of 2,000 grains/10^6 scf. The SO_2 emission factor in this table can be converted to other natural gas sulfur contents by multiplying the SO_2 emission factor by the ratio of the site-specific sulfur content (grains/10^6 scf) to 2,000 grains/10^6 scf.

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION[a]

CAS No.	Pollutant	Emission Factor (lb/10^6 scf)	Emission Factor Rating
91-57-6	2-Methylnaphthalene[b, c]	2.4E-05	D
56-49-5	3-Methylchloranthrene[b, c]	<1.8E-06	E
	7,12-Dimethylbenz(a)anthracene[b,c]	<1.6E-05	E
83-32-9	Acenaphthene[b,c]	<1.8E-06	E
203-96-8	Acenaphthylene[b,c]	<1.8E-06	E
120-12-7	Anthracene[b,c]	<2.4E-06	E
56-55-3	Benz(a)anthracene[b,c]	<1.8E-06	E
71-43-2	Benzene[b]	2.1E-03	B
50-32-8	Benzo(a)pyrene[b,c]	<1.2E-06	E
205-99-2	Benzo(b)fluoranthene[b,c]	<1.8E-06	E
191-24-2	Benzo(g,h,i)perylene[b,c]	<1.2E-06	E
205-82-3	Benzo(k)fluoranthene[b,c]	<1.8E-06	E
106-97-8	Butane	2.1E+00	E
218-01-9	Chrysene[b,c]	<1.8E-06	E
53-70-3	Dibenzo(a,h)anthracene[b,c]	<1.2E-06	E
25321-22-6	Dichlorobenzene[b]	1.2E-03	E
74-84-0	Ethane	3.1E+00	E
206-44-0	Fluoranthene[b,c]	3.0E-06	E
86-73-7	Fluorene[b,c]	2.8E-06	E
50-00-0	Formaldehyde[b]	7.5E-02	B
110-54-3	Hexane[b]	1.8E+00	E
193-39-5	Indeno(1,2,3-cd)pyrene[b,c]	<1.8E-06	E
91-20-3	Naphthalene[b]	6.1E-04	E
109-66-0	Pentane	2.6E+00	E
85-01-8	Phenanathrene[b,c]	1.7E-05	D

TABLE 1.4-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS FROM NATURAL GAS COMBUSTION (Continued)

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
74-98-6	Propane	1.6E+00	E
129-00-0	Pyrene[b, c]	5.0E-06	E
108-88-3	Toluene[b]	3.4E-03	C

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. To convert from $1b/10^6$ scf to lb/MMBtu, divide by 1,020. Emission Factors preceeded with a less-than symbol are based on method detection limits.

[b] Hazardous Air Pollutant (HAP) as defined by Section 112(b) of the Clean Air Act.

[c] HAP because it is Polycyclic Organic Matter (POM). POM is a HAP as defined by Section 112(b) of the Clean Air Act.

[d] The sum of individual organic compounds may exceed the VOC and TOC emission factors due to differences in test methods and the availability of test data for each pollutant.

TABLE 1.4-4. EMISSION FACTORS FOR METALS FROM NATURAL GAS COMBUSTION[a]

CAS No.	Pollutant	Emission Factor ($lb/10^6$ scf)	Emission Factor Rating
7440-38-2	Arsenic[b]	2.0E-04	E
7440-39-3	Barium	4.4E-03	D
7440-41-7	Beryllium[b]	<1.2E-05	E
7440-43-9	Cadmium[b]	1.1E-03	D
7440-47-3	Chromium[b]	1.4E-03	D
7440-48-4	Cobalt[b]	8.4E-05	D
7440-50-8	Copper	8.5E-04	C
7439-96-5	Manganese[b]	3.8E-04	D
7439-97-6	Mercury[b]	2.6E-04	D
7439-98-7	Molybdenum	1.1E-03	D
7440-02-0	Nickel[b]	2.1E-03	C
7782-49-2	Selenium[b]	<2.4E-05	E
7440-62-2	Vanadium	2.3E-03	D
7440-66-6	Zinc	2.9E-02	E

[a] Reference 11. Units are in pounds of pollutant per million standard cubic feet of natural gas fired. Data are for all natural gas combustion sources. Emission factors preceeded by a less-than symbol are based on method detection limits. To convert from $lb/10^6$ scf to $kg/10^6$ m^3, multiply by 16. To convert from $lb/10^6$ scf to 1b/MMBtu, divide by 1,020.

[b] Hazardous Air Pollutant as defined by Section 112(b) of the Clean Air Act.

Table 1.6-1. EMISSION FACTORS FOR PM FROM WOOD RESIDUE COMBUSTION[a]

Fuel	PM Control Device	Filterable PM		Filterable PM-10[b]		Filterable PM-2.5[b]	
		Emission Factor (lb/MMbtu)	EMISSION FACTOR RATING	Emission Factor (lb/MMbtu)	EMISSION FACTOR RATING	Emission Factor (lb/MMbtu)	EMISSION FACTOR RATING
Bark/Bark and Wet Wood	No Control[c]	0.56[d]	C	0.50[e]	D	0.43[e]	D
Dry Wood	No Control[c]	0.40[f]	A	0.36[e]	D	0.31[e]	D
Wet Wood	No Control[c]	0.33[g]	A	0.29[e]	D	0.25[e]	D
Bark	Mechanical Collector	0.54[h]	D	0.49[e]	D	0.29[e]	D
Bark and Wet Wood	Mechanical Collector	0.35[i]	C	0.32[e]	D	0.19[e]	D
Dry Wood	Mechanical Collector	0.30[j]	A	0.27[e]	D	0.16[e]	D
Wet Wood	Mechanical Collector	0.22[k]	A	0.20[e]	D	0.12[e]	D
All Fuels[m]	Electrolyzed Gravel Bed	0.1[m]	D	0.074[e]	D	0.065[e]	D
All Fuels[m]	Wet Scrubber	0.066[n]	A	0.065[e]	D	0.065[e]	D
All Fuels[m]	Fabric Filter	0.1[o]	C	0.074[e]	D	0.065[e]	
All Fuels[m]	Electrostatic Precipitator	0.054[p]	B	0.04[e]	D	0.035[e]	
		Condensible PM					
All Fuels[m]	All Controls/No Controls	0.017[q]	A				

Table 1.6-2. EMISSION FACTORS FOR NO_x, SO_2, AND CO FROM WOOD RESIDUE COMBUSTION[a]

Source Category[c]	NO_x[b]		SO_2[b]		CO[b]	
	Emission Factor (lb/MMbtu)	EMISSION FACTOR RATING	Emission Factor (lb/MMBtu)	EMISSION FACTOR RATING	Emission Factor (lb/MMbtu)	EMISSION FACTOR RATING
Bark/bark and wet wood/wet wood-fired boiler	0.22[d]	A	0.025[e]	A	0.60[f,g,i,j]	A
Dry wood-fired boilers	0.49[h]	C	0.025[e]	A	0.60[f,g,i,j]	A

[a] Units of lb of pollutant/million Btu (MMBtu) of heat input. To convert from lb/MMBtu to lb/ton, multiply by (HHV * 2000), where HHV is the higher heating value of the fuel, MMBtu/lb. To convert lb/MMBtu to kg/J, multiply by 4.3E-10. NO_x = Nitrogen oxides, SO_2 = Sulfur dioxide, CO = Carbon monoxide.

[b] Factors represent boilers with no controls or with particulate matter controls.

[c] These factors apply to Source Classification Codes (SCC) 1-0X-009-YY, where X = 1 for utilities, 2 for industrial, and 3 for commercial/institutional, and where Y = 01 for bark-fired boiler, 02 for bark and wet wood-fired boiler, 03 for wet wood-fired boiler, and 08 for dry wood-fired boiler.

[d] References 19, 33, 34, 39, 40, 41, 55, 62-64, 67, 70, 72, 78, 79, 88-89.

[e] References 26, 45, 50, 72, 88-89.

[f] References 26, 59, 88-89.

[g] References 19, 26, 39-41, 60-64, 67, 68, 70, 75, 79, 88-89.

[h] References 30, 34, 45, 50, 80, 81, 88-89.

[i] References 26, 30, 45-51, 80-82, 88-89.

[j] Emission factor is for stokers and dutch ovens/fuel cells. References 26, 34, 36, 55, 60, 65, 71, 72, 75. **CO Factor for fluidized bed combustors is 0.17 lb/MMbtu.** References 26, 72, 88-89.

Table 1.6-3. EMISSION FACTORS FOR SPECIATED ORGANIC COMPOUNDS, TOC, VOC, NITROUS OXIDE, AND CARBON DIOXIDE FROM WOOD RESIDUE COMBUSTION[a]

Organic Compound	Average Emission Factor[b] (lb/MMBtu)	EMISSION FACTOR RATING
Acenaphthene	**9.1 E-07[c]**	B
Acenaphthylene	**5.0 E-06[d]**	A
Acetaldehyde	**8.3 E-04[e]**	A
Acetone	**1.9 E-04[f]**	D
Acetophenone	**3.2 E-09[g]**	D
Acrolein	**4.0 E-03[h]**	C
Anthracene	**3.0 E-06[i]**	A
Benzaldehyde	**<8.5 E-07[j]**	D
Benzene	**4.2 E-03[k]**	A
Benzo(a)anthracene	**6.5 E-08[l]**	B
Benzo(a)pyrene	**2.6 E-06[m]**	A
Benzo(b)fluoranthene	**1.0 E-07[l]**	B
Benzo(e)pyrene	**2.6 E-09[f]**	D
Benzo(g,h,i)perylene	**9.3 E-08[n]**	B
Benzo(j,k)fluoranthene	**1.6 E-07[o]**	D
Benzo(k)fluoranthene	**3.6 E-08[p]**	B
Benzoic acid	**4.7 E-08[q]**	D
bis(2-Ethylhexyl)phthalate	**4.7 E-08[g]**	D
Bromomethane	**1.5 E-05[f]**	D
2-Butanone (MEK)	**5.4 E-06[f]**	D
Carbazole	**1.8 E-06[f]**	D
Carbon tetrachloride	**4.5 E-05[r]**	D
Chlorine	**7.9 E-04[s]**	D
Chlorobenzene	**3.3 E-05[f]**	D
Chloroform	**2.8 E-05[f]**	D
Chloromethane	**2.3 E-05[f]**	D
2-Chloronaphthalene	**2.4 E-09[f]**	D
2-Chlorophenol	**2.4 E-08[u]**	C
Chrysene	**3.8 E-08[c]**	B
Crotonaldehyde	**9.9 E-06[j]**	D
Decachlorobiphenyl	**2.7 E-10[r]**	D
Dibenzo(a,h)anthracene	**9.1 E-09[l]**	B
1,2-Dibromoethene	**5.5 E-05[f]**	D
Dichlorobiphenyl	**7.4 E-10[r]**	C
1,2-Dichloroethane	**2.9 E-05[r]**	D
Dichloromethane	**2.9 E-04[v]**	D
1,2-Dichloropropane	**3.3 E-05[f]**	D
2,4-Dinitrophenol	**1.8 E-07[w]**	C
Ethylbenzene	**3.1 E-05[f]**	D
Fluoranthene	**1.6 E-06[x]**	B
Fluorene	**3.4 E-06[i]**	A
Formaldehyde	**4.4 E-03[y]**	A
Heptachlorobiphenyl	**6.6E-11[r]**	D

Table 1.6-3. (cont.)

Organic Compound	Average Emission Factor[b] (lb/MMBtu)	EMISSION FACTOR RATING
Hexachlorobiphenyl	**5.5 E-10[r]**	D
Hexanal	**7.0 E-06[z]**	D
Heptachlorodibenzo-p-dioxins	**2.0 E-09[aa]**	C
Heptachlorodibenzo-p-furans	**2.4 E-10[aa]**	C
Hexachlorodibenzo-p-dioxins	**1.6 E-06[aa]**	C
Hexachlorodibenzo-p-furans	**2.8 E-10[aa]**	C
Hydrogen chloride	**1.9 E-02[j]**	C
Indeno(1,2,3,c,d)pyrene	**8.7 E-08[l]**	B
Isobutyraldehyde	**1.2 E-05[z]**	D
Methane	**2.1 E-02[f]**	C
2-Methylnaphthalene	**1.6 E-07[z]**	D
Monochlorobiphenyl	**2.2 E-10[r]**	D
Naphthalene	**9.7 E-05[ab]**	A
2-Nitrophenol	**2.4 E-07[w]**	C
4-Nitrophenol	**1.1 E-07[w]**	C
Octachlorodibenzo-p-dioxins	**6.6 E-08[aa]**	B
Octachlorodibenzo-p-furans	**8.8 E-11[aa]**	C
Pentachlorodibenzo-p-dioxins	**1.5 E-09[aa]**	B
Pentachlorodibenzo-p-furans	**4.2 E-10[aa]**	C
Pentachlorobiphenyl	**1.2 E-09[r]**	D
Pentachlorophenol	**5.1 E-08[ac]**	C
Perylene	**5.2 E-10[f]**	D
Phenanthrene	**7.0 E-06[ad]**	B
Phenol	**5.1 E-05[ae]**	C
Propanal	**3.2 E-06[z]**	D
Propionaldehyde	**6.1 E-05[f]**	D
Pyrene	**3.7 E-06[af]**	A
Styrene	**1.9 E-03[f]**	D
2,3,7,8-Tetrachlorodibenzo-p-dioxins	**8.6 E-12[aa]**	C
Tetrachlorodibenzo-p-dioxins	**4.7 E-10[ag]**	C
2,3,7,8-Tetrachlorodibenzo-p-furans	**9.0 E-11[aa]**	C
Tetrachlorodibenzo-p-furans	**7.5 E-10[aa]**	C
Tetrachlorobiphenyl	**2.5 E-09[r]**	D
Tetrachloroethene	**3.8 E-05[t]**	D
o-Tolualdehyde	**7.2 E-06[j]**	D
p-Tolualdehyde	**1.1 E-05[z]**	D
Toluene	**9.2 E-04[v]**	C
Trichlorobiphenyl	**2.6 E-09[r]**	C
1,1,1-Trichloroethane	**3.1 E-05[t]**	D
Trichloroethene	**3.0 E-05[t]**	D
Trichlorofluoromethane	**4.1 E-05**	D
2,4,6-Trichlorophenol	**<2.2 E-08[ak]**	C

Table 1.6-3. (cont.)

Organic Compound	Average Emission Factor[b] (lb/MMBtu)	EMISSION FACTOR RATING
Vinyl Chloride	**1.8 E-05**[r]	D
o-Xylene	**2.5 E-05**[v]	D
Total organic compounds (TOC)	**0.039**[ai]	D
Volatile organic compounds (VOC)	**0.017**[aj]	D
Nitrous Oxide (N_2O)	**0.013**[ak]	D
Carbon Dioxide (CO_2)	**195**[al]	A

[a] Units of lb of pollutant/million Btu (MMBtu) of heat input. To convert from lb/MMBtu to lb/ton, multiply by (HHV * 2000), where HHV is the higher heating value of the fuel, MMBtu/lb. To convert lb/MMBtu to kg/J, multiply by 4.3E-10. These factors apply to Source Classification Codes (SCC) 1-0X-009-YY, where X = 1 for utilities, 2 for industrial, and 3 for commercial/institutional, and where Y = 01 for bark-fired boiler, 02 for bark and wet wood-fired boiler, 03 for wet wood-fired boiler, and 08 for dry wood-fired boiler.

[b] Factors are for boilers with no controls or with particulate matter controls.

[c] References 26, 34, 36, 59, 60, 65, 71-73, 75.

[d] References 26, 33, 34, 36, 59, 60, 65, 71-73, 75.

[e] References, 26, 35, 36, 46, 50, 59, 60, 65, 71-75.

[f] Reference 26.

[g] Reference 33.

[h] Reference 26, 50, 83.

[i] References 26, 34, 36, 59, 60, 65, 71-73, 75.

[j] References 26, 50.

[k] References 26, 35, 36, 46, 59, 60, 65, 70, 71-75.

[l] References 26, 36, 59, 60, 65, 70-75.

[m] References 26, 33, 36, 59, 60, 65, 70-73, 75.

[n] References 26, 33, 36, 59, 60, 65, 71-73, 75.

[o] Reference 34.

[p] References 26, 36, 60, 65, 71-75.

[q] References 26, 33.

[r] References 26.

[s] Reference 83.

[t] References 26, 72.

[u] References 35, 60, 65, 71, 72.

[v] References 26, 72.

[w] References 35, 60, 65, 71, 72.

[x] References 26, 33, 34, 59, 60, 65, 71-75.

[y] References 26, 28, 35, 36, 46 - 51, 59, 60, 65, 70, 71-75, 79, 81, 82.

[z] Reference 50.

[aa] Reference 26, 45.

[ab] References 26, 33, 34, 36, 59, 60, 65, 71-75, 83.

[ac] References 26, 35, 60, 65, 71, 72.

[ad] References 26, 33, 34, 36, 59, 60, 65, 71 - 73.

[ae] References 26, 33, 34, 35, 60, 65, 70, 71, 72.

[af] References 26, 33, 34, 36, 59, 60, 65, 71 - 73, 83.

[ag] References 26, 45.

[ah] References 26, 35, 60, 65, 71.

[ai] TOC = total organic compounds. Factor is the sum of all factors in table except nitrous oxide and carbon dioxide.

[aj] VOC volatile organic compounds. Factor is the sum of all factors in table except hydrogen chloride, chlorine, formaldehyde, tetrachloroethene, 1,1,1,-trichloroethane, dichloromethane, acetone, nitrous oxide, methane, and carbon dioxide.

[ak] Reference 83.

[al] References 19 - 26, 33 - 49, 51- 57, 77, 79 - 82, 84 - 86.

Table 1.6-4. EMISSION FACTORS FOR TRACE ELEMENTS FROM WOOD RESIDUE COMBUSTION[a]

Trace Element	Average Emission Factor (lb/MMBtu)[b]	EMISSION FACTOR RATING
Antimony	**7.9 E-06**[c]	C
Arsenic	**2.2 E-05**[d]	A
Barium	**1.7 E-04**[c]	C
Beryllium	**1.1 E-06**[e]	B
Cadmium	**4.1 E-06**[f]	A
Chromium, total	**2.1 E-05**[g]	A
Chromium, hexavalent	**3.5 E-06**[h]	C
Cobalt	**6.5 E-06**[i]	C
Copper	**4.9 E-05**[g]	A
Iron	**9.9 E-04**[k]	C
Lead	**4.8 E-05**[l]	A
Manganese	**1.6 E-03**[d]	A
Mercury	**3.5 E-06**[m]	A
Molybdenum	**2.1 E-06**[c]	D
Nickel	**3.3 E-05**[n]	A
Phosphorus	**2.7 E-05**[c]	D
Potassium	**3.9 E-02**[c]	D
Selenium	**2.8 E-06**[o]	A
Silver	**1.7 E-03**[p]	D
Sodium	**3.6 E-04**[c]	D
Strontium	**1.0 E-05**[c]	D
Tin	**2.3 E-05**[c]	D
Titanium	**2.0 E-05**[c]	D
Vanadium	**9.8 E-07**[c]	D
Yttrium	**3.0 E-07**[c]	D
Zinc	**4.2 E-04**[o]	A

[a] Units of lb of pollutant/million Btu (MMBtu) of heat input. To convert from lb/MMBtu to lb/ton, multiply by (HHV * 2000), where HHV is the higher heating value of the fuel, MMBtu/lb. To convert lb/MMBtu to kg/J, multiply by 4.3E-10. These factors apply to Source Classification Codes (SCC) 1-0X-009-YY, where X = 1 for utilities, 2 for industrial, and 3 for commercial/institutional, and where Y = 01 for bark-fired boiler, 02 for bark and wet wood-fired boiler, 03 for wet wood-fired boiler, and 08 for dry wood-fired boiler.

[b] Factors are for boilers with no controls or with particulate matter controls.

[c] Reference 26.

[d] References 26, 33, 36, 46, 59, 60, 65, 71-73, 75, 81.

[e] References 26, 35, 36, 46, 59, 60, 65, 71-73, 75.

[f] References 26, 35, 36, 42, 46, 59, 60, 65, 71-73, 75, 81.

[g] References 26, 34, 35, 36, 42, 59, 60, 65, 71-73, 75, 81.

[h] References 26, 36, 46, 59, 60, 71, 72, 73, 75.

[i] References 26, 34, 83.

[j] References 26, 33-36, 46, 59, 60, 65, 71-73, 75, 81.

[k] References 26, 71, 72, 81.

[l] References 26, 33-36, 46, 59, 60, 65, 71-73, 75.

[m] References 26, 35, 36, 46, 59, 60, 65, 71-73, 75, 81.

[n] References 26, 33 - 36, 46, 59, 60, 65, 71-73, 75, 81.

[o] References 26, 33, 35, 46, 59, 60, 65, 71-73, 75, 81.

[p] Reference 34.

Table 1.6-5. CUMULATIVE PARTICLE SIZE DISTRIBUTION AND SIZE-SPECIFIC EMISSION FACTORS FOR WOOD/BARK-FIRED BOILERS[a]

EMISSION FACTOR RATING: E

Particle Size[b] (µm)	Cumulative Mass % ≤ Stated Size				
		Controlled			
	Uncontrolled[c]	Multiple Cyclone[d]	Multiple Cyclone[e]	Scrubber[f]	Dry Electrostatic Granular Filter (DEGF)
15	94	96	35	98	77
10	90	91	32	98	74
6	86	80	27	98	69
2.5	76	54	16	98	65
1.25	69	30	8	96	61
1.00	67	24	6	95	58
0.625	ND	16	3	ND	51
Total	100	100	100	100	100

[a] Reference 89.

[b] Expressed as aerodynamic equivalent diameter.

[c] From data on underfeed stokers. May also be used as size distribution for wood-fired boilers.

[d] From data on spreader stokers with flyash reinjection.

[e] From data on spreader stokers without flyash reinjection.

[f] From data on Dutch ovens. Assumed control efficiency is 94%.

13.2.1.3 Predictive Emission Factor Equations [10]

The quantity of particulate emissions from resuspension of loose material on the road surface due to vehicle travel on a dry paved road may be estimated using the following empirical expression:

$$E = k\left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5} - C \qquad (1)$$

where:
E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m^2),
W = average weight (tons) of the vehicles traveling the road, and
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

It is important to note that Equation 1 calls for the average weight of all vehicles traveling the road. For example, if 99 percent of traffic on the road are 2 ton cars/trucks while the remaining 1 percent consists of 20 ton trucks, then the mean weight "W" is 2.2 tons. More specifically, Equation 1 is *not* intended to be used to calculate a separate emission factor for each vehicle weight class. Instead, only one emission factor should be calculated to represent the "fleet" average weight of all vehicles traveling the road.

The particle size multiplier (k) above varies with aerodynamic size range as shown in Table 13.2.1-1. To determine particulate emissions for a specific particle size range, use the appropriate value of k shown in Table 13.2.1-1.

The emission factors for the exhaust, brake wear and tire wear of a 1980's vehicle fleet (C) was obtained from EPA's MOBILE6.2 model [28]. The emission factor also varies with aerodynamic size range

Table 13.2-1.1. PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Size range[a]	Particle Size Multiplier k[b]		
	g/VKT	g/VMT	lb/VMT
PM-2.5[c]	1.1	1.8	0.0040
PM-10	4.6	7.3	0.016
PM-15	5.5	9.0	0.020
PM-30[d]	24	38	0.082

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.

[c] Ratio of PM-2.5 to PM-10 taken from Reference 22.

[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

as shown in Table 13.2.1-2.

Table 13.2.1-2. EMISSION FACTOR FOR 1980'S VEHICLE FLEET EXHAUST, BRAKE WEAR AND TIRE WEAR

Particle Size Range[a]	*C*, Emission Factor for Exhaust, Brake Wear and Tire Wear[b]		
	g/VMT	g/VKT	lb/VMT
$PM_{2.5}$	0.1617	0.1005	0.00036
PM_{10}	0.2119	0.1317	0.00047
PM_{15}	0.2119	0.1317	0.00047
PM_{30}[c]	0.2119	0.1317	0.00047

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT).

[c] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Equation 1 is based on a regression analysis of numerous emission tests, including 65 tests for PM-10.[10] Sources tested include public paved roads, as well as controlled and uncontrolled industrial paved roads. All sources tested were of freely flowing vehicles traveling at constant speed on relatively level roads. No tests of "stop-and-go" traffic or vehicles under load were available for inclusion in the data base. The equations retain the quality rating of A (B for PM-2.5), if applied within the range of source conditions that were tested in developing the equation as follows:

Silt loading:	0.03 - 400 g/m^2 0.04 - 570 grains/square foot (ft^2)
Mean vehicle weight:	1.8 - 38 megagrams (Mg) 2.0 - 42 tons
Mean vehicle speed:	16 - 88 kilometers per hour (kph) 10 - 55 miles per hour (mph)

Note: There may be situations where low silt loading and/or low average weight will yield calculated negative emissions from equation 1. If this occurs, the emissions calculated from equation 1 should be set to zero.

Users are cautioned that application of equation 1 outside of the range of variables and operating conditions specified above, e.g., application to roadways or road networks with speeds below 10 mph and with stop-and-go traffic, will result in emission estimates with a higher level of uncertainty. In these situations, users are encouraged to consider alternative methods that are

The following empirical expressions may be used to estimate the quantity in pounds (lb) of size-specific particulate emissions from an unpaved road, per vehicle mile traveled (VMT):

For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated from the following equation:

$$E = k\ (s/12)^a (W/3)^b \tag{1a}$$

and, for vehicles traveling on publicly accessible roads, dominated by light duty vehicles, emissions may be estimated from the following:

$$E = \frac{k\ (s/12)^a (S/30)^d}{(M/0.5)^c} - C \tag{1b}$$

where k, a, b, c and d are empirical constants (Reference 6) given below and

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
M = surface material moisture content (%)
S = mean vehicle speed (mph)
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

The source characteristics s, W and M are referred to as correction parameters for adjusting the emission estimates to local conditions. The metric conversion from lb/VMT to grams (g) per vehicle kilometer traveled (VKT) is as follows:

1 lb/VMT = 281.9 g/VKT

The constants for Equations 1a and 1b based on the stated aerodynamic particle sizes are shown in Tables 13.2.2-2 and 13.2.2-4.

Table 13.2.2-2. CONSTANTS FOR EQUATIONS 1a AND 1b

Constant	Industrial Roads (Equation 1a)			Public Roads (Equation 1b)		
	PM-2.5	PM-10	PM-30*	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.23	1.5	4.9	0.27	1.8	6.0
a	0.9	0.9	0.7	1	1	1
b	0.45	0.45	0.45	-	-	-
c	-	-	-	0.2	0.2	0.3
d	-	-	-	0.5	0.5	0.3
Quality Rating	C	B	B	C	B	B

*Assumed equivalent to total suspended particulate matter (TSP)
"-" = not used in the emission factor equation

Table 13.2.2-2 also contains the quality ratings for the various size-specific versions of Equation 1a and 1b. The equation retains the assigned quality rating, if applied within the ranges of source conditions, shown in Table 13.2.2-3, that were tested in developing the equation:

Table 13.2.2-3. RANGE OF SOURCE CONDITIONS USED IN DEVELOPING EQUATION 1a AND 1b

Emission Factor	Surface Silt Content, %	Mean Vehicle Weight		Mean Vehicle Speed		Mean No. of Wheels	Surface Moisture Content, %
		Mg	ton	km/hr	mph		
Industrial Roads (Equation 1a)	1.8-25.2	1.8-260	2-290	8-69	5-43	4-17[a]	0.03-13
Public Roads (Equation 1b)	1.8-35	1.4-2.7	1.5-3	16-88	10-55	4-4.8	0.03-13

[a] See discussion in text.

As noted earlier, the models presented as Equations 1a and 1b were developed from tests of traffic on unpaved surfaces. Unpaved roads have a hard, generally nonporous surface that usually dries quickly after a rainfall or watering, because of traffic-enhanced natural evaporation. (Factors influencing how fast a road dries are discussed in Section 13.2.2.3, below.) The quality ratings given above pertain to the mid-range of the measured source conditions for the equation. A higher mean vehicle weight and a higher than normal traffic rate may be justified when performing a worst-case analysis of emissions from unpaved roads.

The emission factors for the exhaust, brake wear and tire wear of a 1980's vehicle fleet (*C*) was

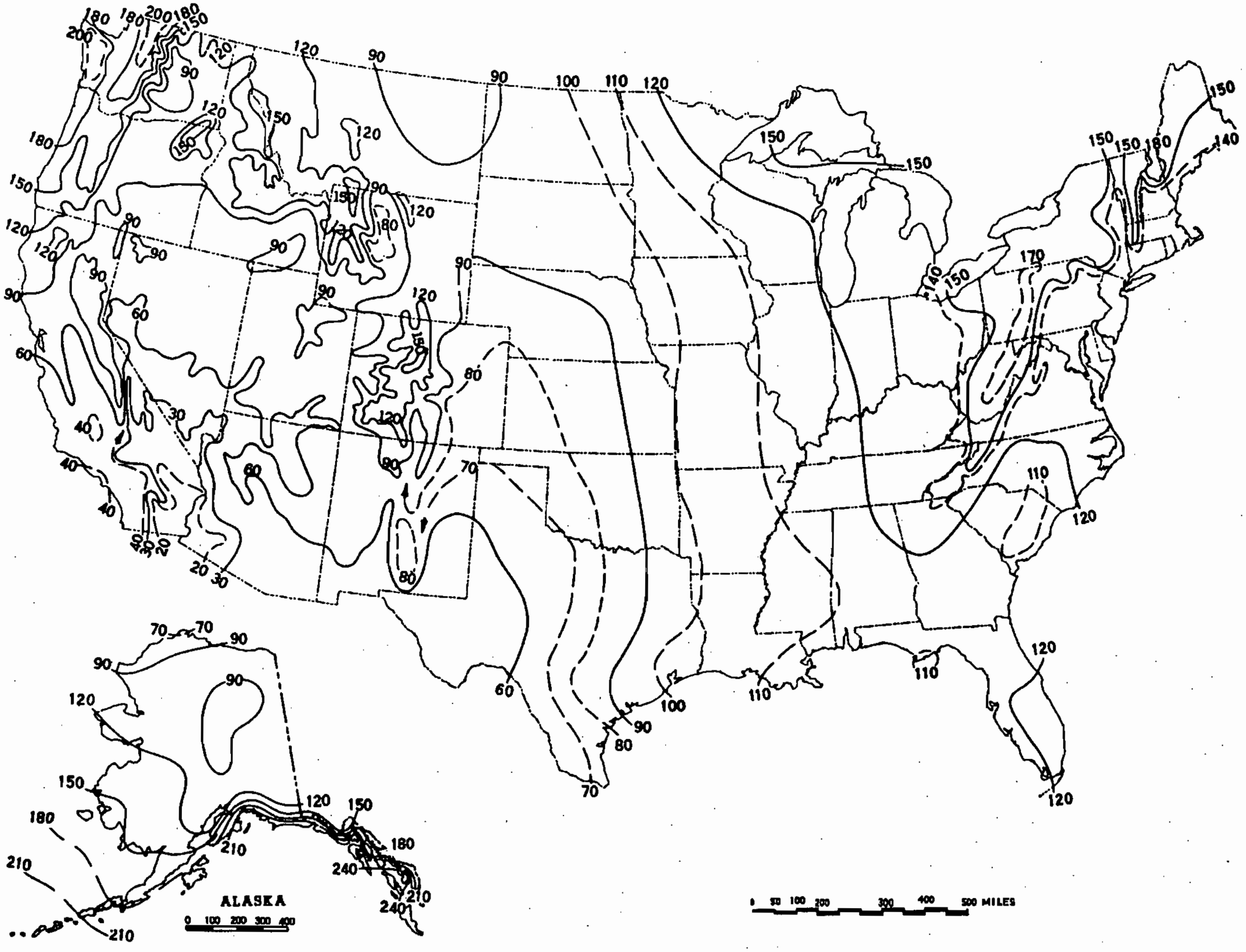

Figure 13.2.2-1. Mean number of days with 0.01 inch or more of precipitation in United States.

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

			Silt Content (%)			Moisture Content (%)		
Industry	No. Of Facilities	Material	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.

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]

$$E = k(0.0016)\ \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}\ \text{(kg/megagram [Mg])} \tag{1}$$

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

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	0.11

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

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NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

EMISSION FACTORS FOR NO_X, SO_2, AND VOLATILE ORGANIC COMPOUNDS FOR BOILERS, KRAFT PULP MILLS, AND BLEACH PLANTS

TECHNICAL BULLETIN NO. 646

FEBRUARY 1993

TABLE 9 NDCE KRAFT RECOVERY FURNACE NO_x EMISSION FACTORS FROM COMPLIANCE TEST DATA - CURRENT OPERATIONS

MILL CODE	FURNACE Make	FURNACE Install Year	FURNACE Rebuild Year	BLACK LIQUOR SOLIDS RATE, 10^6 lb/day	LIQUOR SOLIDS, PERCENT	AVERAGE NO_x @ 8% O_2, ppm	NO_x, lb/ADTP Average	NO_x, lb/ADTP Range	NO_x, lb/per 10^6 Btu Average	NO_x, lb/per 10^6 Btu Range	DATE TESTED
RA	GOT	1989	None	4.08	68.0	71.0	2.55	-	0.124[a]	-	1989/90
RB	B&W	1966	1988	2.79	70.9 to 73.0	64.7	1.91	1.89 to 2.01	0.113[a]	0.112 to 0.118	1989
RC	B&W	1977	1992	1.94	62.5	67.0	3.01	-	0.171[a]	-	1989
RD	GOT	1984	1991	5.5	70.0	66.4	1.78	-	0.116[a]	-	1989
RE	B&W	1976	1990	2.66	68.5	69.0	2.24	2.20 to 2.30	0.121[a]	0.119 to 0.124	1991
RF	CE	1976	None	3.01	65.0	53.0	2.17	1.89 to 2.48	0.092[a]	0.080 to 0.105	1991
RG	B&W	1991	1992	4.20	70.0	70.0	1.96	1.86 to 2.04	0.122[a]	0.111 to 0.134	1991
RH	CE	1991	None	1.80	69.0	92.0	2.83	2.56 to 3.10	0.161[a]	0.136 to 0.180	1991
RI	B&W	1990	None	5.00	NA	85.0	1.76	1.70 to 1.81	0.148[a]	0.143 to 0.152	1990
RJ	B&W	1976	1991	4.32	72.0	94.8	3.45	2.96 to 3.90	0.177[a]	0.152 to 0.200	1991
RK	GOT	1991	None	5.98	75.0	73.5	1.83	1.73 to 1.92	0.138[a]	0.096 to 0.106	1992
all eleven furnaces						73.3	2.32	1.70 to 3.90	0.130	0.080 to 0.200	

Notes

Data for furnaces with mill codes RA to RI were reported in NCASI Technical Bulletin No. 636 (July 1992)

[a] - ppm values are converted to lb/10^6 Btu using an assumed "F" factor for black liquor of 9000 dscf/10^6 Btu.

TABLE 11 KRAFT RECOVERY FURNACE VOC EMISSION FACTORS

MILL	FURNACE	VOC, as lb C/ADTP		VOC, as lb C/10^6 Btu		DATE	
CODE	TYPE	Average	Range	Average	Range	TESTED	REFERENCE
A	NDCE w/ESP	0.54	0.16 to 0.68	0.03	0.01 to 0.05	1980	NCASI TB 112
B	NDCE w/ESP	0.50	0.09 to 1.04	0.03	0.01 to 0.06	1980	NCASI TB 112
C	NDCE w/ESP	0.83	0.36 to 1.60	0.04	0.02 to 0.09	1980	NCASI TB 112
RA	NDCE w/ESP	0.06	-	0.005	-	1991	11
RO	NDCE w/ESP	0.00	-	0.00	-	1990	11
RP	NDCE w/ESP	0.02	0.01 to 0.02	0.001	-	1990	11
RF	NDCE w/ESP	0.34	<0.02 to 0.98	0.012	0.00 to 0.04	1991	11
RQ	NDCE w/ESP	0.02	0.00 to 0.03	0.001	0.00 to 0.001	1992	11
RT	NDCE w/ESP	0.09	0.03 to 0.04	0.002	0.00 to 0.002	1992	10
	Nine NDCE Furnaces	0.27	0.00 to 1.60	0.013	0.00 to 0.09		
D	DCE w/ESP	1.35	0.86 to 2.25	0.08	0.05 to 0.14	1980	NCASI TB 112
E	DCE w/ESP	1.58	0.86 to 2.02	0.08	0.05 to 0.11	1980	NCASI TB 112
RF	DCE w/ESP	1.83	1.73 to 1.94	0.10	0.10 to 0.11	1991	11
RM	DCE w/ESP & WS	0.18	0.01 to 0.28	0.008[1]	6.5E-04 to 0.013	1992	11
RR	DCE w/ESP	0.99	0.38 to 1.81	0.055[1]	0.021 to 0.100	1992	10
RS	DCE w/ESP	0.42	0.21 to 0.88	0.023[1]	0.009 to 0.038	1992	10
	Six DCE Furnaces	1.06	0.01 to 2.25	0.058	7E-04 to 0.14		

Notes

[1] assumed 3000 lbs bls/ton and 6000 Btu/lb bls

WS - wet scrubber, ESP - electrostatic precipitator

TABLE 13 LIME KILN SULFUR DIOXIDE EMISSIONS

MILL CODE	TEST DATE	CONTROL DEVICE	PULP ADTPD	LIME TPD	FUEL & PERCENT S	BURN NCG Y/N	INPUT NCG S[1] lb/ton CaO	INPUT tot S[2] lb/ton CaO	OUTPUT SO_2, ppm @ 10% O_2	OUTPUT lb SO_2/ ton CaO	OUTPUT lb/SO_2 10^6 Btu[3]	ESTIMATE OF % SULFUR CAPTURED
LIME KILNS WITH SCRUBBERS												
LA	1986-87	VEN SCBR	1375	344	NATURAL GAS	Y	4.4 to 14.0	4.4 to 14.0	13 to 15	0.33	0.037	96.3 to 98.8
LB	1988	VEN SCBR	800	220	OIL, 2.5% S	Y	5.8 to 20.0	16.4 to 30.5	10.0	0.18[6]	0.023	98.9 to 99.7
LC	1986	VEN SCBR	1090	300	OIL, 1.0% S	N	0.0	1.17	1.3	0.02	0.003	99.8
LE	1979	SCRUBBER[4]	495	136	OIL, 1.3% S	Y	18.5	28.7[5]	-	0.45	0.057	99.2
LF	1984	VEN SCBR	290	80	NATURAL GAS	NA	NA	NA	3.9[6]	0.07	0.009	-
LG	1984	VEN SCBR	240	60	NATURAL GAS	Y	NA	NA	<2.0[6]	<0.04	<0.005	-
LH1	1987	VEN SCBR	717	180	NATURAL GAS	N	0.0	small	0.4[6]	0.01	0.001	-
LH2	1987	VEN SCBR	717	180	COKE/GAS	N	0.0	18.8	4.8[6]	0.10	0.011	99.7
LJ	1977	SCRUBBER[4]	267	73	OIL, 2.8% S	NA	NA	12.0	1 to 7	0.07[6]	0.009	99.7
LK	-	SCRUBBER	400	110	NATURAL GAS	N	0.0	small	0 to 6	0.09	0.011	-
LL	1984	VEN SCBR	740	221	NATURAL GAS	N	0.0	small	26.0[6]	0.47	0.059	-
LO1	1991	VEN SCBR	422	155	NATURAL GAS	N	0.0	small	<1.0	<0.02	<0.003	-
LO2	1991	VEN SCBR	1056	260	NATURAL GAS	N	0.0	small	<1.0	<0.02	<0.002	-
LP1	1990	VEN SCBR	820	225	OIL, 1.8% S	Y	NA	7.73	37 to 61	1.63	0.204	87.3 to 92.1
LT	1991	VEN SCBR	830	311	NATURAL GAS	N	0.0	small	0.5 to 1	0.01	0.002	-
LU	1992	VEN SCBR	890	306	NATURAL GAS	Y	NA	NA	4 to 16	0.13	0.020	-
									Average of 16 Kilns	0.23	0.028	
LIME KILNS WITH ESPs												
LD	1988	ESP	1700	468	OIL, 2.5% S	N	0.0	8.15[7]	1.03	0.02[6]	0.002	>99.9
LM	1989	ESP	840	230	NATURAL GAS	N	0.0	small	1.80	0.03[6]	0.004	-
LN	1990	ESP	1375	330	OIL/COKE/NG	Y	2.2	14.04[8]	10 to 100	1.00[6]	0.125	88.8 to 98.9
LP2	1991	ESP	2050	565	OIL, 1.8% S	NA	NA	7.69	72 to 237	2.98	0.373	93.0
									Average of 4 Kilns	1.00	0.126	

Range - 0.01 to 1.63 lb/ton CaO or ≤0.002 to 0.204 lb/10^6 Btu (16 kilns with scrubbers)

range - 0.02 to 2.98 lb/ton CaO or 0.002 to 0.373 lb/10^6 Btu (4 kilns with ESPs)

Notes

NA - not available or not known; [1] estimated from NCASI Technical Bulletin No. 469; [2] sulfur input from oil firing estimated assuming 8.0 x 10^6 Btu/ton CaO and 18,750 Btu/lb oil; [3] lb/ton CaO converted to lb/10^6 Btu using conversion factor of 8.0 x 10^6 Btu/ton CaO; [4] dust chamber followed by Peabody scrubber; [5] sulfur input from oil, lime mud and NCG were 31.8, 26.7 and 104.3 lb/hr, respectively; [6] assumed 5.5 ppm SO_2 in vent equals 0.1 lb SO_2/ton CaO; [7] sulfur input from oil firing for this kiln estimated using 6.2 x 10^6 Btu/ton CaO and 18,750 Btu/lb oil; [8] 2 lime kilns firing gas/coke with NCG and fuel oil/coke with NCG; NCGs are first scrubbed with white liquor or NaOH.

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

VOLATILE ORGANIC EMISSIONS FROM PULP AND PAPER MILL SOURCES

PART II - LIME KILNS, SMELT DISSOLVING TANKS AND MISCELLANEOUS CAUSTICIZING AREA VENTS

TECHNICAL BULLETIN NO. 676

SEPTEMBER 1994

TABLE VII.A.5 SUMMARY OF EMISSION TEST RESULTS
MILL M SLAKER AND CAUSTICIZER VENTS

ANALYTE	SLAKER SCRUBBER (MC3)	NO. 2 CAUSTICIZING TANK (MC4)
HEATED CANISTER	AVG (lb/T)	AVG (lb/T)
acetaldehyde (H)	5.3E-2	1.0E-3
methanol (H)	5.3E-2	5.5E-4
methyl mercaptan	< 1.6E-3	< 5.5E-6
acetone	1.9E-2	2.1E-4
dimethyl sulfide	< 2.1E-3	< 7.1E-6
methylene chloride (H)	< 5.1E-4	< 1.7E-6
1,2-dichloroethylene	7.8E-4	< 6.6E-7
methyl ethyl ketone (H)	1.2E-3	7.0E-6
n-hexane (H)	< 5.8E-5	< 2.0E-7
chloroform (H)	< 9.6E-4	< 3.3E-6
1,2-dichloroethane (H)	< 2.7E-4	< 9.0E-7
1,1,1-trichloroethane (H)	< 2.7E-4	< 9.1E-7
benzene (H)	1.3E-4	6.8E-7
carbon tetrachloride (H)	< 1.2E-3	< 4.2E-6
trichloroethylene (H)	< 2.7E-4	< 9.0E-7
methyl isobutyl ketone (H)	< 6.1E-5	1.6E-6
dimethyl disulfide	< 3.2E-3	< 1.1E-5
1,1,2-trichloroethane (H)	< 2.7E-4	< 9.1E-7
toluene (H)	3.1E-4	< 2.1E-7
tetrachloroethylene (H)	< 3.3E-4	U 6.6E-6
chlorobenzene (H)	< 7.6E-5	< 2.6E-7
m,p-xylene (H)	< 7.1E-5	1.2E-6
o-xylene (H)	< 7.1E-5	< 2.4E-7
xylenes (H)		
styrene (H)	1.1E-3	2.2E-5
alpha-pinene		
beta-pinene		
terpenes	8.2E-3	7.4E-5
1,2,4-trichlorobenzene (H)	< 1.2E-4	U 1.3E-6
acrolein (H)	< 1.1E-4	U 1.7E-5
IMPINGER		
methanol (H)		
acetone		
methyl ethyl ketone (H)		
acetaldehyde (H)		
acrolein (H)		
formaldehyde (H)	< 2.4E-3	< 5.4E-6
Total HAPs	1.1E-1	1.6E-3
THC (Method 25A)	4.1E-2	8.3E-4
Flow (DSCFM)	5117	15
PROD RATE, TCaO/D	549	549

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
TCaO/D = TONS OF CaO PER DAY
H = CAA HAP

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

VOLATILE ORGANIC EMISSIONS FROM PULP AND PAPER MILL SOURCES, PART III - MISCELLANEOUS SOURCES AT KRAFT AND TMP MILLS

TECHNICAL BULLETIN NO. 677

SEPTEMBER 1994

TABLE V.A.1 SUMMARY OF EMISSION TEST RESULTS
MILL G AND M BLACK LIQUOR STORAGE TANK VENTS

ANALYTE	MILL G SOFTWOOD WEAK BLACK LIQUOR TANK VENT (GV23)	MILL G HARDWOOD WEAK LIQUOR TANK VENT (GV24)	MILL G NO. 1 COMBINED INTERMEDIATE BLACK LIQUOR TANK VENT (HW, SW, SC) (GV28)	MILL G COMBINED HEAVY BLACK LIQUOR TANK VENT (HW, SW, SC) (GV26)	MILL M SOFTWOOD WEAK BLACK LIQUOR STORAGE TANK VENT (MWBL)
HEATED CANISTER	**AVG (lb/hr)**	**AVG (lb/hr)**	**AVG (lb/hr)**	**AVG (lb/hr)**	**AVG (lb/hr)**
acetaldehyde (H)	3.2E-3	5.1E-3	1.7E-2	1.2E-2	8.7E-5
methanol (H)	7.1E-1	1.3E+0	9.2E-2	1.3E-1	3.4E-3
methyl mercaptan	< 2.7E-4	3.7E-3	8.0E-4	8.1E-3	< 2.5E-4
acetone	1.6E-2	7.9E-2	2.3E-2	2.8E-2	1.2E-3
dimethyl sulfide	4.1E-2	2.4E-1	6.9E-2	1.2E-1	5.2E-4
methylene chloride (H)	< 8.2E-5	< 1.6E-4	< 4.0E-5	< 6.3E-5	< 7.4E-5
1,2-dichloroethylene	U 3.2E-4	U 6.9E-4	U < 1.6E-5	U 9.7E-5	U 4.1E-5
methyl ethyl ketone (H)	4.4E-3	2.1E-2	1.8E-2	1.5E-2	< 2.8E-5
n-hexane (H)	7.2E-5	1.0E-3	3.4E-5	4.1E-5	< 8.8E-6
chloroform (H)	< 1.6E-4	< 3.2E-4	U 1.4E-4	U 1.0E-3	< 1.5E-4
1,2-dichloroethane (H)	< 4.5E-5	U 5.3E-4	< 2.2E-5	< 3.4E-5	< 4.0E-5
1,1,1-trichloroethane (H)	U 2.0E-4	U 5.3E-4	< 2.2E-5	< 3.5E-5	< 4.1E-5
benzene (H)	2.4E-5	5.4E-5	9.0E-6	1.1E-5	< 8.0E-6
carbon tetrachloride (H)	U 3.2E-4	U 1.6E-3	< 1.0E-4	< 1.6E-4	< 1.9E-4
trichloroethylene (H)	U 2.2E-4	U 2.3E-4	< 2.2E-5	< 3.4E-5	< 4.0E-5
methyl isobutyl ketone (H)	2.9E-4	7.6E-4	7.0E-5	7.3E-5	< 9.0E-6
dimethyl disulfide	1.2E-2	6.9E-2	1.3E-2	5.5E-2	< 4.8E-4
1,1,2-trichloroethane (H)	< 4.5E-5	< 8.9E-5	< 2.2E-5	< 3.5E-5	< 4.1E-5
toluene (H)	1.6E-4	2.0E-3	1.9E-4	2.8E-4	< 7.4E-6
tetrachloroethylene (H)	U 1.3E-4	< 1.1E-4	< 2.8E-5	< 4.3E-5	< 5.1E-5
chlorobenzene (H)	< 1.3E-5	< 2.5E-5	< 6.3E-6	< 9.8E-6	< 1.2E-5
m,p-xylene (H)	2.3E-4	7.2E-4	2.7E-5	3.3E-5	< 1.1E-5
o-xylene (H)	5.6E-4	4.5E-4	6.8E-5	7.3E-5	< 1.1E-5
xylenes (H)					
styrene (H)	3.5E-4	< 2.3E-5	1.5E-4	1.3E-4	2.4E-4
alpha-pinene					
beta-pinene					
terpenes	1.4E-1	1.8E+0	5.8E-3	9.9E-3	4.1E-2
1,2,4-trichlorobenzene (H)	< 2.0E-5	< 4.0E-5	U 3.5E-5	U 4.1E-4	U 1.4E-4
acrolein (H)	5.5E-5	7.7E-4	< 9.4E-6	3.1E-5	< 1.7E-5
IMPINGER					
methanol (H)					
acetone					
methyl ethyl ketone (H)			4.5E-3		
acetaldehyde (H)					
acrolein (H)					
formaldehyde (H)	< 2.0E-4	< 3.4E-4	2.3E-4	5.0E-4	< 6.2E-4
Total HAPs	7.2E-1	1.3E+0	1.3E-1	1.6E-1	4.6E-3
THC (Method 25A)	5.9E-1	1.6E+0	9.1E-2	1.8E-1	2.0E-2
Flow (DSCFM)	71	129	16	33	66
PROD RATE, ODTP/D	1368	438	1326	2587	421

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
ODTP/D = OVEN DRIED TONS OF PULP PER DAY
H = CAA HAP

TABLE IX.A.1 SUMMARY OF EMISSION TEST RESULTS MILL G AND O HIGH DENSITY PULP STORAGE TANK VENTS

ANALYTE	MILL G SOFTWOOD HIGH DENSITY PULP STORAGE CHEST VENT (GV16)	MILL G HARDWOOD HIGH DENSITY PULP STORAGE CHEST VENT (GV19)	MILL O SOFTWOOD HIGH DENSITY PULP STORAGE TANK VENT (OV6)	MILL O HARDWOOD HIGH DENSITY PULP STORAGE TANK VENT (OV3)
HEATED CANISTER	**AVG (lb/hr)**	**AVG (lb/hr)**	**AVG (lb/hr)**	**AVG (lb/hr)**
acetaldehyde (H)	7.6E-2	8.2E-2	4.9E-4	5.2E-3
methanol (H)	5.0E+0	4.7E+0	5.0E-2	2.4E-1
methyl mercaptan	2.5E-2	2.5E-2	< 2.5E-4	< 3.2E-4
acetone	2.1E-1	2.4E-1	1.7E-3	1.2E-2
dimethyl sulfide	5.0E-1	4.9E-1	3.9E-4	6.7E-2
methylene chloride (H)	< 3.4E-3	< 3.4E-3	< 7.5E-5	< 9.8E-5
1,2-dichloroethylene	U 6.9E-3	U 1.2E-3	< 3.0E-5	U 1.2E-4
methyl ethyl ketone (H)	1.1E-1	1.4E-1	3.7E-4	5.9E-3
n-hexane (H)	3.7E-3	1.8E-3	< 8.9E-6	3.3E-4
chloroform (H)	< 6.7E-3	< 6.8E-3	< 1.5E-4	2.7E-4
1,2-dichloroethane (H)	U 3.7E-3	< 1.9E-3	< 4.1E-5	< 5.3E-5
1,1,1-trichloroethane (H)	< 1.9E-3	< 1.9E-3	< 4.1E-5	< 5.4E-5
benzene (H)	8.6E-4	< 3.7E-4	1.7E-5	1.4E-5
carbon tetrachloride (H)	< 8.6E-3	< 8.7E-3	< 1.9E-4	< 2.5E-4
trichloroethylene (H)	< 1.8E-3	< 1.9E-3	< 4.1E-5	U 8.5E-5
methyl isobutyl ketone (H)	2.3E-3	1.7E-3	3.3E-5	1.2E-3
dimethyl disulfide	6.5E-1	3.6E-1	8.5E-4	1.1E-1
1,1,2-trichloroethane (H)	< 1.9E-3	< 1.9E-3	U 9.6E-5	< 5.4E-5
toluene (H)	1.1E-2	1.4E-3	2.5E-5	3.8E-4
tetrachloroethylene (H)	< 2.3E-3	< 2.4E-3	< 5.1E-5	< 6.7E-5
chlorobenzene (H)	< 5.2E-4	< 5.3E-4	< 1.2E-5	U 2.0E-5
m,p-xylene (H)	5.8E-3	7.4E-4	< 1.1E-5	2.6E-5
o-xylene (H)	< 4.9E-4	1.7E-3	9.5E-5	3.7E-4
xylenes (H)				
styrene (H)	3.5E-2	3.8E-3	< 1.1E-5	5.1E-4
alpha-pinene				
beta-pinene				
terpenes	7.7E+0	7.4E-1	1.6E-2	7.8E-1
1,2,4-trichlorobenzene (H)	U 1.6E-1	< 8.6E-4	< 1.9E-5	< 2.4E-5
acrolein (H)	U 2.8E-3	U 6.7E-4	< 1.7E-5	< 2.3E-5
IMPINGER				
methanol (H)				
acetone				
methyl ethyl ketone (H)				
acetaldehyde (H)				
acrolein (H)				
formaldehyde (H)	< 8.2E-3	< 8.4E-3	< 1.1E-4	< 2.3E-4
Total HAPs	5.4E+0	5.0E+0	5.2E-2	2.6E-1
THC (Method 25A)	1.5E+1	4.4E+0	5.7E-2	8.6E-1
Flow (DSCFM)	2967	3043	64	81
PROD RATE, ODTP/D	1372	248	256	214

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
ODTP/D = OVEN DRIED TONS OF PULP PER DAY
H = CAA HAP

TABLE IX.B.1 SUMMARY OF HIGH DENSITY PULP STORAGE TANK EMISSIONS

SOURCE	Vent Gas Flow Rate, DSCFM	TANK EMISSIONS		
		HAPs, lb/hr	Methanol, lb/hr	VOCs, lb C/hr
Mill G Softwood High Density Storage Tank	2967	5.4E0	5.0E0	1.5E1
Mill G Hardwood High Density Storage Tank	3043	5.0E0	4.7E0	4.4E0
Mill O Softwood High Density Storage Tank	64	5.2E-2	5.0E-2	5.7E-2
Mill O Softwood High Density Storage Tank	81	2.6E-1	2.4E-1	8.6E-1

TABLE X.A.1 SUMMARY OF EMISSION TEST RESULTS MILLS L AND N SALT CAKE MIX TANK VENTS

ANALYTE	MILL L NO. 2 SALT CAKE MIX TANK VENT (HW,SW,DCE RF) (LV25)	MILL L NO. 3 SALT CAKE MIX TANK VENT (HW, SW NDCE RF) (LV26)	MILL N SALT CAKE MIX TANK (NDCE RF) (NSCT)	AVERAGE OF ALL MIX TANKS
HEATED CANISTER	AVG (lb/T)	AVG (lb/T)	AVG (lb/T)	AVG (lb/T)
acetaldehyde (H)	1.7E-4	2.6E-4	1.0E-5	1.5E-4
methanol (H)	9.8E-4	6.5E-3	6.4E-5	2.5E-3
methyl mercaptan	7.2E-5	2.2E-4	< 1.4E-6	9.8E-5
acetone	1.1E-4	3.0E-4	1.2E-5	1.4E-4
dimethyl sulfide	< 3.1E-5	7.6E-3	5.2E-5	2.6E-3
methylene chloride (H)	< 7.1E-6	< 4.8E-6	< 4.5E-7	< 4.1E-6
1,2-dichloroethylene	U 3.0E-6	< 1.9E-6	< 1.7E-7	U 1.4E-6
methyl ethyl ketone (H)	1.2E-5	8.9E-5	4.1E-6	3.5E-5
n-hexane (H)	< 8.5E-7	6.3E-7	< 5.1E-8	3.6E-7
chloroform (H)	< 1.4E-5	< 7.4E-6	< 6.6E-7	< 7.4E-6
1,2-dichloroethane (H)	< 3.9E-6	< 2.6E-6	< 2.3E-7	< 2.2E-6
1,1,1-trichloroethane (H)	< 3.9E-6	< 2.6E-6	< 2.4E-7	< 2.3E-6
benzene (H)	< 7.7E-7	< 5.2E-7	9.9E-8	2.5E-7
carbon tetrachloride (H)	< 1.8E-5	< 1.2E-5	< 1.1E-6	< 1.0E-5
trichloroethylene (H)	< 3.9E-6	< 2.6E-6	< 2.3E-7	< 2.2E-6
methyl isobutyl ketone (H)	1.4E-6	2.0E-6	8.2E-8	1.2E-6
dimethyl disulfide	4.3E-5	3.4E-3	4.1E-5	1.2E-3
1,1,2-trichloroethane (H)	U 6.4E-6	< 2.6E-6	< 2.4E-7	U 2.6E-6
toluene (H)	8.8E-6	2.8E-5	5.6E-7	1.2E-5
tetrachloroethylene (H)	< 4.9E-6	< 3.3E-6	U 1.4E-6	U 1.8E-6
chlorobenzene (H)	U 1.3E-6	< 7.4E-7	< 6.6E-8	U 5.8E-7
m,p-xylene (H)	1.3E-6	< 7.0E-7	< 6.3E-8	5.4E-7
o-xylene (H)	1.7E-6	< 7.0E-7	2.1E-7	7.5E-7
xylenes (H)				
styrene (H)	1.7E-6	3.0E-6	1.1E-7	1.6E-6
alpha-pinene				
beta-pinene				
terpenes	2.1E-4	5.9E-5	3.5E-5	1.0E-4
1,2,4-trichlorobenzene (H)	U 2.4E-5	< 1.2E-6	< 1.1E-7	U 8.1E-6
acrolein (H)	< 1.7E-6	7.0E-6	2.1E-7	2.7E-6
IMPINGER				
methanol (H)				
acetone				
methyl ethyl ketone (H)				
acetaldehyde (H)				
acrolein (H)				
formaldehyde (H)	6.4E-6	2.7E-5	< 7.3E-7	1.1E-5
Total HAPs	1.2E-3	6.9E-3	8.3E-5	2.8E-3
THC (Method 25A)	1.3E-3	7.6E-3	3.9E-5	3.0E-3
Flow (DSCFM)	482	114	33	210
PROD RATE, TBLS/D	1883	1982	2456	2107

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
TBLS/D = TONS OF BLACK LIQUOR SOLIDS PER DAY
H = CAA HAP

TABLE XI.A.5 SUMMARY OF EMISSION TEST RESULTS
MILL O TALL OIL SYSTEM

ANALYTE	TALL OIL REACTOR VENT (OV8)	TALL OIL REACTOR VENT - LIGNIN COOK (OV8B)	BRINE STORAGE TANK (OV9)	WET OIL SETTLING TANK (OV10)	WET OIL DRYING TANK (OV11)	SYSTEM TOTAL
HEATED CANISTER	**AVG (lb/T)**	**AVG (lb/T)**	**AVG (lb/T)**	**AVG (lb/T)**	**AVG (lb/T)**	**SUM (lb/T)**
acetaldehyde (H)	3.9E-3	8.5E-4	3.5E-6	1.9E-4	3.4E-5	4.9E-3
methanol (H)	2.4E-2	3.8E-3	4.0E-5	7.6E-4	2.5E-4	2.9E-2
methyl mercaptan	3.0E-3	< 4.7E-4	< 5.0E-6	1.5E-4	3.8E-5	3.4E-3
acetone	1.2E-2	7.4E-4	9.4E-6	1.1E-3	4.2E-4	1.5E-2
dimethyl sulfide	< 5.6E-4	< 6.0E-4	< 6.5E-6	< 2.3E-5	< 1.1E-5	< 1.2E-3
methylene chloride (H)	< 1.3E-4	< 1.4E-4	< 1.5E-6	< 5.5E-6	< 2.8E-6	< 2.8E-4
1,2-dichloroethylene	< 5.2E-5	< 5.7E-5	< 6.0E-7	U 1.4E-5	< 1.1E-6	U 6.9E-5
methyl ethyl ketone (H)	3.1E-4	< 5.3E-5	8.1E-7	1.9E-5	5.1E-6	3.6E-4
n-hexane (H)	4.0E-5	< 1.7E-5	< 1.8E-7	1.1E-5	1.2E-6	6.1E-5
chloroform (H)	< 2.6E-4	< 2.8E-4	< 3.0E-6	U 3.8E-5	< 5.2E-6	U 3.1E-4
1,2-dichloroethane (H)	< 7.1E-5	< 7.7E-5	< 8.2E-7	< 3.0E-6	< 1.4E-6	< 1.5E-4
1,1,1-trichloroethane (H)	< 7.2E-5	< 7.8E-5	< 8.3E-7	U 3.0E-5	< 1.5E-6	U 1.1E-4
benzene (H)	1.6E-4	3.4E-5	< 1.6E-7	2.2E-6	2.5E-6	2.0E-4
carbon tetrachloride (H)	< 3.3E-4	< 3.6E-4	< 3.8E-6	< 1.4E-5	< 6.7E-6	< 7.1E-4
trichloroethylene (H)	< 7.1E-5	< 7.7E-5	< 8.2E-7	< 3.0E-6	U 2.2E-6	U 7.8E-5
methyl isobutyl ketone (H)	7.8E-5	< 1.7E-5	< 1.8E-7	2.5E-6	5.0E-6	9.4E-5
dimethyl disulfide	< 8.4E-4	< 9.2E-4	< 9.8E-6	< 3.5E-5	2.1E-5	9.2E-4
1,1,2-trichloroethane (H)	U 5.6E-5	< 7.8E-5	< 8.3E-7	U 5.8E-5	U 3.1E-6	U 1.6E-4
toluene (H)	3.4E-4	2.7E-5	2.1E-7	3.1E-5	2.3E-5	4.2E-4
tetrachloroethylene (H)	U 1.1E-4	< 9.7E-5	U 2.2E-5	< 3.7E-6	U 4.9E-6	U 1.9E-4
chlorobenzene (H)	< 2.0E-5	< 2.2E-5	U 8.0E-7	< 8.5E-7	U 8.1E-7	U 2.3E-5
m,p-xylene (H)	8.8E-5	3.2E-5	< 2.2E-7	8.6E-6	6.2E-6	1.3E-4
o-xylene (H)	1.6E-3	< 2.1E-5	2.6E-7	1.8E-5	2.2E-6	1.6E-3
xylenes (H)						
styrene (H)	1.1E-3	< 2.0E-5	3.0E-7	< 7.8E-7	1.1E-5	1.1E-3
alpha-pinene						
beta-pinene						
terpenes	1.4E-1	1.1E-3	4.4E-5	1.3E-2	3.5E-3	1.6E-1
1,2,4-trichlorobenzene (H)	< 3.3E-5	< 3.5E-5	< 3.8E-7	6.6E-6	< 6.6E-7	4.1E-5
acrolein (H)	1.0E-4	< 3.3E-5	< 3.5E-7	U 1.0E-5	< 6.1E-7	U 1.3E-4
IMPINGER						
methanol (H)						
acetone						
methyl ethyl ketone (H)						
acetaldehyde (H)						
acrolein (H)						
formaldehyde (H)	< 3.0E-4	< 1.7E-4	< 6.0E-6	< 2.5E-5	< 1.1E-5	< 5.1E-4
Total HAPs	3.3E-2	5.5E-3	7.8E-5	1.2E-3	3.6E-4	4.0E-2
THC (Method 25A)	9.9E-2	4.7E-3	1.1E-4	4.8E-3	4.9E-3	1.1E-1
Flow (DSCFM)	2312	2970	51	183	72	
PROD RATE, TTO/S	57	162	59	49	59	

U = UNEXPECTED AND UNCONFIRMED BY GC/MSD
TTO/S = TONS OF TALL OIL PER SAMPLE
H = CAA HAP

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC.
P.O. BOX 13318, RESEARCH TRIANGLE PARK, NC 27709-3318

A PRELIMINARY INVESTIGATION OF RELEASES OF VOLATILE ORGANIC COMPOUNDS FROM WOOD RESIDUAL STORAGE PILES

TECHNICAL BULLETIN NO. 700

OCTOBER 1995

ncasi

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC.
P.O. Box 13318, Research Triangle Park, NC 27709-3318
Phone (919) 558-1999 Fax (919) 558-1998

Ronald A. Yeske, Ph.D.
President
(919) 558-1995

October 20, 1995

TECHNICAL BULLETIN NO. 700

A PRELIMINARY INVESTIGATION OF RELEASES OF VOLATILE ORGANIC COMPOUNDS FROM WOOD RESIDUAL STORAGE PILES

There is a need for developing information on volatile organic compounds (VOCs) emissions for operating permit applications. In recent years there has been an interest in determining the magnitude of fugitive VOC releases from the production, handling, and storage of wood residuals (chips, sawdust, planer shavings, and bark) at forest products manufacturing facilities. Measurement of fugitive VOC emissions from these operations is difficult and complicated by the large natural variability in the VOC content of woody materials. No emission factors are currently available. Considering the complexity of the problem, it is not surprising that little information has been published on this subject.

Because of the importance of this topic to the forest products industry, NCASI has undertaken a project to determine if techniques can be developed for estimating fugitive VOC emissions from operations related to the wood residuals of species commonly used for lumber and pulp production. This report summarizes the first phase of the project.

A literature review was conducted. Only one study of VOC emissions from chip piles was found in the literature. However, numerous studies established the complex interactions among biological, microbiological, chemical, and physical processes occurring in wood material storage piles. These activities could affect the release of VOCs both spatially and over time. Research on turpentine loss during softwood chips storage suggested temporal variability in VOC emission potential, with rates declining with time. The literature review clearly indicated a need for field and laboratory studies.

Field measurements on VOCs in long-term storage piles of Douglas fir chips were performed. The measurements were used to estimate VOC emissions from the surface of these piles and during retrieval of chips from the pile. The estimated VOC emissions from the surface ranged from 1.6 to 3.6 pound carbon per acre-day (lb C/acre-day), while the release during chip retrieval was less than

Street Address: 79 T.W. Alexander Drive, Building 4401, Suite 205

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COMPILATION OF 'AIR TOXIC' AND TOTAL HYDROCARBON EMISSIONS DATA FOR SOURCES AT CHEMICAL WOOD PULP MILLS

VOLUME 1

TECHNICAL BULLETIN NO. 701

OCTOBER 1995

TABLE 7 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM KRAFT BLACK LIQUOR AND PULP STORAGE TANKS, CONTD.

SOURCE: WEAK BLACK LIQUOR STORAGE TANKS

			EMISSIONS			
VOLATILE ORGANIC COMPOUND		MILL CODE	RANGE lb/hr/tank	AVG lb/hr/tank	TEST METHOD	COMMENTS
TOLUENE		BLTMG1		1.6E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
TOLUENE		BLTMG2		2.0E-03	HEATED CANISTER	FID WITH CONCENTRATOR
TOLUENE		BLTMM	ND[7.4E-06]	3.7E-06	HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.0E-03	1.6E-04		
1,2,4-TRICHLOROBENZENE		BLTMG1	ND[2.0E-05]	1.0E-05	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE		BLTMG2	ND[4.0E-05]	2.0E-05	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE		BLTMM		1.4E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 1.4E-04	2.0E-05		
1,1,1-TRICHLOROETHANE		BLTMG1		2.0E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,1,1-TRICHLOROETHANE		BLTMG2		5.3E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,1,1-TRICHLOROETHANE		BLTMM		ND[4.1E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 5.3E-04	2.0E-04		
1,1,2-TRICHLOROETHANE		BLTMG1	ND[4.5E-05]		HEATED CANISTER	FID WITH CONCENTRATOR
1,1,2-TRICHLOROETHANE		BLTMG2	ND[8.9E-05]		HEATED CANISTER	FID WITH CONCENTRATOR
1,1,2-TRICHLOROETHANE		BLTMM	ND[4.1E-05]		HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	0		ND	ND		
TRICHLOROETHYLENE		BLTMG1		1.3E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
TRICHLOROETHYLENE		BLTMG2		2.3E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
TRICHLOROETHYLENE		BLTMM		ND[4.0E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.3E-04	1.3E-04		
m,p-XYLENE		BLTMG1		2.3E-04	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE		BLTMG2		7.2E-04	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE		BLTMM		ND[1.1E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.3E-04	2.3E-04		
o-XYLENE		BLTMG1		5.6E-04	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE		BLTMG2		4.5E-04	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE		BLTMM		ND[1.1E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 5.6E-04	4.5E-04		
TERPENES		BLTMG1		1.4E-01	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES		BLTMG2		1.8E+00	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES		BLTMM		4.1E-02	HEATED CANISTER	FID WITH CONCENTRATOR
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	3		4.1E-02 to 1.8	1.4E-01		
			lb C/hr/tank	lb C/hr/tank		
TOTAL HYDROCARBONS		BLTMG1		5.9E-01	M25A	
TOTAL HYDROCARBONS		BLTMG2		1.6E+00	M25A	
TOTAL HYDROCARBONS		BLTMM		2.0E-02	M25A	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	3		2.0E-02 to 1.6	5.9E-01		

MEDIAN - empirical median

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COMPILATION OF 'AIR TOXIC' AND TOTAL HYDROCARBON EMISSIONS DATA FOR SOURCES AT CHEMICAL WOOD PULP MILLS

VOLUME 2

TECHNICAL BULLETIN NO. 701

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TABLE 12D SUMMARY OF TRACE METAL EMISSIONS FROM NDCE KRAFT RECOVERY FURNACES

			EMISSIONS			
TRACE METAL		MILL CODE	RANGE lb/1E+6 TON BLS	AVG	TEST METHOD	COMMENT
Chromium+6		RC		8.3E+00	CARB 425	
Chromium+6		RE		5.8E-01	NA	
Chromium+6		RF		3.3E+01	CARB 425	
Chromium+6		RG		2.7E+01	NA	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	4		0.58 to 33	1.7E+01		
Copper		RA		9.1E+00	NA	
Copper		RF		4.6E+01	CARB 436	
Copper		RG		2.0E+01	NA	
Copper		RH		3.2E+02	EPA DRAFT MM	
Copper		RFIF2	ND to 25	2.1E+01	METHOD 29	
Copper		RFIJ	ND to 24	1.7E+01	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
6	6		ND to 320	2.1E+01		
Cobalt		RFIF2		ND[10]	METHOD 29	
Cobalt		RFIJ		ND[42]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
2	0		ND	ND		
Lead		RB2		1.6E+01	NA	
Lead		RF		3.5E+01	CARB 436	
Lead		RG		3.1E+01	NA	
Lead		RH		2.1E+02	EPA DRAFT MM	
Lead		RI		ND[1.1E+02]	EPA DRAFT MM	
Lead		RFIF2	47 to 52	5.0E+01	METHOD 29	
Lead		RFIJ		ND[56]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	5		ND to 2.1E+02	3.1E+01		
Manganese		RA		1.2E+01	NA	
Manganese		RB2		7.9E+01	NA	
Manganese		RC		1.0E+01	EPA DRAFT MM	
Manganese		RE		1.2E+02	NA	
Manganese		RF		5.1E+01	CARB 436	
Manganese		RG		1.2E+01	NA	
Manganese		RH		8.8E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	7		10 to 120	5.1E+01		
Mercury		RA		2.0E+00	NA	
Mercury		RB2		2.8E+01	NA	
Mercury		RF		4.3E+01	CARB 436	
Mercury		RH		9.0E+01	EPA DRAFT MM	
Mercury		RI		5.7E+00	EPA DRAFT MM	
Mercury		RFIF2		ND[15]	METHOD 29	
Mercury		RFIJ	ND to 56	3.7E+01	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
7	6		ND to 90	2.8E+01		
Nickel		RA		4.4E+00	NA	

TABLE 14B SUMMARY OF TRACE METAL EMISSIONS FROM LIME KILNS, CONTD.

		MILL	EMISSIONS IN lb/1E+6 TON CaO		TEST	
TRACE METAL		CODE	RANGE	AVG	METHOD	COMMENTS
Antimony		LB1		3.2E+02	NA	
Antimony		LB2		1.3E+01	EPA M0012	
Antimony		LD		ND[46]	EPA DRAFT MM	
Antimony		LKIC1	ND to 7.6E+00	5.7E+00	METHOD 29	
Antimony		LKID1		ND[4.7E+01]	METHOD 29	
Antimony		LKID2		ND[2.9E+00]	METHOD 29	
Antimony		LKIE		ND[5.8E+01]	METHOD 29	
Antimony		LKIF3	ND to 6.9E+00	5.1E+00	METHOD 29	
Antimony		LKIG		ND[3.0E+00]	METHOD 29	
Antimony		LKIJ	ND to 1.4E+01	9.0E+00	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN*		
10	5		ND to 3.2E+02	2.0E+00		
Arsenic		LB1		ND[1000]	NA	
Arsenic		LB2		8.9E+00	EPA M0012	
Arsenic		LC		1.6E+00	CARB 436	
Arsenic		LD		3.9E+01	EPA DRAFT MM	
Arsenic		LE		ND[24]	CARB 436	
Arsenic		LKIC1		8.8E+00	METHOD 29	
Arsenic		LKID1		ND[1.1E+02]	METHOD 29	
Arsenic		LKID2		ND[6.5E+01]	METHOD 29	
Arsenic		LKIE		ND[8.3E+01]	METHOD 29	
Arsenic		LKIF3		ND[2.0E+01]	METHOD 29	
Arsenic		LKIG		ND[9.0E+00]	METHOD 29	
Arsenic		LKIJ		ND[5.6E+01]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
12	4		ND to 3.9E+01	6.0E-01		
Barium		LA		7.6E+01	NA	
Barium		LB2		1.8E+04	EPA M0012	
Barium		LD		ND[4E+4]	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 7.6E+01	7.6E+01		
Beryllium		LB1		1.0E+01	NA	
Beryllium		LB2		1.4E+00	EPA M0012	
Beryllium		LC		3.4E+01	CARB 436	
Beryllium		LD		2.3E+01	EPA DRAFT MM	
Beryllium		LE		ND[0.78]	CARB 436	
Beryllium		LKIC1		ND[2.8E+00]	METHOD 29	
Beryllium		LKID1		ND[3.1E+00]	METHOD 29	
Beryllium		LKID2		ND[2.2E+00]	METHOD 29	
Beryllium		LKIE		ND[5.3E+00]	METHOD 29	
Beryllium		LKIF3		ND[6.9E+00]	METHOD 29	
Beryllium		LKIG		ND[3.0E+00]	METHOD 29	
Beryllium		LKIJ		ND[3.4E+00]	METHOD 29	
NO. OF TESTS	DETECTS		RANGE	MEDIAN**		
12	4		ND to 3.4E+01	5.2E-01		
Cadmium		LB1		ND[13]	NA	
Cadmium		LB2		1.1E+02	EPA M0012	
Cadmium		LC		9.7E+00	CARB 436	
Cadmium		LD		ND[46]	EPA DRAFT MM	
Cadmium		LE		2.2E+01	CARB 436	
Cadmium		LKIC1	1.3E+01 to 2.2E+01	1.7E+01	METHOD 29	
Cadmium		LKID1		ND[3.1E+01]	METHOD 29	
Cadmium		LKID2		ND[1.8E+01]	METHOD 29	
Cadmium		LKIE	ND to 7.8E+01	4.9E+01	METHOD 29	
Cadmium		LKIF3	ND to 2.1E+02	1.4E+02	METHOD 29	

TABLE 15B SUMMARY OF 'AIR TOXIC' METAL EMISSIONS FROM SMELT DISSOLVING TANK VENTS, CONTD.

			EMISSIONS IN			
		MILL	lb/1E+6 ton BLS		TEST	
TRACE METAL		CODE	RANGE	AVG	METHOD	COMMENTS
Antimony		SDTB		8.7E+00	EPA DRAFT MM	
Antimony		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Antimony		SDTI		2.0E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.0E+01	8.7E+00		
Arsenic		SDTA		7.0E-01	EPA DRAFT MM	
Arsenic		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Arsenic		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Arsenic		SDTI		2.1E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 2.1E+01	3.0E+00		
Barium		SDTB	ND[5600]		EPA DRAFT MM	
Barium		SDTE	ND[3982]		EPA DRAFT MM	
Barium		SDTI		2.0E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	1		ND to 2.0E+01	2.0E+01		
Beryllium		SDTA		1.4E-01	EPA DRAFT MM	
Beryllium		SDTB	ND[7.0]		EPA DRAFT MM	
Beryllium		SDTE	ND[5.0]		EPA DRAFT MM	
Beryllium		SDTI		1.8E+00	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 1.8E+00	9.6E-01		
Cadmium		SDTA		1.1E-01	EPA DRAFT MM	
Cadmium		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Cadmium		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Cadmium		SDTI		3.8E+02	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 3.8E+02	3.0E+00		
Chromium		SDTA		2.3E+01	CARB 425	
Chromium		SDTB	ND[14.0]	7.0E+00	EPA DRAFT MM	
Chromium		SDTE	ND[10.0]	5.0E+00	EPA DRAFT MM	
Chromium		SDTI		2.5E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 2.5E+01	1.5E+01		
Chromium+6		SDTA		3.4E+00	CARB 425	
Copper		SDTA		6.0E+00	EPA DRAFT MM	
Copper		SDTB		1.6E+01	EPA DRAFT MM	
Copper		SDTE		8.2E+00	EPA DRAFT MM	
Copper		SDTI		2.1E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	4		ND to 2.1E+01	1.2E+01		
Lead		SDTA		1.2E+00	EPA DRAFT MM	
Lead		SDTB		4.5E+01	EPA DRAFT MM	
Lead		SDTE	ND[10.0]	5.0E+00	EPA DRAFT MM	

TABLE 15B SUMMARY OF 'AIR TOXIC' METAL EMISSIONS FROM SMELT DISSOLVING TANK VENTS, CONTD.

			EMISSIONS IN lb/1E+6 ton BLS			
		MILL			TEST	
TRACE METAL		CODE	RANGE	AVG	METHOD	COMMENTS
Lead		SDTI		1.1E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	3		ND to 4.5E+01	8.2E+00		
Manganese		SDTA		3.1E+01	EPA DRAFT MM	
Manganese		SDTB		2.3E+01	EPA DRAFT MM	
Manganese		SDTE		4.4E+01	EPA DRAFT MM	
Manganese		SDTI		2.2E+02	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	4		2.3E+01 to 2.2E+02	3.8E+01		
Mercury		SDTA		1.8E-01	EPA DRAFT MM	
Mercury		SDTB	ND[7.0]		EPA DRAFT MM	
Mercury		SDTE	ND[5.0]		EPA DRAFT MM	
Mercury		SDTI	ND[14.3]		EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	1		ND to 1.8E-01	1.8E-01		
Nickel		SDTA		6.8E-01	EPA DRAFT MM	
Nickel		SDTB	ND[7.0]	4.0E+00	EPA DRAFT MM	
Nickel		SDTE		8.0E+00	EPA DRAFT MM	
Nickel		SDTI		2.5E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	3		ND to 2.5E+01	6.0E+00		
Phosphorus		SDTB	ND[14]	7.0E+00	EPA DRAFT MM	P is a non-metal
Phosphorus		SDTE		1.2E+02	EPA DRAFT MM	P is a non-metal
Phosphorus		SDTI		2.4E+02	EPA DRAFT MM	P is a non-metal
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 2.4E+02	1.2E+02		
Selenium		SDTA		8.6E-01	EPA DRAFT MM	
Selenium		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Selenium		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Selenium		SDTI		1.2E+01	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 1.2E+01	3.0E+00		
Silver		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Silver		SDTE	ND[5.0]	2.5E+00	EPA DRAFT MM	
Silver		SDTI		7.3E+00	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	1		ND to 7.3E+00	3.5E+00		
Thallium		SDTB	ND[7.0]	3.5E+00	EPA DRAFT MM	
Thallium		SDTE		3.0E+00	EPA DRAFT MM	
Thallium		SDTI		5.4E+00	EPA DRAFT MM	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 5.4E+00	3.5E+00		
Zinc		SDTA		4.4E+01	EPA DRAFT MM	

TABLE 16 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM TALL OIL REACTOR VENTS, CONTD.

VOLATILE ORGANIC COMPOUND		MILL CODE	EMISSIONS RANGE lb/ton TO	AVG lb/ton TO	TEST METHOD	COMMENTS
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	3		ND to 2.4E-04	1.4E-04		
1,1,2-TRICHLOROETHANE		TORMC		2.6E-03	HEATED CANISTER	FID, U
1,1,2-TRICHLOROETHANE		TORMD		1.3E-03	HEATED CANISTER	FID
1,1,2-TRICHLOROETHANE		TORMO		1.6E-04	HEATED CANISTER	FID, U
1,1,2-TRICHLOROETHANE		TORIH	ND[4.0E-02]		HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	3		ND to 2.6E-03	1.3E-03		
TRICHLOROETHYLENE		TORMC	ND[3.3E-04]	1.7E-04	HEATED CANISTER	FID
TRICHLOROETHYLENE		TORMD		2.1E-04	HEATED CANISTER	FID
TRICHLOROETHYLENE		TORMO		7.8E-05	HEATED CANISTER	FID, U
TRICHLOROETHYLENE		TORIH	ND[4.0E-02]		HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
4	2		ND to 2.1E-04	1.7E-04		
TRICHLOROFLUOROMETHANE		TORA	7.47 ppm	1.1E-02	VOST	
m-,p-XYLENE		TORA	ND[5.6E-02]		M18	
m-,p-XYLENE		TORB	ND[3.3E-02]		M18	
m-,p-XYLENE		TORMD		3.8E-04	HEATED CANISTER	FID
m-,p-XYLENE		TORMO		1.3E-04	HEATED CANISTER	FID
m-,p-XYLENE		TORIH	ND[3.3E-02]		HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	2		ND to 3.8E-04	2.6E-04		
o-XYLENE		TORA	ND[5.6E-02]		M18	
o-XYLENE		TORB	ND[3.3E-02]		M18	
o-XYLENE		TORMD		1.5E-03	HEATED CANISTER	FID
o-XYLENE		TORMO		1.6E-03	HEATED CANISTER	FID
o-XYLENE		TORIH	ND[3.3E-02]		HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	2		ND to 1.6E-03	1.6E-03		
XYLENES		TORMC		6.4E-04	HEATED CANISTER	FID
TERPENES		TORMD	ND[1.8E-05]	9.0E-06	HEATED CANISTER	FID
TERPENES		TORMO		1.6E-01	HEATED CANISTER	FID
TERPENES		TORIH	ND to 0.081	5.1E-02	HEATED CANISTER	FID
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
3	2		ND to 1.6E-01	5.1E-02		
			lb C/ton TO	lb C/ton TO		
TOTAL HYDROCARBONS		TORA	4.1 to 9.8	6.9E+00	M25A	
TOTAL HYDROCARBONS		TORB	0.2 to 2.8	1.0E+00	M25A	
TOTAL HYDROCARBONS		TORMC		5.1E+01	M25A	
TOTAL HYDROCARBONS		TORMD		2.9E+00	M25A	
TOTAL HYDROCARBONS		TORMO		1.1E-01	M25A	
NO. OF TESTS	DETECTS		RANGE	MEDIAN		
5	5		1.1E-01 to 9.8E+00	2.9E+00		

Notes

(a) U - unidentified and unconfirmed by GC/MS

(b) For Tall Oil Reactors with codes TORMX (X = A to Q) the heated canister gases were concentrated before analysis on the FID;

(c) For Tall Oil Reactors with codes TORIX (X = A to J) the heated canister gases were not concentrated before analysis on the FID;

MEDIAN - empirical median

TABLE 17 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM CAUSTICIZING AREA VENTS, CONTD.

SOURCE: SLAKER AND CAUSTICIZER TANK VENT EMISSIONS

VOLATILE ORGANIC COMPOUND	NO. OF SOURCES	EMISSIONS RANGE lb/ton CaO	MEDIAN lb/ton CaO	TEST METHOD	COMMENTS
ACETALDEHYDE	3	1.5E-03 to 5.6E-02	6.8E-03	HEATED CANISTER	FID WITH CONCENTRATOR
ACETONE	3	8.8E-04 to 1.9E-02	8.0E-03	HEATED CANISTER	FID WITH CONCENTRATOR
ACROLEIN	3	ND to 1.1E-04	4.7E-05	HEATED CANISTER	FID WITH CONCENTRATOR, U
AMMONIA	7	1.1E-01 to 1.0E+00	4.6E-01	Modified M6	
BENZENE	3	ND to 1.4E-04	5.0E-05	HEATED CANISTER	FID WITH CONCENTRATOR
CARBON TETRACHLORIDE	3		ND[5.8E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROBENZENE	3		ND[3.5E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROFORM	3		ND[4.5E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
1,2-DICHLOROETHANE	3		ND[1.2E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
1,2-DICHLOROETHYLENE	3	ND to 7.8E-04	3.8E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
DIMETHYL DISULFIDE	3		ND[3.2E-03]	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL SULFIDE	3		ND[9.7E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
FORMALDEHYDE	3		ND[4.7E-04]	NMIT	NCASI IMPINGER METHOD
n-HEXANE	2		ND[4.3E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
METHANOL	3	9.1E-03 to 2.4E-01	5.4E-02	HEATED CANISTER	FID WITH CONCENTRATOR
METHYLENE CHLORIDE	3		ND[2.4E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ETHYL KETONE	3	1.5E-04 to 1.4E-03	1.2E-03	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ISOBUTYL KETONE	3	ND to 1.1E-4	4.9E-05	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL MERCAPTAN	3		ND[7.5E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
STYRENE	3	ND to 1.2E-03	4.0E-04	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES	3	2.7E-03 to 1.8E-02	8.4E-03	HEATED CANISTER	FID WITH CONCENTRATOR
TETRACHLOROETHYLENE	3	ND to 1.9E-04	9.6E-05	HEATED CANISTER	FID WITH CONCENTRATOR, U
TOLUENE	3	ND to 3.1E-04	1.7E-04	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE	3	ND to 6.5E-05	3.9E-05	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,1,1-TRICHLOROETHANE	3		ND[1.3E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
1,1,2-TRICHLOROETHANE	3		ND[1.3E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
TRICHLOROETHYLENE	3		ND[1.2E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE	3	ND to 6.6E-05	4.1E-05	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE	3	ND to 5.0E-05	3.4E-05	HEATED CANISTER	FID WITH CONCENTRATOR
		lb C/ton CaO	lb C/ton CaO		
TOTAL HYDROCARBONS	3	1.1E-02 to 5.7E-02	4.4E-02	M25A	

Notes

(a) Where the median has been represented as ND, the detection limit is the median of the three detection limits of the three tests.

(b) Non-Detect observations are included in the median determination (at half the detection limit) if their detection limits are less than or equal to twice the largest average detected observation.

MEDIAN - empirical median

TABLE 17 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM CAUSTICIZING AREA VENTS, CONTD.

SOURCE: LIME MUD PRECOAT FILTER VENTS

VOLATILE ORGANIC COMPOUND	NO. OF SOURCES	EMISSIONS RANGE lb/ton CaO	EMISSIONS MEDIAN lb/ton CaO	TEST METHOD	COMMENTS
ACETALDEHYDE	2	6.7E-05 to 2.9E-03	1.1E-03	CANISTER/NMIT	FID WITH CONCENTRATOR
ACETONE	3	1.2E-05 to 1.1E-03	8.5E-04	HEATED CANISTER	FID WITH CONCENTRATOR
ACROLEIN	2	ND to 1.0E-04	5.3E-05	HEATED CANISTER	FID WITH CONCENTRATOR
BENZENE	3	ND to 4.1E-05	1.9E-05	HEATED CANISTER	FID WITH CONCENTRATOR
CARBON TETRACHLORIDE	3		ND[4.6E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROBENZENE	3	ND to 1.5E-04	6.2E-05	HEATED CANISTER	FID WITH CONCENTRATOR, U
CHLOROFORM	3		ND[3.6E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
1,2-DICHLOROETHANE	3		ND[9.8E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
1,2-DICHLOROETHYLENE	3		ND[7.2E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL DISULFIDE	3		ND[1.2E-03]	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL SULFIDE	3	ND to 1.0E-03	5.0E-04	HEATED CANISTER	FID WITH CONCENTRATOR
FORMALDEHYDE	2	ND to 2.0E-04	2.1E-04	NMIT	NCASI IMPINGER METHOD
n-HEXANE	1		ND[6.8E-06]	HEATED CANISTER	FID WITH CONCENTRATOR
METHANOL	3	1.5E-04 to 1.2E-02	1.2E-02	HEATED CANISTER	FID WITH CONCENTRATOR
METHYLENE CHLORIDE	3		ND[1.9E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ETHYL KETONE	3	2.0E-05 to 3.0E-04	1.5E-04	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ISOBUTYL KETONE	3	ND to 2.2E-4	9.2E-05	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL MERCAPTAN	3		ND[6.0E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
STYRENE	3	ND to 6.9E-05	3.7E-05	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES	3	7.7E-05 to 5.3E-03	2.6E-03	HEATED CANISTER	FID WITH CONCENTRATOR
TETRACHLOROETHYLENE	3	ND to 3.7E-05	6.3E-05	HEATED CANISTER	FID WITH CONCENTRATOR, U
TOLUENE	3	ND to 5.4E-04	1.9E-04	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE	3		ND[4.5E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
1,1,1-TRICHLOROETHANE	3	ND to 1.7E-04	8.5E-05	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,1,2-TRICHLOROETHANE	3		ND[9.9E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
TRICHLOROETHYLENE	3		ND[9.8E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE	3	ND to 2.2E-04	8.2E-05	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE	3	1.0E-05 to 9.5E-05	4.5E-05	HEATED CANISTER	FID WITH CONCENTRATOR
		lb C/ton CaO	lb C/ton CaO		
TOTAL HYDROCARBONS	3	1.0E-03 to 3.0E-02	4.1E-03	M25A	

Notes

(a) Where the median has been represented as ND, the detection limit is the median of the three detection limits of the three tests.

(b) Non-Detect observations are included in the median determination (at half the detection limit) if their detection limits are less than or equal to twice the largest average detected observation.

MEDIAN - empirical median

TABLE 17 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM CAUSTICIZING AREA VENTS, CONTD.

SOURCE: PRECOAT FILTER VACUUM PUMP EXHAUSTS

VOLATILE ORGANIC COMPOUND	NO. OF SOURCES	EMISSIONS RANGE lb/ton CaO	AVG lb/ton CaO	TEST METHOD	COMMENTS
ACETALDEHYDE	2	ND to 4.0E-04	2.0E-04	CANISTER/NMIT	FID WITH CONCENTRATOR
ACETONE	2	ND to 2.2E-03	1.1E-03	HEATED CANISTER	FID WITH CONCENTRATOR
ACROLEIN	2		ND[8.7E-06]	HEATED CANISTER	FID WITH CONCENTRATOR
BENZENE	2		ND[9.2E-06]	HEATED CANISTER	FID WITH CONCENTRATOR
CARBON TETRACHLORIDE	2		ND[7.4E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROBENZENE	2		ND1.3E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROFORM	2	ND to 1.1E-04	7.1E-05	HEATED CANISTER	FID WITH CONCENTRATOR
1,2-DICHLOROETHANE	2		ND[2.0E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
1,2-DICHLOROETHYLENE	2	ND to 4.4E-05	2.8E-05	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL DISULFIDE	2	ND to 3.4E-4	2.1E-04	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL SULFIDE	2	ND to 1.4E-03	7.5E-04	HEATED CANISTER	FID WITH CONCENTRATOR
FORMALDEHYDE	2		ND[2.8E-05]	NMIT	NCASI IMPINGER METHOD
METHANOL	2	5.1E-04 to 3.5E-02	1.8E-02	HEATED CANISTER	FID WITH CONCENTRATOR
METHYLENE CHLORIDE	2		ND[5.6E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ETHYL KETONE	2	ND to 9.8E-04	4.9E-04	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ISOBUTYL KETONE	2	ND to 1.4E-4	7.6E-05	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL MERCAPTAN	2	ND to 2.7E-04	1.5E-04	HEATED CANISTER	FID WITH CONCENTRATOR
STYRENE	2	ND to 4.2E-05	2.4E-05	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES	1		5.0E-03	HEATED CANISTER	FID WITH CONCENTRATOR
TETRACHLOROETHYLENE	2		ND[9.7E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
TOLUENE	2	ND to 1.0E-05	8.1E-06	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE	2	ND to 6.6E-04	3.3E-04	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,1,1-TRICHLOROETHANE	2		ND[2.0E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
1,1,2-TRICHLOROETHANE	2		ND[2.0E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
TRICHLOROETHYLENE	2		ND[2.2E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE	2	ND to 1.9E-05	1.5E-05	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE	2	ND to 3.5E-05	2.3E-05	HEATED CANISTER	FID WITH CONCENTRATOR
		lb C/ton CaO	lb C/ton CaO		
TOTAL HYDROCARBONS	2	1.7E-04 to 3.5E-02	1.8E-02	M25A	

Notes

(a) Where the average has been represented as ND, the detection limit is the average of the two detection limits of the two tests.

(b) If one test is ND, then this ND is included in the average determination (at half the detection limit) if its detection limit is less than or equal to twice the largest average detected observation.

TABLE 17 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM CAUSTICIZING AREA VENTS, CONTD.

SOURCE: GREEN LIQUOR CLARIFIER AND SURGE TANK VENTS

VOLATILE ORGANIC COMPOUND	NO. OF SOURCES	CLARIFIER VENT AVG lb/ton CaO	SURGE TNK VENT AVG lb/ton CaO	TEST METHOD	COMMENTS
ACETALDEHYDE	1	1.0E-04	5.8E-05	CANISTER/NMIT	FID WITH CONCENTRATOR
ACETONE	1	1.5E-03	6.6E-05	HEATED CANISTER	FID WITH CONCENTRATOR
ACROLEIN	1		ND[1.5E-07]	HEATED CANISTER	FID WITH CONCENTRATOR
BENZENE	1	2.8E-05	4.7E-06	HEATED CANISTER	FID WITH CONCENTRATOR
CARBON TETRACHLORIDE	1	ND[7.3E-05]	ND[1.6E-06]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROBENZENE	1	ND[4.4E-06]	1.9E-07	HEATED CANISTER	FID WITH CONCENTRATOR, U
CHLOROFORM	1	ND[5.6E-05]	2.0E-06	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,2-DICHLOROETHANE	1	ND[1.6E-05]	1.2E-06	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,2-DICHLOROETHYLENE	*1*	*1.0E-04*	*ND[2.5E-07]*	*HEATED CANISTER*	*FID WITH CONCENTRATOR, U*
DIMETHYL DISULFIDE	1	2.0E-04	3.1E-05	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL SULFIDE	1	ND[1.2E-04]	4.8E-05	HEATED CANISTER	FID WITH CONCENTRATOR
FORMALDEHYDE	1		ND[1.5E-06]	NMIT	NCASI IMPINGER METHOD
n-HEXANE	1		1.1E-06	HEATED CANISTER	FID WITH CONCENTRATOR
METHANOL	1	1.3E-01	1.1E-03	HEATED CANISTER	FID WITH CONCENTRATOR
METHYLENE CHLORIDE	1	ND[3.0E-05]	ND[6.7E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ETHYL KETONE	1	2.0E-04	2.0E-05	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ISOBUTYL KETONE	1	1.1E-05	2.9E-06	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL MERCAPTAN	1	4.2E-04	2.1E-06	HEATED CANISTER	FID WITH CONCENTRATOR
STYRENE	1	1.1E-04	ND[9.1E-08]	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES	1	6.3E-03	1.2E-03	HEATED CANISTER	FID WITH CONCENTRATOR
TETRACHLOROETHYLENE	1	ND[2.0E-05]	1.4E-06	HEATED CANISTER	FID WITH CONCENTRATOR, U
TOLUENE	1	1.0E-05	3.2E-06	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE	1	ND[7.2E-06]	ND[1.6E-07]	HEATED CANISTER	FID WITH CONCENTRATOR
1,1,1-TRICHLOROETHANE	1	ND[1.6E-05]	8.9E-07	HEATED CANISTER	FID WITH CONCENTRATOR, U
1,1,2-TRICHLOROETHANE	1	ND[1.6E-05]	6.5E-06	HEATED CANISTER	FID WITH CONCENTRATOR, U
TRICHLOROETHYLENE	1	ND[1.6E-05]	ND[3.4E-07]	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE	1	1.9E-04	ND[9.3E-08]	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE	1	1.0E-05	3.4E-07	HEATED CANISTER	FID WITH CONCENTRATOR
		lb C/ton CaO	lb C/ton CaO		
TOTAL HYDROCARBONS	1	6.6E-02	1.4E-03	M25A	

TABLE 17 SUMMARY OF 'AIR TOXIC' EMISSIONS FROM CAUSTICIZING AREA VENTS, CONTD.

SOURCE: WHITE LIQUOR AND WEAK WASH PRESSURE FILTER VENT

VOLATILE ORGANIC COMPOUND	NO. OF SOURCES	WHITE LIQ & WEAK WASH AVG lb/ton CaO	WHITE LIQUOR AVG lb/ton CaO	TEST METHOD	COMMENTS
ACETALDEHYDE	1	1.8E-03	ND[7.1E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
ACETONE	1	1.4E-03	5.3E-04	HEATED CANISTER	FID WITH CONCENTRATOR
ACROLEIN	1	5.9E-05	ND[6.8E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
BENZENE	1	6.1E-05	2.9E-05	HEATED CANISTER	FID WITH CONCENTRATOR
CARBON TETRACHLORIDE	1	ND[7.6E-04]	ND[7.4E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROBENZENE	1	ND[4.6E-05]	ND[4.5E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
CHLOROFORM	1	ND[5.9E-04]	ND[5.8E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
~~1,2-DICHLOROETHANE~~	~~1~~	~~ND[1.6E-04]~~	~~ND[1.6E-04]~~	~~HEATED CANISTER~~	~~FID WITH CONCENTRATOR~~
1,2-DICHLOROETHYLENE	1	1.0E-04	ND[1.2E-04]	HEATED CANISTER	FID WITH CONCENTRATOR, U
DIMETHYL DISULFIDE	1	ND[1.9E-03]	ND[1.9E-03]	HEATED CANISTER	FID WITH CONCENTRATOR
DIMETHYL SULFIDE	1	ND[1.3E-03]	ND[1.3E-03]	HEATED CANISTER	FID WITH CONCENTRATOR
FORMALDEHYDE	1	ND[3.7E-04]	2.2E-03	NMIT	NCASI IMPINGER METHOD
METHANOL	1	3.3E-02	1.5E-02	HEATED CANISTER	FID WITH CONCENTRATOR
METHYLENE CHLORIDE	1	ND[3.1E-04]	ND[3.1E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ETHYL KETONE	1	1.9E-04	1.6E-04	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL ISOBUTYL KETONE	1	3.9E-05	ND[3.6E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
METHYL MERCAPTAN	1	ND[9.9E-04]	ND[9.7E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
STYRENE	1	4.2E-05	4.9E-05	HEATED CANISTER	FID WITH CONCENTRATOR
TERPENES	1	1.4E-02	3.3E-03	HEATED CANISTER	FID WITH CONCENTRATOR
TETRACHLOROETHYLENE	1	ND[2.0E-04]	ND[2.0E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
TOLUENE	1	1.5E-05	ND[3.7E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
1,2,4-TRICHLOROBENZENE	1	ND[7.4E-05]	ND[7.3E-05]	HEATED CANISTER	FID WITH CONCENTRATOR
1,1,1-TRICHLOROETHANE	1	ND[1.6E-04]	ND[1.6E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
1,1,2-TRICHLOROETHANE	1	ND[1.6E-04]	ND[1.6E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
TRICHLOROETHYLENE	1	ND[1.6E-04]	ND[1.6E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
m,p-XYLENE	1	4.6E-05	ND[4.3E-04]	HEATED CANISTER	FID WITH CONCENTRATOR
o-XYLENE	1	3.9E-05	6.2E-05	HEATED CANISTER	FID WITH CONCENTRATOR
		lb C/ton CaO	lb C/ton CaO		
TOTAL HYDROCARBONS	1	7.5E-03	5.6E-03	M25A	

ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC.
P.O. BOX 13318, RESEARCH TRIANGLE PARK, NC 27709-3318

LABORATORY AND LIMITED FIELD MEASUREMENTS OF VOC EMISSIONS FROM WOOD RESIDUALS

TECHNICAL BULLETIN NO. 723

SEPTEMBER 1996

two batches of samples. This result may indicate that the VOC emission rate is related to log harvest location.

For loblolly pine, the winter and spring sawdust and shavings were taken from the same site. The VOC emission rates measured for the spring harvest materials were less than half of those for the winter harvest materials. Because the logs were harvested from the same location and the lumber was manufactured at the same site, this difference in VOC emissions suggests seasonal variability in VOC content of the wood.

TABLE 4 VOC EMISSION RATES FROM SOFTWOOD RESIDUALS

WOOD SPECIES	WOOD RESIDUAL	VOC EMISSION RATE, lb C/Tdw WINTER[a]	VOC EMISSION RATE, lb C/Tdw SPRING[b]
Douglas fir	Sawdust	1.05	1.66
	Shavings	0.80	0.71
	Chips	0.70	0.72
	Bark	0.63	0.37
Ponderosa pine	Sawdust	7.66	5.40
	Shavings	2.79	4.47
	Chips	4.02	2.90
	Bark	2.12	2.43
Slash pine	Chips	2.86	-
	Bark	2.60	-
Loblolly pine	Sawdust	6.93	2.76
	Shavings	1.49	0.36
	Chips	-	2.16
	Bark	-	2.82
A Mexican pine	Shavings	-	2.22
Western SW&HW	Mixed hog fuel	0.27	-

[a] Residuals produced from winter-harvested logs.
[b] Residuals produced from spring-harvested logs.

Loblolly pine chips and bark had similar VOC emission rates to those measured for chips and bark of slash pine. The VOC emission rate measured from the kiln-dried Mexican pine

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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

VOLATILE ORGANIC COMPOUND EMISSIONS FROM NON-CHEMICAL PULP AND PAPER MILL SOURCES

Part V - Paper Machines

Volume 1

TECHNICAL BULLETIN NO. 740

JULY 1997

Table 5-47. Summary of Wet End Emission Test Results for the No. 14 Paper Machine, Mill HH

Analyte		Fan Pump Silo Vent HH20 Avg (lb/ADTFP)	Vacuum Systems Vent HH23 Avg (lb/ADTFP)	Wet End Roof Vent HH24 Avg (lb/ADTFP)	Total Wet End Emissions (lb/ADTFP)
acetaldehyde	(H)	2.6E-4	2.0E-3	7.9E-3	1.0E-2
biphenyl	(H)	4.7E-4	3.9E-3	ND 2.7E-2	4.4E-3
carbon disulfide	(H)	ND 2.6E-4	ND 9.3E-4	ND 5.6E-3	ND 6.7E-3
3-carene		ND 4.5E-4	ND 1.6E-3	ND 9.8E-3	ND 1.2E-2
chloroform	(H)	7.3E-4	ND 1.8E-3	1.4E-2	1.5E-2
cumene	(H)	ND 4.1E-4	ND 1.5E-3	ND 8.9E-3	ND 1.1E-2
p-cymene		ND 5.4E-4	ND 2.0E-3	ND 1.2E-2	ND 1.4E-2
1,2-dimethoxyethane	(H)	ND 2.8E-4	ND 9.9E-4	ND 6.0E-3	ND 7.2E-3
limonene		ND 5.5E-4	ND 2.0E-3	ND 1.2E-2	ND 1.4E-2
methanol	(H)	7.4E-5	2.0E-4	3.1E-2	3.1E-2
methyl ethyl ketone (MEK)	(H)	ND 3.4E-4	ND 1.2E-3	ND 7.4E-3	ND 9.0E-3
methylene chloride	(H)	ND 2.6E-4	ND 9.4E-4	ND 5.6E-3	ND 6.8E-3
naphthalene	(H)	ND 5.0E-4	ND 1.8E-3	ND 1.1E-2	ND 1.3E-2
phenol	(H)	ND 1.4E-2	ND 4.9E-2	ND 2.9E-1	ND 3.6E-1
alpha-pinene		ND 6.5E-4	ND 2.4E-3	ND 1.4E-2	ND 1.7E-2
beta-pinene		ND 5.1E-4	ND 1.9E-3	ND 1.1E-2	ND 1.3E-2
propionaldehyde	(H)	ND 2.4E-4	ND 8.8E-4	ND 5.2E-3	ND 6.4E-3
toluene	(H)	ND 3.6E-4	ND 1.3E-3	ND 7.7E-3	ND 9.4E-3
formaldehyde	(H)	ND 1.2E-5	ND 5.8E-6	1.8E-5	1.8E-5
THC (as C)		8.1E-3	1.5E-2	1.7E-3	2.5E-2
Total HAPs		1.5E-3	6.1E-3	5.3E-2	6.1E-2
Prod. Rate (ADTFP/D)		192	192	33	
Vol. Flow Rate (DSCFM)		10000	13200	13400	
Source Moisture (%)		2.2	7.2	3.7	
Source Temp (C)		25.1	40.2	31.5	

ND x.xEx = Below Detection Limit of x.xEx

ADTFP/D = Air Dried Tons of Finished Product Per Day

H = CAA HAP

TABLE B76. SUMMARY OF EMISSION TEST RESULTS
No. 12 Paper Machine, Fourdrinier Vent
HH12

ANALYTE		RUN1			RUN2			RUN3			AVERAGE EMISSION		
			ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP
acetaldehyde	(H)		3.5E-2	1.1E-3		1.5E-1	4.8E-3	ND	4.2E-2	1.4E-3		6.1E-2	2.0E-3
biphenyl	(H)		1.6E-1	1.8E-2		1.8E-1	2.1E-2		1.4E-1	1.6E-2		1.6E-1	1.8E-2
carbon disulfide	(H)	ND	1.7E-2	9.5E-4	ND	2.5E-2	1.4E-3	ND	2.7E-2	1.5E-3	ND	2.3E-2	1.3E-3
3-carene		ND	1.7E-2	1.7E-3	ND	2.4E-2	2.4E-3	ND	2.6E-2	2.6E-3	ND	2.2E-2	2.3E-3
chloroform	(H)	ND	2.1E-2	1.8E-3	ND	3.1E-2	2.7E-3	ND	3.3E-2	2.9E-3	ND	2.8E-2	2.5E-3
cumene	(H)	ND	1.7E-2	1.5E-3	ND	2.5E-2	2.2E-3	ND	2.7E-2	2.4E-3	ND	2.3E-2	2.1E-3
p-cymene		ND	2.0E-2	2.0E-3	ND	3.0E-2	2.9E-3	ND	3.2E-2	3.2E-3	ND	2.7E-2	2.7E-3
1,2-dimethoxyethane	(H)	ND	1.5E-2	1.0E-3	ND	2.2E-2	1.5E-3	ND	2.4E-2	1.6E-3	ND	2.1E-2	1.4E-3
limonene		ND	2.0E-2	2.0E-3	ND	2.9E-2	3.0E-3	ND	3.2E-2	3.2E-3	ND	2.7E-2	2.7E-3
methanol	(H)	ND	3.5E-2	8.4E-4	ND	5.2E-2	1.2E-3	ND	5.6E-2	1.3E-3	ND	4.8E-2	1.1E-3
methyl ethyl ketone (MEK)	(H)	ND	2.4E-2	1.3E-3	ND	3.5E-2	1.9E-3	ND	3.8E-2	2.0E-3	ND	3.2E-2	1.7E-3
methylene chloride	(H)		2.5E-2	1.5E-3		2.6E-2	1.7E-3	ND	2.4E-2	1.5E-3		1.7E-2	1.1E-3
naphthalene	(H)	ND	2.0E-2	1.9E-3	ND	2.9E-2	2.7E-3	ND	3.1E-2	2.9E-3	ND	2.6E-2	2.5E-3
phenol	(H)		9.1E-1	6.3E-2	ND	1.1E+0	7.3E-2	ND	1.1E+0	7.9E-2		3.0E-1	2.1E-2
alpha-pinene		ND	2.4E-2	2.4E-3	ND	3.5E-2	3.5E-3	ND	3.8E-2	3.8E-3	ND	3.2E-2	3.3E-3
beta-pinene		ND	1.9E-2	1.9E-3	ND	2.8E-2	2.8E-3	ND	3.0E-2	3.0E-3	ND	2.5E-2	2.6E-3
propionaldehyde	(H)	ND	2.1E-2	9.0E-4	ND	3.1E-2	1.3E-3	ND	3.3E-2	1.4E-3	ND	2.8E-2	1.2E-3
toluene	(H)	ND	1.9E-2	1.3E-3	ND	2.8E-2	1.9E-3	ND	3.1E-2	2.1E-3	ND	2.6E-2	1.8E-3
formaldehyde	(H)	ND	2.0E-3	4.4E-5	ND	1.3E-3	2.8E-5	ND	1.3E-3	2.9E-5	ND	1.5E-3	3.4E-5
THC (as C)			6.8E+0	6.1E-2		8.0E+0	7.1E-2		6.9E+0	6.1E-2		7.3E+0	6.4E-2
Total HAPs				8.4E-2			2.7E-2			1.6E-2			4.2E-2
Prod. Rate (ADTP/D)				240			240			240			240
Vol. Flow Rate (DSCFM)				47400			47400			47400			47400
Source Moisture (%)				2.7			2.8			2.8			2.8
Source Temp (C)				23.0			23.4			23.4			23.3

ND x.xEx = Below Detection Limit of x.xEx

ADTFP = Air Dried Tons of Finished Product per Day

H = CAA HAP

TABLE B77. SUMMARY OF EMISSION TEST RESULTS
No. 12 Paper Machine, Fan Pump Silo Vent
HH13

ANALYTE		RUN1			RUN2			RUN3			AVERAGE EMISSION	
			ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP
acetaldehyde	(H)		1.8E-1	6.0E-4		4.0E-2	1.3E-4		8.4E-2	2.8E-4		1.0E-1	3.4E-4
biphenyl	(H)	ND	3.5E-2	4.2E-4	ND	3.7E-2	4.4E-4	ND	3.5E-2	4.1E-4	ND	3.6E-2	4.2E-4
carbon disulfide	(H)	ND	1.5E-2	8.6E-5	ND	1.5E-2	9.0E-5	ND	1.5E-2	8.6E-5	ND	1.5E-2	8.7E-5
3-carene		ND	1.5E-2	1.5E-4	ND	1.5E-2	1.6E-4	ND	1.4E-2	1.5E-4	ND	1.5E-2	1.5E-4
chloroform	(H)		1.1E-1	9.7E-4		9.2E-2	8.4E-4		4.4E-2	4.0E-4		8.1E-2	7.4E-4
cumene	(H)	ND	1.5E-2	1.4E-4	ND	1.6E-2	1.4E-4	ND	1.5E-2	1.4E-4	ND	1.5E-2	1.4E-4
p-cymene		ND	1.8E-2	1.8E-4	ND	1.9E-2	1.9E-4	ND	1.8E-2	1.8E-4	ND	1.8E-2	1.8E-4
1,2-dimethoxyethane	(H)	ND	1.3E-2	9.2E-5	ND	1.4E-2	9.6E-5	ND	1.3E-2	9.2E-5	ND	1.4E-2	9.3E-5
limonene		ND	1.8E-2	1.8E-4	ND	1.8E-2	1.9E-4	ND	1.8E-2	1.8E-4	ND	1.8E-2	1.9E-4
methanol	(H)		5.2E-1	1.3E-3		3.3E-1	8.1E-4		2.4E-1	6.0E-4		3.7E-1	8.9E-4
methyl ethyl ketone (MEK)	(H)		4.3E-2	2.4E-4	ND	2.2E-2	1.2E-4	ND	2.1E-2	1.1E-4		1.4E-2	7.9E-5
methylene chloride	(H)	ND	1.3E-2	8.7E-5	ND	1.4E-2	9.1E-5	ND	1.3E-2	8.6E-5	ND	1.4E-2	8.8E-5
naphthalene	(H)	ND	1.7E-2	1.7E-4	ND	1.8E-2	1.8E-4	ND	1.7E-2	1.7E-4	ND	1.7E-2	1.7E-4
phenol	(H)	ND	6.3E-1	4.5E-3	ND	6.6E-1	4.7E-3	ND	6.3E-1	4.5E-3	ND	6.4E-1	4.6E-3
alpha-pinene		ND	2.1E-2	2.2E-4	ND	2.2E-2	2.3E-4	ND	2.1E-2	2.2E-4	ND	2.1E-2	2.2E-4
beta-pinene		ND	1.6E-2	1.7E-4	ND	1.7E-2	1.8E-4	ND	1.6E-2	1.7E-4	ND	1.7E-2	1.7E-4
propionaldehyde	(H)		1.8E-2	8.2E-5	ND	1.9E-2	8.5E-5	ND	1.8E-2	8.1E-5		6.1E-3	2.7E-5
toluene	(H)		1.9E-1	1.4E-3		1.4E-1	9.5E-4		6.3E-2	4.4E-4		1.3E-1	9.2E-4
formaldehyde	(H)		2.1E-3	4.9E-6	ND	2.2E-3	5.2E-6		2.3E-3	5.2E-6		1.5E-3	3.3E-6
THC (as C)			4.9E+0	4.5E-3		3.2E+0	2.9E-3		2.0E+0	1.8E-3		3.4E+0	3.1E-3
Total HAPs				4.5E-3			2.7E-3			1.7E-3			3.0E-3
Prod. Rate (ADTP/D)		240			240			240			240		
Vol. Flow Rate (DSCFM)		4900			4900			4900			4900		
Source Moisture (%)		2.2			2.0			2.0			2.1		
Source Temp (C)		20.0			20.9			20.1			20.3		

ND x.xEx = Below Detection Limit of x.xEx

ADTFP = Air Dried Tons of Finished Product per Day

H = CAA HAP

8/11/97
11:29 AM

TABLE B78. SUMMARY OF EMISSION TEST RESULTS
No. 12 Paper Machine, Vacuum Systems Vent
HH14

ANALYTE		RUN1			RUN2			RUN3			AVERAGE EMISSION		
			ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP
acetaldehyde	(H)		1.5E-1	1.6E-3	ND	4.5E-2	4.8E-4		6.4E-2	7.0E-4		7.2E-2	7.8E-4
biphenyl	(H)		1.4E-1	5.4E-3	ND	6.7E-2	2.5E-3	ND	7.0E-2	2.7E-3		4.7E-2	1.8E-3
carbon disulfide	(H)	ND	3.0E-2	5.6E-4	ND	2.8E-2	5.3E-4	ND	2.9E-2	5.5E-4	ND	2.9E-2	5.4E-4
3-carene		ND	2.9E-2	9.8E-4	ND	2.8E-2	9.2E-4	ND	2.9E-2	9.6E-4	ND	2.9E-2	9.6E-4
chloroform	(H)		1.0E-1	2.9E-3	ND	3.5E-2	1.0E-3		9.6E-2	2.8E-3		6.5E-2	1.9E-3
cumene	(H)	ND	3.0E-2	9.0E-4	ND	2.9E-2	8.5E-4	ND	3.0E-2	8.8E-4	ND	3.0E-2	8.8E-4
p-cymene		ND	3.6E-2	1.2E-3	ND	3.4E-2	1.1E-3	ND	3.5E-2	1.2E-3	ND	3.5E-2	1.1E-3
1,2-dimethoxyethane	(H)	ND	2.7E-2	6.0E-4	ND	2.5E-2	5.6E-4	ND	2.6E-2	5.9E-4	ND	2.6E-2	5.8E-4
limonene		ND	3.6E-2	1.2E-3	ND	3.3E-2	1.1E-3	ND	3.5E-2	1.2E-3	ND	3.5E-2	1.2E-3
methanol	(H)		5.4E-1	4.3E-3		2.5E-1	2.0E-3		7.2E-2	5.6E-4		2.9E-1	2.3E-3
methyl ethyl ketone (MEK)	(H)	ND	4.2E-2	7.5E-4	ND	3.9E-2	7.0E-4	ND	4.1E-2	7.3E-4	ND	4.1E-2	7.3E-4
methylene chloride	(H)	ND	2.7E-2	5.6E-4	ND	2.5E-2	5.3E-4	ND	2.6E-2	5.5E-4	ND	2.6E-2	5.5E-4
naphthalene	(H)	ND	3.5E-2	1.1E-3	ND	3.2E-2	1.0E-3	ND	3.4E-2	1.1E-3	ND	3.4E-2	1.1E-3
phenol	(H)	ND	1.3E+0	2.9E-2	ND	1.2E+0	2.8E-2	ND	1.2E+0	2.9E-2	ND	1.2E+0	2.9E-2
alpha-pinene		ND	4.2E-2	1.4E-3	ND	4.0E-2	1.3E-3	ND	4.2E-2	1.4E-3	ND	4.1E-2	1.4E-3
beta-pinene		ND	3.3E-2	1.1E-3	ND	3.1E-2	1.0E-3	ND	3.3E-2	1.1E-3	ND	3.2E-2	1.1E-3
propionaldehyde	(H)	ND	3.7E-2	5.3E-4	ND	3.5E-2	5.0E-4	ND	3.6E-2	5.2E-4	ND	3.6E-2	5.1E-4
toluene	(H)		1.6E-1	3.7E-3		6.0E-2	1.4E-3	ND	3.4E-2	7.6E-4		7.4E-2	1.7E-3
formaldehyde	(H)		1.1E-3	8.4E-6		1.4E-3	1.0E-5	ND	1.1E-3	8.4E-6		8.4E-4	6.2E-6
THC (as C)			2.2E+0	6.6E-3		3.9E+0	1.2E-2		2.1E+0	6.2E-3		2.7E+0	8.1E-3
Total HAPs				1.8E-2			3.3E-3			4.1E-3			8.4E-3
Prod. Rate (ADTP/D)				240			240			240			240
Vol. Flow Rate (DSCFM)				15800			15800			15800			15800
Source Moisture (%)				5.1			4.9			5.2			5.1
Source Temp (C)				33.6			32.8			34.1			33.5

ND x.xEx = Below Detection Limit of x.xEx

ADTFP = Air Dried Tons of Finished Product per Day

H = CAA HAP

TABLE B79. SUMMARY OF EMISSION TEST RESULTS
No. 12 Paper Machine, After-dryer Vent
HH15

ANALYTE		RUN1			RUN2			RUN3			AVERAGE EMISSION		
			ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP
acetaldehyde	(H)	ND	9.7E-2	1.3E-3		6.4E-2	8.7E-4	ND	9.0E-2	1.2E-3		2.1E-2	2.9E-4
biphenyl	(H)		3.9E-1	1.8E-2		2.6E-1	1.2E-2		9.3E-2	4.4E-3		2.5E-1	1.2E-2
carbon disulfide	(H)	ND	6.1E-2	1.4E-3	ND	6.2E-2	1.5E-3	ND	5.7E-2	1.3E-3	ND	6.0E-2	1.4E-3
3-carene		ND	6.0E-2	2.5E-3	ND	6.1E-2	2.6E-3	ND	5.6E-2	2.3E-3	ND	5.9E-2	2.5E-3
chloroform	(H)	ND	7.6E-2	2.8E-3	ND	7.7E-2	2.8E-3	ND	7.0E-2	2.6E-3	ND	7.4E-2	2.7E-3
cumene	(H)	ND	6.3E-2	2.3E-3	ND	6.3E-2	2.3E-3	ND	5.8E-2	2.1E-3	ND	6.1E-2	2.3E-3
p-cymene		ND	7.3E-2	3.0E-3	ND	7.4E-2	3.1E-3	ND	6.8E-2	2.8E-3	ND	7.2E-2	3.0E-3
1,2-dimethoxyethane	(H)	ND	5.6E-2	1.5E-3	ND	5.6E-2	1.6E-3	ND	5.1E-2	1.4E-3	ND	5.4E-2	1.5E-3
limonene		ND	7.3E-2	3.1E-3	ND	7.4E-2	3.1E-3	ND	6.8E-2	2.8E-3	ND	7.2E-2	3.0E-3
methanol	(H)	ND	1.3E-1	1.3E-3	ND	1.3E-1	1.3E-3	ND	1.2E-1	1.2E-3	ND	1.3E-1	1.2E-3
methyl ethyl ketone (MEK)	(H)	ND	8.6E-2	1.9E-3	ND	8.8E-2	1.9E-3	ND	8.0E-2	1.8E-3	ND	8.5E-2	1.9E-3
methylene chloride	(H)	ND	5.6E-2	1.4E-3	ND	5.6E-2	1.5E-3	ND	5.1E-2	1.3E-3	ND	5.4E-2	1.4E-3
naphthalene	(H)	ND	7.1E-2	2.8E-3	ND	7.2E-2	2.8E-3	ND	6.6E-2	2.6E-3	ND	7.0E-2	2.7E-3
phenol	(H)	ND	2.6E+0	7.6E-2	ND	2.6E+0	7.7E-2	ND	2.4E+0	7.0E-2	ND	2.6E+0	7.4E-2
alpha-pinene		ND	8.7E-2	3.6E-3	ND	8.8E-2	3.7E-3	ND	8.1E-2	3.4E-3	ND	8.5E-2	3.6E-3
beta-pinene		ND	6.8E-2	2.9E-3	ND	6.9E-2	2.9E-3	ND	6.3E-2	2.7E-3	ND	6.7E-2	2.8E-3
propionaldehyde	(H)	ND	7.6E-2	1.4E-3	ND	7.7E-2	1.4E-3	ND	7.0E-2	1.3E-3	ND	7.4E-2	1.3E-3
toluene	(H)	ND	7.1E-2	2.0E-3	ND	7.2E-2	2.0E-3	ND	6.5E-2	1.8E-3	ND	6.9E-2	2.0E-3
formaldehyde	(H)	ND	5.3E-4	4.9E-6	ND	5.7E-4	5.3E-6	ND	6.0E-4	5.5E-6	ND	5.7E-4	5.2E-6
THC (as C)			1.0E+1	3.7E-2		3.7E+0	1.4E-2		3.7E+0	1.4E-2		5.9E+0	2.2E-2
Total HAPs				1.8E-2			1.3E-2			4.4E-3			1.2E-2
Prod. Rate (ADTP/D)				240			240			240			240
Vol. Flow Rate (DSCFM)				19700			19700			19700			19700
Source Moisture (%)				3.0			3.0			3.0			3.0
Source Temp (C)				42.8			42.8			42.8			42.8

ND x.xEx = Below Detection Limit of x.xEx

ADTFP = Air Dried Tons of Finished Product per Day

H = CAA HAP

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TABLE B80. SUMMARY OF EMISSION TEST RESULTS

No. 12 Paper Machine, Yankee Dryer Vent

HH16

ANALYTE		RUN1			RUN2			RUN3			AVERAGE EMISSION	
		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP		ppmVd	lb/ADTFP
acetaldehyde (H)	ND	3.6E-1	1.5E-2		5.0E-1	2.1E-2		1.1E-1	4.6E-3		2.0E-1	8.5E-3
biphenyl (H)	ND	5.5E-1	8.0E-2		6.2E-1	9.0E-2		2.7E-1	3.9E-2		3.0E-1	4.3E-2
carbon disulfide (H)	ND	2.3E-1	1.6E-2	ND	1.4E-1	1.0E-2	ND	1.3E-1	9.3E-3	ND	1.7E-1	1.2E-2
3-carene	ND	2.3E-1	2.9E-2	ND	1.4E-1	1.8E-2	ND	1.3E-1	1.6E-2	ND	1.6E-1	2.1E-2
chloroform (H)	ND	2.8E-1	3.2E-2	ND	1.8E-1	2.0E-2	ND	1.6E-1	1.8E-2	ND	2.1E-1	2.3E-2
cumene (H)	ND	2.3E-1	2.6E-2	ND	1.5E-1	1.6E-2	ND	1.3E-1	1.5E-2	ND	1.7E-1	1.9E-2
p-cymene	ND	2.7E-1	3.5E-2	ND	1.7E-1	2.2E-2	ND	1.6E-1	2.0E-2	ND	2.0E-1	2.5E-2
1,2-dimethoxyethane (H)	ND	2.1E-1	1.8E-2	ND	1.3E-1	1.1E-2	ND	1.2E-1	1.0E-2	ND	1.5E-1	1.3E-2
limonene	ND	2.7E-1	3.5E-2	ND	1.7E-1	2.2E-2	ND	1.6E-1	2.0E-2	ND	2.0E-1	2.6E-2
methanol (H)	ND	4.8E-1	1.5E-2	ND	3.0E-1	9.0E-3	ND	2.7E-1	8.2E-3	ND	3.5E-1	1.1E-2
methyl ethyl ketone (MEK) (H)	ND	3.2E-1	2.2E-2	ND	2.0E-1	1.4E-2	ND	1.8E-1	1.2E-2	ND	2.4E-1	1.6E-2
methylene chloride (H)	ND	2.1E-1	1.7E-2	ND	1.3E-1	1.0E-2	ND	1.2E-1	9.4E-3	ND	1.5E-1	1.2E-2
naphthalene (H)	ND	2.7E-1	3.2E-2	ND	1.7E-1	2.0E-2	ND	1.5E-1	1.8E-2	ND	1.9E-1	2.3E-2
phenol (H)	ND	9.8E+0	8.7E-1	ND	6.1E+0	5.4E-1	ND	5.6E+0	4.9E-1	ND	7.1E+0	6.3E-1
alpha-pinene	ND	3.3E-1	4.2E-2	ND	2.0E-1	2.6E-2	ND	1.9E-1	2.4E-2	ND	2.4E-1	3.1E-2
beta-pinene	ND	2.6E-1	3.3E-2	ND	1.6E-1	2.0E-2	ND	1.5E-1	1.9E-2	ND	1.9E-1	2.4E-2
propionaldehyde (H)	ND	2.8E-1	1.6E-2	ND	1.8E-1	9.6E-3	ND	1.6E-1	8.8E-3	ND	2.1E-1	1.1E-2
toluene (H)	ND	2.6E-1	2.3E-2	ND	1.6E-1	1.4E-2	ND	1.5E-1	1.3E-2	ND	1.9E-1	1.7E-2
formaldehyde (H)		4.0E-4	1.1E-5		5.7E-4	1.6E-5		1.0E-3	2.9E-5		6.7E-4	1.9E-5
THC (as C)		5.0E+0	5.6E-2		1.1E+1	1.2E-1		1.1E+1	1.3E-1		9.0E+0	1.0E-1
Total HAPs			1.1E-5			1.1E-1			4.4E-2			5.2E-2
Prod. Rate (ADTP/D)			240			240			240			240
Vol. Flow Rate (DSCFM)			60400			60400			60400			60400
Source Moisture (%)			17.0			17.0			17.0			17.0
Source Temp (C)			196.1			196.1			196.1			196.1

ND x.xEx = Below Detection Limit of x.xEx

ADTFP = Air Dried Tons of Finished Product per Day

H = CAA HAP

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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

COMPILATION OF SPECIATED REDUCED SULFUR COMPOUND AND TOTAL REDUCED SULFUR EMISSIONS DATA FOR KRAFT MILL SOURCES

TECHNICAL BULLETIN NO. 849
AUGUST 2002

by
Arun V. Someshwar, Ph.D.
National Council for Air and Stream Improvement
Southern Regional Center, Gainesville, Florida

Table 17. TRS Data Summary – Kraft Thermal Oxidizers

	Gas Flow Rate		Vent Gas Properties			Prod.		Reduced Sulfur Compounds					TRS[1] as S
	acfm	dscfm	Temp °F	% H_2O	% O_2	ADTP/ day	dscfm/ ADTPD	Units	H_2S	MM	DMS	DMDS	
mean[a]	15,031[2]	5,343	486	36.3	16.5	1,585	4.1	ppmd	*0.26*	0.67	0.64	0.51	2.57
median	9,939[2]	4,719	173	43.1	16.5	1,306	3.5	ppmd	*0.18*	*0.53*	0.52	0.49	2.20
minimum		2,273	160	11.1	16.0	875	0.7	ppmd	*0.07*	*0.25*	*0.25*	*0.25*	*1.10*
maximum		9,887	1,290	53.0	17.1	3,270	8.3	ppmd	*0.89*	1.59	1.23	0.82	4.66
mean[a]								lb/ADTP	*7.9E-05*	4.6E-04	5.8E-04	7.5E-04	1.2E-03
median								lb/ADTP	*7.9E-05*	*3.4E-04*	4.6E-04	6.0E-04	9.5E-04
minimum								lb/ADTP	*6.5E-05*	*6.6E-05*	*4.6E-05*	*6.9E-05*	*1.9E-04*
maximum								lb/ADTP	*9.2E-05*	1.2E-03	1.5E-03	2.3E-03	3.2E-03
number of sources tested	7	8	7	8	3	8	8		2	8	8	8	8
number of sources with detects									0	3	2	1	3
% of TRS, S basis[b]									9.4%	22.6%	28.1%	39.9%	100.0%

[a] computed treating ND as ½ DL; [b] based upon mean of two data sets with all 4 reduced sulfur compounds tested

[1] Note: For total reduced sulfur or TRS, the mean and median are estimated from the means and medians of the individual reduced sulfur compounds, respectively. However, the minimum and maximum correspond to the actual minimum and maximum TRS concentration estimated among all sources.

[2] estimated from dscfm, T and % H_2O

All data in italics correspond to non-detects shown at one-half detection limit

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NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

COMPILATION OF 'AIR TOXIC' AND TOTAL HYDROCARBON EMISSIONS DATA FOR SOURCES AT KRAFT, SULFITE AND NON-CHEMICAL PULP MILLS – AN UPDATE

TECHNICAL BULLETIN NO. 858
FEBRUARY 2003

by
Arun Someshwar, Ph.D.
National Council for Air and Stream Improvement
Southern Regional Center
Gainesville, Florida

Table 6. Summary of 'Air Toxic' Emissions from Vacuum Drum Type Brownstock Washers

Volatile Organic Compound	No. of Sources	Detects	Range	Emissions, lb/ADTUBP			
				NDs > 50%	NDs ≤ 50%		
				NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2]	Mean[2]
						using ND = ½ DL	
1,2-Dichloroethane	6	3	ND to 6.2E-04		3.0E-05	1.3E-04	2.1E-04
1,2-Dichloroethylene	6	4	ND to 7.5E-03		1.8E-04	1.9E-04	1.5E-03
1,2,4-Trichlorobenzene	6	4	ND to 1.6E-04		9.7E-05	1.2E-04	1.2E-04
1,1,1-Trichloroethane	17	3	ND to 2.7E-04	1.9E-06[b]			
1,1,2-Trichloroethane	18	5	ND to 0.196	7.4E-07[b]			
Acetaldehyde	20	19	ND to 0.100		1.5E-02	1.5E-02	1.9E-02
Acetone	29	29	ND to 0.272		4.1E-02	4.1E-02	5.6E-02
Acetophenone	12	1	ND to 0.091	6.2E-04[c]			
Acrolein	18	7	ND to 1.9E-03	1.9E-05[b]			
Benzaldehyde	10	2	ND to 0.002	7.9E-05[c]			
Benzene	24	6	ND to 2.7E-04	4.7E-06[b]			
Bromodichloromethane	4	0			*7.5E-03*	*7.5E-03*	*7.5E-03*[d]
Carbon Disulfide	10	4	ND to 0.039	9.8E-07[b]			
Carbon Tetrachloride	17	5	ND to 0.061	6.1E-05[b]			
Carbonyl Sulfide	5	0			*1.6E-03*	*1.6E-03*	*1.6E-03*[d]
3-Carene	4	0			*3.0E-03*	*3.0E-03*	*3.0E-03*[d]
Chlorobenzene	17	5	ND to 1.9E-04	5.2E-06[b]			
Chloroform	22	8	ND to 0.045	1.0E-04[b]			
Chloromethane	3	3	2.0E-05 to 3.4E-03		5.6E-05	5.6E-05	1.2E-03
o-Cresol	11	3	ND to 0.216	9.9E-03[b]			
Crotonaldehyde	10	4	ND to 0.002	1.2E-04[b]			
Cumene	16	0			*2.0E-03*	*2.0E-03*	*2.0E-03*[d]
Cyclohexanone	7	1	ND to 0.0021	3.0E-05[c]			
p-Cymene	4	2	ND to 1.5E-02	3.5E-03[c]			
Dibromomethane	2	0	ND[0 ppb]				
Ethanol	20	12	ND to 0.07		8.7E-03	1.1E-02	1.3E-02[a]
Ethyl Benzene	15	1	ND to 0.199	8.9E-04[c]			
Formaldehyde	13	10	ND to 0.0175		1.9E-03	1.6E-03	2.0E-03[a]
Hexachlorocyclopentadiene	3	0			*2.5E-02*	*2.5E-02*	*2.5E-02*[d]
Hexachloroethane	3	0			*2.2E-02*	*2.2E-02*	*2.2E-02*[d]
n-Hexane	17	5	ND to 1.1E-03	5.3E-06[b]			
Isopropanol	15	1	ND to 1.6E-03	1.6E-05[c]			
Methanol	32	32	8.7E-02 to 2.5		6.6E-01	6.6E-01	8.5E-01
Methyl Ethyl Ketone	29	20	ND to 0.067		3.2E-03	1.2E-02	1.2E-02[a]
Methyl Isobutyl Ketone	20	8	ND to 3.4E-02	1.1E-05[b]			
Methylene Chloride	21	8	ND to 0.102	6.4E-05[b]			
Naphthalene	2	0			*3.0E-03*	*3.0E-03*	*3.0E-03*[d]
Phenol	12	3	ND to 0.065	5.4E-04[b]			
Propionaldehyde	7	5	ND to 0.005		6.0E-04	8.0E-04	1.3E-03[a]
Styrene	9	8	ND to 3.0E-03		1.8E-04	1.8E-04	6.3E-04

Table 6 (Cont'd). Summary of 'Air Toxic' Emissions from Vacuum Drum Type Brownstock Washers

Volatile Organic Compound	No. of Sources	Detects	Range	Emissions, lb/ADTUBP			
				NDs > 50%	NDs ≤ 50%		
				NOR-PLOT^{b} or SDln^{c} avg	Median^{1} using ND = 0	Median^{2} using ND = ½ DL	Mean^{2} using ND = ½ DL
Alpha-Pinene	14	10	ND to 2.0		1.8E-02	2.3E-02	6.6E-02^{a}
Beta-Pinene	14	10	ND to 0.75		4.6E-03	2.1E-02	3.1E-02^{a}
Terpenes	28	27	ND to 6.0		8.5E-02	8.5E-02	9.3E-01
Alpha-Terpeniol	2	1	ND to 9.7E-04		4.9E-04	9.7E-04	9.7E-04
Tetrachloroethylene	6	6	1.4E-04 to 7.7E-04		4.7E-04	4.7E-04	4.5E-04
Toluene	24	10	ND to 0.144	2.3E-05^{b}			
Trichloroethylene	18	5	ND to 7.0E-04	9.7E-05^{b}			
Vinyl Chloride	1	1	58 ppb		5.1E-04	5.1E-04	5.1E-04
m,p-Xylene	22	7	ND to 0.153	9.0E-07^{b}			
o-Xylene	22	7	ND to 0.162	5.5E-06^{b}			
Xylenes	2	2	6.1E-05 to 8.5E-04		4.5E-04	4.5E-04	4.5E-04
Total Hydrocarbons^{3}	12	12	0.002 to 1.04		1.8E-01	1.8E-01	2.9E-01
TRS & Speciated Reduced Sulfur Compounds							
Dimethyl Disulfide	24	22	1.4E-03 to 0.40			7.0E-02^{4}	9.2E-02^{4}
Dimethyl Sulfide	24	23	1.5E-03 to 1.70			1.1E-01^{4}	3.0E-01^{4}
Hydrogen Sulfide	13	6	ND to 0.041	1.1E-03^{b,5}			
Methyl Mercaptan	24	14	ND to 0.36			1.9E-02^{4}	2.0E-02^{a,5}
Total TRS^{6}	24	24	5.4E-03 to 1.20			1.2E-01	2.3E-01

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[1] median based upon assuming all NDs = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[3] total hydrocarbon emissions in lb C/ADTUBP

[4] from NCASI Technical Bull. No. 849 – all NDs were assumed at ½ the DL when estimating averages

[5] using NOR-PLOT average for H_2S and Trimmed Mean for CH_3SH and data from NCASI Technical Bulletin No. 849

[6] total TRS emissions in lb S/ADTUBP

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b]NOR-PLOT Average; [c]SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with greater than 50% NDs; [d]when more than 1 source is tested and all observations are ND, averages shown correspond to ½ of the lowest detection limit.

Non-detects are shown in italics at ½ the detection limit

Table 8. Summary of 'Air Toxic' Emissions from Kraft Pulp Deckers

Volatile Organic Compound	No. of Sources	Detects	Emissions, lb/ADTUBP				
				NDs > 50%	NDs ≤ 50%		
			Range	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2] using ND = ½ DL	Mean[2] using ND = ½ DL
1,2-Dichloroethane	4	0			*6.0E-05*	*6.0E-05*	*6.0E-05*[d]
1,2-Dichloroethylene	6	1	ND to 8.6E-05	1.1E-05[c]			
1,2,4-Trichlorobenzene	4	2	ND to 1.0E-02		1.1E-03	1.8E-03	3.4E-03
1,1,1-Trichloroethane	6	0			*6.0E-05*	*6.0E-05*	*6.0E-05*[d]
1,1,2-Trichloroethane	6	1	ND to 4.8E-04	6.0E-05[c]			
Acetaldehyde	6	4	ND to 1.4E-02		2.3E-03	5.6E-03	5.9E-03
Acetone	6	5	ND to 2.8E-02		8.1E-03	8.1E-03	9.1E-03
Acetophenone	3	0			*9.5E-04*	*9.5E-04*	*9.5E-04*[d]
Acrolein	5	1	ND to 5.5E-04	8.1E-05[c]			
Benzaldehyde	1	1	1.6E-04 to 1.0E-03		3.4E-04	6.8E-04	6.8E-04
Benzene	6	1	ND to 4.6E-5	5.8E-06[c]			
Carbon Tetrachloride	6	2	ND to 2.6E-03	2.9E-04[c]			
3-Carene	1	0	ND [5.6E-04]				
Chlorine	1	0	ND [2.0E-04]				
Chlorobenzene	6	1	ND to 2.1E-04	2.6E-05[c]			
Chloroform	7	1	ND to 0.02	2.2E-03[c]			
m,p-Cresol	2	1	ND to 2.4E-02		1.2E-02	1.2E-02	1.2E-02
o-Cresol	4	2	ND to 2.3E-02		1.0E-02	1.5E-02	1.3E-02
Crotonaldehyde	1	1	ND to 1.4E-04		4.4E-05	8.7E-05	8.7E-05
Cumene	2	0			*3.2E-03*	*3.2E-03*	*3.2E-03*[d]
Ethanol	3	1	ND to 2.3E-02	5.4E-03[c]			
Ethyl Benzene	3	0			*8.5E-04*	*8.5E-04*	*8.5E-04*[d]
Formaldehyde	4	2	ND to 1.0E-02		7.0E-05	1.5E-03	3.3E-03
Hexachlorocyclopentadiene	1	0	ND [4.4E-03]				
Hexachloroethane	1	0	ND [3.8E-03]				
n-Hexane	3	0			*2.5E-05*	*2.5E-05*	*2.5E-05*[d]
Isopropanol	3	1	ND to 6.2E-03	1.4E-03[c]			
Methanol	6	6	2.2E-02 to 0.20		3.5E-02	3.5E-02	6.3E-02
Methyl Ethyl Ketone	6	5	ND to 8.4E-03		1.5E-03	1.5E-03	2.9E-03
Methyl Isobutyl Ketone	6	2	ND to 0.01	7.7E-05[c]			
Methylene Chloride	6	0			*1.1E-04*	*1.1E-04*	*1.1E-04*[d]
Phenol	3	0			*7.5E-04*	*7.5E-04*	*7.5E-04*[d]
Propionaldehyde	2	2	ND to 2.8E-03		1.6E-03	1.6E-03	1.6E-03
Styrene	3	2	ND to 4.5E-04		2.3E-04	2.3E-04	2.8E-04
Alpha-Pinene	2	2	2.9E-03 to 4.4E-02		8.8E-03	8.8E-03	8.8E-03
Beta-Pinene	2	2	ND to 1.9E-02		1.3E-02	1.3E-02	1.3E-02
Terpenes	5	5	1.5E-02 to 1.0E-01		2.3E-02	2.3E-02	4.8E-02
Alpha-Terpineol	1	0	ND [2.4E-03]				
Tetrachloroethylene	3	2	ND to 7.9E-04		4.1E-04	6.5E-04	6.2E-04

Table 8 (Cont'd). Summary of 'Air Toxic' Emissions from Kraft Pulp Deckers

				Emissions, lb/ADTUBP			
				NDs > 50%	NDs ≤ 50%		
Volatile Organic Compound	No. of Sources	Detects	Range	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2] using ND = ½ DL	Mean[2] using ND = ½ DL
Toluene	6	2	ND to 2.1E-04	5.3E-05[c]			
Trichloroethylene	3	2	ND to 1.5E-03		8.4E-04	8.4E-04	9.8E-04
m,p-Xylene	3	3	1.1E-04 to 3.5E-04		5.5E-05	1.6E-04	2.1E-04
o-Xylene	3	2	ND to 2.3E-04	5.3E-05[c]			
Total Hydrocarbons[3]	3	3	5.1E-02 to 9.0E-02		7.7E-02	7.7E-02	7.3E-02
TRS & Speciated Reduced Sulfur Compounds							
Dimethyl Disulfide	11	8	ND to 0.058			2.8E-02[4]	2.8E-02[a, 5]
Dimethyl Sulfide	11	10	4.1E-03 to 0.19			2.7E-02[4]	4.8E-02[4]
Hydrogen Sulfide	1	0				*ND*	*ND*
Methyl Mercaptan	11	2	ND to 0.074	7.4E-04[c, 5]			
Total TRS[6]	11	10	9.1E-03 to 0.14			3.5E-02	4.4E-02

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[1] median based upon assuming all NDs = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[3] total hydrocarbon emissions in lb C/ADTUBP

[4] from NCASI Technical Bull. No. 849 – all NDs were assumed at ½ the DL when estimating averages

[5] using SDln average for CH_3SH and trimmed mean for DMDS and data from NCASI Technical Bulletin No. 849

[6] total TRS emissions in lb S/ADTUBP

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b] NOR-PLOT Average; [c] SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with greater than 50% NDs; [d] when more than 1 source is tested and all observations are ND, averages shown correspond to ½ of the lowest detection limit.

Non-detects are shown in italics at ½ the detection limit

Table 14A. Summary of 'Air Toxic' Emissions from Kraft NDCE Recovery Furnaces

Volatile Organic Compound	No. of Sources	Detects	Emissions, lb/ton BLS				
				NDs > 50%	NDs ≤ 50%		
			Range	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2]	Mean[2]
						using ND = ½ DL	
1,1,1-Trichloroethane H	12	0			*6.0E-04*	*6.0E-04*	*6.0E-04*[d]
1,1,2-Trichloroethane H	11	0			*6.0E-04*	*6.0E-04*	*6.0E-04*[d]
1,2,4-Trichlorobenzene	7	1	ND to 8.7E-03	7.7E-04[c]			
1,2-Dichloroethane	7	0			*6.0E-04*	*6.0E-04*	*6.0E-04*[d]
1,2-Dichloroethylene	1	0	ND [2.2E-02]				
Acetaldehyde	14	5	ND to 5.0E-02	4.2E-04[b]			
Acetone	15	8	ND to 0.048		2.1E-03	1.3E-02	1.1E-02[a]
Acetophenone H	5	0			*1.2E-02*	*1.2E-02*	*1.2E-02*[d]
Acrolein H	11	0			*2.6E-04*	*2.6E-04*	*2.6E-04*[d]
Benzaldehyde	1	1			3.5E-03	7.0E-03	7.0E-03
Benzene H	13	5	ND to 2.5E-02	6.4E-04[b]			
Bromodichloromethane	1	0	ND [8.1E-02]				
Carbon Disulfide H	3	0			*7.0E-03*	*7.0E-03*	*7.0E-03*[d]
Carbon Tetrachloride H	12	0			*5.5E-04*	*5.5E-04*	*5.5E-04*[d]
Carbonyl Sulfide H	1	0	ND [0.5 ppm]				
3-Carene	1	0	ND [3.2E-02]				
Chlorobenzene H	11	0			*1.8E-04*	*1.8E-04*	*1.8E-04*[d]
Chloroform H	15	1	ND to 1.8E-03	2.4E-05[c]			
Chloromethane H	1	0	ND [3.2E-04]				
m-Cresol H	1	0	ND [2.6E-02]				
o-Cresol H	5	0			*1.3E-02*	*1.3E-02*	*1.3E-02*[d]
Cumene H	5	0			*1.5E-02*	*1.5E-02*	*1.5E-02*[d]
p-Cymene	1	1	30 ppb		1.2E-03	1.2E-03	1.2E-03
Ethanol	6	0			*5.5E-03*	*5.5E-03*	*5.5E-03*[d]
Ethyl Benzene H	6	0			*1.3E-02*	*1.3E-02*	*1.3E-02*[d]
Formaldehyde H	9	5	ND to 0.044		4.8E-03	7.8E-03	6.6E-03[a]
Hexachlorocyclopentadiene H	1	0	ND [6.4E-02]				
Hexachloroethane H	1	0	ND [5.6E-02]				
n-Hexane H	9	1	ND to 3.6E-03	2.5E-04[c]			
Hydrogen Chloride H	27	25	ND to 1.23		5.5E-02	5.5E-02	2.5E-01
Isopropanol	6	0			*7.0E-03*	*7.0E-03*	*7.0E-03*[d]
Methanol H	17	12	ND to 0.23		4.4E-02	4.4E-02	4.5E-02[a]
Methyl Ethyl Ketone H	15	5	ND to 7.1E-03	9.4E-04[b]			
Methyl Isobutyl Ketone H	12	3	ND to 5.1E-03	3.3E-05[b]			
Methylene Chloride H	13	2	ND to 0.011	4.8E-04[c]			
Naphthalene H	3	3	1.6E-04 to 5.4E-04		2.6E-04	2.6E-04	3.2E-04
Phenol H	5	0			*1.1E-02*	*1.1E-02*	*1.1E-02*[d]
Styrene H	7	4	ND to 2.0E-03		5.6E-04	5.6E-04	8.0E-04[a]
Sulfuric Acid	6	4	ND to 0.071		2.0E-02	2.0E-02	2.8E-02
alpha-Pinene	2	2	1.5E-03 to 2.0E-03		1.5E-03	1.7E-03	1.7E-03
beta-Pinene	3	1	ND to 4.6E-03	9.8E-04[c]			

Table 14A (Cont'd). Summary of 'Air Toxic' Emissions from Kraft NDCE Recovery Furnaces

Volatile Organic Compound	No. of Sources	Detects	Range	Emissions, lb/ton BLS			
				NDs > 50%	NDs ≤ 50%		
				NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2]	Mean[2]
						using ND = ½ DL	
Terpenes	8	4	ND to 9.2E-02		2.3E-03	3.4E-02	4.1E-02[a]
Alpha-Terpineol	1	0	ND [3.6E-02]				
Tetrachloroethylene	6	2	ND to 3.0E-03	4.8E-04[c]			
Toluene H	12	3	ND to 1.1E-03	3.3E-05[b]			
Trichloroethylene H	11	0			*6.0E-04*	*6.0E-04*	*6.0E-04*[d]
o-Xylene H	11	5	ND to 1.2E-03	3.3E-04[b]			
m,p-Xylene H	11	3	ND to 1.7E-03	1.8E-04[b]			
Total Hydrocarbons[3]	19	17	ND to 0.98		9.7E-02	9.7E-02	1.6E-01
TRS & Speciated Reduced Sulfur Compounds							
Dimethyl Disulfide	13	1	ND to 0.044	2.4E-04[c, 5]			
Dimethyl Sulfide	13	2	ND to 0.033	6.8E-04[c, 5]			
Hydrogen Sulfide	5	4	ND to 0.13			3.4E-03[4]	1.6E-02[4]
Methyl Mercaptan	13	3	ND to 0.054	1.5E-03[b, 5]			
Total TRS[6]	13	5	ND to 0.17			4.7E-03	1.6E-02

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[1] median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[3] total hydrocarbon emissions in lb C/ton BLS

[4] from NCASI Technical Bull. No. 849 – all NDs were assumed at ½ the DL when estimating averages

[5] using SDln average for DMS and DMDS, NOR-PLOT average for CH_3SH and data from NCASI Technical Bulletin No. 849

[6] total TRS emissions in lb S/ton BLS

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b] NOR-PLOT Average; [c] SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with greater than 50% NDs; [d] when more than 1 source is tested and all observations are ND, averages shown correspond to ½ of the lowest detection limit.

Non-detects are shown in italics at ½ the detection limit

Table 14B. Summary of Trace Metal Emissions from Kraft NDCE Recovery Furnaces

Trace Metal	Reference No.	No. of Sources	Detects	Emissions, lb/ton BLS					
						NDs > 50%	NDs ≤ 50%		
				Min	Max	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2] using ND = ½ DL	Mean[2] using ND = ½ DL
PM	1	11	11	0.02	3.50		0.32	0.32	0.57
Sb	1	11	3	*4.3E-07*	4.5E-06	1.5E-06[b]			
As	1	11	3	*1.0E-06*	5.4E-04	1.3E-08[b]			
Be	1	9	3	5.9E-08	1.2E-06	1.3E-08[b]			
Cd	1	11	9	*9.7E-07*	4.8E-05		7.1E-06	7.1E-06	1.2E-05[a]
Cr	1	9	9	2.7E-06	3.8E-05		1.9E-05	1.9E-05	1.7E-05
Co	1	11	6	*1.1E-06*	7.7E-06		1.6E-06	2.8E-06	3.2E-06[a]
Pb	1	11	9	1.1E-06	7.0E-05		1.2E-05	1.2E-05	2.3E-05[a]
Mn	1	10	10	5.4E-06	1.7E-04		5.2E-05	5.2E-05	5.9E-05
Hg	1	10	5	*1.0E-07*	7.0E-06		1.8E-07	2.0E-06	2.0E-06[a]
Ni	1	9	8	8.8E-06	6.2E-05		3.3E-05	3.2E-05	2.8E-05
Se	1	11	5	*1.1E-06*	2.2E-04	8.0E-07[b]			
P	1	8	8	6.4E-05	5.5E-04		2.0E-04	2.0E-04	2.2E-04
Ba	1	6	4	1.5E-05	5.6E-05		1.7E-05	4.1E-05	3.8E-05
Cu	1	5	5	1.5E-05	4.3E-05		2.1E-05	2.1E-05	2.6E-05
Zn	1	5	5	6.6E-06	8.0E-04		5.8E-05	5.8E-05	2.8E-04
Ag	1	3	2	*9.2E-07*	4.7E-06		4.1E-06	4.1E-06	3.2E-06
Th	1	2	0				*4.3E-07*	*4.3E-07*	*4.3E-07*[d]
Cr^{+6}	1,2	5	4	*5.8E-07*	3.3E-05		1.4E-05	1.4E-05	1.6E-05

[1] median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b] NOR-PLOT Average; [c] SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with >50% NDs; [d] when more than 1 source is tested and all observations are ND, averages shown correspond to ½ of the lowest detection limit.

PM – simultaneous total particulate matter emissions

References: 1 (NCASI 2002b); 2 (NCASI 1995a)

Non-detects are shown in italics at ½ the detection limit

Table 16C. Summary of Trace Metal Emissions from Kraft Lime Kilns with Wet Scrubbers

Trace Metal	Reference No.	No. of Sources	Detects	Emissions, lb/ton CaO					
						NDs > 50%	NDs ≤ 50%		
				Min	Max	NOR-PLOT[b] or SDln[c] avg	Median[1] using ND = 0	Median[2]	Mean[2]
								using ND = ½ DL	
PM	1	12	12	0.00	5.34		0.78	0.78	1.52
Sb	1	10	6	*1.5E-06*	1.0E-05		2.1E-06	3.1E-06	3.7E-06[a]
As	1	12	5	1.1E-06	1.2E-04	6.1E-07[b]			
Be	1	13	4	*1.6E-07*	1.0E-05	2.4E-08[b]			
Cd	1	10	9	1.8E-06	3.3E-05		5.8E-06	1.3E-05	1.4E-05
Cr	1	13	12	5.8E-06	9.6E-04		2.0E-04	2.0E-04	2.7E-04
Co	1	11	8	1.9E-06	3.6E-05		2.3E-06	1.0E-05	1.0E-05[a]
Pb	1	12	9	9.0E-06	1.7E-02		2.1E-04	1.6E-04	3.2E-03[a]
Mn	1	13	13	1.0E-04	8.3E-03		3.0E-04	3.0E-04	1.7E-03
Hg	1	6	1	*7.7E-09*	5.2E-06	6.2E-07[c]			
Ni	1	13	12	1.5E-05	1.3E-03		9.5E-05	9.5E-05	3.1E-04
Se	1	12	4	*4.7E-07*	1.2E-04	2.6E-06[b]			
P	1	7	7	2.5E-05	2.9E-03		1.7E-03	1.7E-03	1.5E-03
Ba	1	3	3	3.4E-04	1.2E-03		5.3E-04	5.3E-04	6.8E-04
Cu	1	2	2	2.2E-05	1.8E-04		1.0E-04	1.0E-04	1.0E-04
Zn	1	2	2	6.7E-05	1.0E-04		8.4E-05	8.4E-05	8.4E-05
Ag	1	1	0				*7.8E-07*	*7.8E-07*	*7.8E-07*
Th	2	2	1	*2.3E-05*	7.8E-06		7.8E-06	7.8E-06	2.8E-06
Cr^{+6}	1,2	3	1	*9.1E-06*	7.6E-05	1.8E-05[c]			

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[1] median based upon assuming all non-detects (NDs) = 0 as in NCASI Technical Bulletin No. 701 (1995)

[2] median/mean based upon assuming ND = ½ detection limit (DL)

[a] Trimmed Mean for data sets with 15 to 50% NDs; [b] NOR-PLOT Average; [c] SDln Average; The "NOR-PLOT Average" and "SDln Average" are statistically derived sample averages applicable to all data sets with >50% NDs.

PM – simultaneous total particulate matter emissions

References: 1 (NCASI 2002b); 2 (NCASI 1995a)

Non-detects are shown in italics at ½ the detection limit

ncasi

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT

COMPILATION OF CRITERIA AIR POLLUTANT EMISSIONS DATA FOR SOURCES AT PULP AND PAPER MILLS INCLUDING BOILERS

TECHNICAL BULLETIN NO. 884

AUGUST 2004

by
Arun V. Someshwar, Ph.D.
NCASI Southern Regional Center
Gainesville, Florida

kilns, smelt dissolving tanks), boilers burning fuels, wood preparation activities, and to a lesser extent, paper machines and thermal oxidizers. Limited data on particulate matter emissions from paper machines and wood preparation activities are presented in Section 8.0. Oxides of nitrogen (or NOx) are expected to be present in all combustion-related source vents and thermal oxidizers burning stripper off-gases.

4.1 Tall Oil Reactors

Because soap skimmings contain some black liquor, total reduced sulfur (TRS) and organic compounds (e.g., methanol) present in the black liquor may be released during acidulation. VOCs are the only criteria-related pollutant emissions expected from tall oil reactors. The reactor vent is the primary emission point for these compounds, with only minor emissions coming from subsequent settling and storage tanks. Table 4.1 presents a summary of VOC emissions from five tall oil reactors. Detailed data including reactor descriptions are provided in Appendix A, Table A1. Considering that typical tall oil yield in kraft mills pulping softwoods is about 1% of the wood or about 4% of the kraft pulp, the estimates in Table 4.1 should be divided by about 25 to convert them to a lb/ADTP basis.

Table 4.1 VOC[a] Emissions from Tall Oil Reactor Vents

No.[b]	Range	Median	Mean
		lb C/ton tall oil	
5	0.11 – 51.0	2.9	12.4

[a] as measured by EPA Method 25A
[b] number of sources tested

4.2 Non-Condensible Gases

Occasionally, non-condensible gases (NCGs) that are routed to a collection system for burning may be vented to the atmosphere prior to combustion. Venting may involve bypassing all of the collected gases around the combustion device, or partial venting of gases from an individual piece of equipment, depending on the design and operating characteristics of the collection system and combustion device. In such instances, the composition of vented gases from sources including digesters, evaporators, knotters and screens, brownstock washers, deckers, and oxygen delignification systems may be used to estimate atmospheric releases of VOCs. NCGs also arise from the batch digester fill exhausts and from continuous digester chip bin exhausts. VOCs are typically the only criteria-related pollutants in these NCGs. Limited data on VOCs in pulp mill and evaporator NCGs, batch digester fill exhausts, and continuous digester chip bin exhausts prior to their incineration in pulp mill devices are shown in Table 4.2. Detailed data including NCG descriptions are provided in Appendix A, Table A2.

Table 4.2 VOC[a] Content of Uncontrolled Non-Condensible Gases

NCG Stream Description & Wood Type	No.[b]	Units	Range	Median	Mean
Pulping & Evaporator NCGs (SW/HW)	1	lb C/ADTUBP		0.71	0.71
Batch Digester Fill Exhaust (SW)	1	lb C/ton chips		0.012	0.012
Cont. Digester Chip Bin Exhaust[c] (SW)	3	lb C/ton chips	0.022 – 1.20	0.46	0.43

[a] as measured by EPA Method 25A
[b] number of sources tested
[c] live steam

4.3 Uncontrolled Liquor and Unbleached Pulp Storage Tank Vents

Black liquor and unbleached pulp storage tank vents also contain small amounts of VOCs. Table 4.3 summarizes the VOC content of vent gases from four weak liquor tanks, four strong liquor tanks, and three high density unbleached pulp tanks. Detailed data including tank descriptions are provided in Appendix A, Table A3.

Table 4.3 VOC[a] Content of Uncontrolled Liquor and Unbleached Pulp Storage Tanks

		Range	Median	Mean
Storage Tank Vent	No.[b]	lb C/hr/tank		
Weak Black Liquor	4	0.02 – 1.6	0.54	0.67
Strong Liquor	4	0.018 – 0.18	0.11	0.11
High Density Unbleached Pulp	3	0.86 – 5.66	4.84	3.72

[a] as measured by EPA Method 25A
[b] number of sources tested

4.4 Thermal Oxidizers

Kraft pulp mills burn their high volume low concentration (HVLC) and low volume high concentration (LVHC) NCGs and stripper off-gases (SOGs) in various incineration devices including lime kilns, boilers, stand-alone thermal oxidizers, and recovery furnaces. Because of their low TRS and VOC content, the burning of HVLC NCGs in boilers and recovery furnaces is not expected to affect emissions of VOCs from these combustion devices. However, the LVHC NCGs and SOGs can be rich in reduced sulfur compounds and organics such as terpenes and methanol; the SOGs can also contain significant amounts of ammonia. The sulfur in the reduced sulfur compounds will oxidize to SO_2, yielding two pounds of SO_2 for every pound of S in the NCG stream. Some of the ammonia will oxidize to NO_x, although this conversion is highly dependent on the relationship between temperature, residence time, NH_3, NO, and O_2 in the specific incineration device.

Thermal oxidizers that burn LVHC NCGs and SOGs are generally quite efficient in oxidizing the organics and reduced sulfur compounds contained in these gas streams to CO_2 and SO_2, respectively. Because of the high levels of SO_2 resulting from oxidation of the reduced sulfur compounds, most thermal oxidizers are equipped with a wet scrubber for SO_2 removal.

When ammonia-containing SOGs are burned in a thermal oxidizer, the ammonia partly converts to NO_x. Theoretical considerations suggest the extent of this conversion depends on several factors including temperature and the availability of oxygen for oxidation of the NH_3. Typically, only a small fraction of the SOG ammonia converts to NO_x. The contribution of ammonia-containing kraft mill steam stripper off-gases to thermal oxidizer NO_x emissions was recently investigated in an NCASI study (NCASI 2004b). Measurements at nine oxidizers showed conversion rates of NH_3 to NO_x ranging from 5% to 38%. In this study, temperature and oxygen measurements in the post-combustion zone did not relate well to conversion rates. The study results did show that oxidizers using air staging to create an oxidizing and a reducing zone in the combustion chamber (dual-stage combustion) had NH_3 to NO_x conversion rates about 40% lower than comparable single-stage oxidizers. Introduction of the stripper off-gases with natural gas or LVHC NCGs in single-stage oxidizers resulted in higher conversion rates.

Table 4.4 provides estimates of emissions for VOC, SO_2, NO_x, CO, and total PM (TPM) from thermal oxidizers. NO_x emissions are shown from thermal oxidizers burning just LVHC NCGs (or CNCGs) and also from those burning SOGs and LVHC NCGs. Detailed data including descriptions for each thermal oxidizer are provided in Appendix A, Table A4.

Table 4.4 VOC[a], SO_2, NO_x, CO, and TPM Emissions from Thermal Oxidizers

	No.[b]	Units	Range	Median	Mean
VOC[a]	5	lb C/ADTUBP	0.0027 – 0.027	0.007	0.012
SO_2	3	lb/ADTUBP[c]	0.01 – 0.25	0.072	0.111
NO_x[d]	9	lb/1000 gpm[f]	0.54 – 3.12	1.48	1.51
NO_x[4]	12	lb/ADTUBP	0.10 – 0.41	0.235	0.233
NO_x[e]	8	lb/ADTUBP	0.008 – 0.09	0.041	0.046
CO	6	lb/1000 gpm[f]	0.007 – 3.23	0.15	1.11
CO	9	lb/ADTUBP	3.1E-05 – 0.83	0.019	0.175
TPM[g]	1	lb/ADTUBP	--	0.15	0.15

[a] as measured by EPA Method 25A; [b] number of sources tested; [c] alternately, one could use estimates of uncontrolled SO_2 emissions prior to scrubber and combine with scrubber SO_2 removal efficiency to obtain controlled SO_2 emissions - from NCASI Technical Bulletin No. 847 (NCASI 2002b), average values for lb SO_2 per ADTUBP were 0.14 for HVLC NCGs, 2.2 for LVHC NCGs, and 8.4 for LVHC NCGs + SOGs; [d] thermal oxidizers burning CNCGs & SOGs; [e] thermal oxidizers burning only CNCGs; [f] gpm – gallons per minute foul condensate to stripper; [g] total (filterable) particulate matter from one unit only – use with caution

4.5 Knotters and Pre-Washer Screens

Pressurized knotters and screens generally have no exhausts to the atmosphere. However, knotters and screens that operate at atmospheric pressure can emit reduced sulfur and volatile organic compounds, including hazardous air pollutants (HAPs) such as methanol, acetaldehyde, and methyl ethyl ketone (MEK). Table 4.5 provides a summary of limited data for VOC emissions from knotters and screens. Detailed data including descriptions for each knotter and screen are provided in Appendix A, Table A5.

extraction and peroxide stages were typically small. At elemental chlorine free (ECF) bleach plants, the CO emissions were weakly correlated with total percent ClO_2 applied on pulp. However, for bleaching with less than complete substitution, CO emissions exhibited a poor correlation with percent ClO_2 applied on pulp. The data reviewed during the NCASI investigation suggested that as long as the total amount of equivalent chlorine applied on pulp remains the same, the total bleach plant CO emissions will remain unaffected by increasing the ClO_2 substitution levels in the first stage (NCASI 1998).

Table 4.9 gives estimates of VOC and CO emissions from kraft mill bleach plant vents. Included are bleach plant scrubber vents, extraction-stage vents, and ClO_2 generator scrubber vents. Detailed data including descriptions for each bleach plant vent are provided in Appendix A, Tables A9a, A9b, A9c, and A9d. The CO emissions from 100% ClO_2 substitution bleach plant vents are presented as equations relating to the amount of ClO_2 applied on pulp (NCASI 1998).

Table 4.9 VOC[b] and CO Emissions from Bleach Plant Vents

			Range	Median	Mean
Vent(s)		No.[4]	lb/ODTUBP		
Bleach Plant Scrubber[a]	VOC[b]	33	0.001 – 0.31	0.050	0.092
Bleach Plant Scrubber	CO	A	0.20 – 1.65	A	A
Extraction Stage Vents	VOC[b]	10	1.1E-04 – 0.231	0.021	0.050
Extraction Tower Only	CO	4	0.004 to 0.13	0.037	0.040
ClO_2 Generator Scrubber	VOC[c]	1		0.017	0.017
R8 Tail Gas Scrubber	VOC[b]	1		3.5E-05	3.5E-05

[a] 32 of 33 bleach plant vents passed through a scrubber; [b] measured as C using EPA Method 25A, 25, or CARB 100; [c] l b C/ton ClO_2 as measured by EPA Method 25A; [d] number of sources tested

A – for bleaching with 100% ClO_2 substitution, the following correlations may be used:

$Y = 0.18 \bullet X + 0.45$ (for softwoods) $n = 9$

$Y = -0.03 \bullet X + 0.69$ (for hardwoods) $n = 7$

where

Y = CO emissions in lb/ODTUBP; and
X = % ClO_2 applied (total) in lb ClO_2 per 100 lb ODTUBP (NCASI 1998)
n = number of sources tested

4.10 Black Liquor Oxidation Systems

Vent gases from black liquor oxidation (BLO) towers and tanks have high moisture contents and large flow rates. Concentrations of organic sulfide gases tend to be low, normally under 50 ppmv. Volatile organic compounds are also present in these gases, having been stripped from the black liquor. Table 4.10 gives estimates of VOC emissions from seven BLO systems. All data correspond to oxidation of strong liquors. Table 4.10 also provides total particulate matter emission data reported on just one BLO system (USEPA 1992). Detailed data including descriptions for each BLO system are provided in Appendix A, Table A10.

Table 4.15 VOC[a], SO_2, NO_x, TPM, PM_{10} and $PM_{2.5}$ Emissions from Smelt Dissolving Tank Vents

	No.[b]	Range	Median	Mean
		lb/ton BLS		
VOC[a]	13	ND – 0.25	0.010	0.066
SO_2	20	ND – 0.073	0.005	0.015
NO_x[d]	10	ND – 0.151	0.020	0.033
CO	3	ND to 0.025	0.008	0.013
TPM[c]	36	0.04 – 0.64	0.15	0.16
CPM[e]	8		See table note e	
PM_{10}[f]	8	as % of TPM[c]	108.8%	103.7%
$PM_{2.5}$[f]	7	as % of TPM[c]	89.3%	89.6%

[a] lb C/ton BLS as measured by EPA Method 25A; [b] number of smelt tanks tested; [c] total (filterable) particulate matter; [d] most likely ammonia emissions reported as NO_x; [e] condensible particulate matter – for estimating CPM, use 19% of TPM for smelt dissolving tanks (see footnote 6); [f] primary + condensible PM_{10} and $PM_{2.5}$; if only primary PM_{10} and $PM_{2.5}$ is desired, subtract 19% for average CPM contribution

4.15 Paper Machine Vents

Vent or exhaust gases from the paper machine area consist mainly of air and water vapor; little or no particulate matter is emitted from the dryers (USEPA 1995). Paper machines and pulp dryers can, however, be a source of volatile organic compound emissions (VOCs). Typically, the wet-end and the dry-end speciated and total VOC emissions are approximately equal. VOCs present in the water carrying the pulp to the paper machine or dryer can be released as the water is removed from the sheet. Volatile organic compounds are sometimes present in paper machine additives (defoamers, slimicides, retention aids, wet strength agents, wire and felt cleaners, etc.), and these can also be released during the papermaking process. On some paper machines, especially machines used for tissue production, direct-fired dryers burning natural gas, distillate oil, or propane are used for additional drying capacity, and these dryers are a source of combustion byproducts such as NO_x and CO. Application of coatings to the paper can also be a source of volatile organic compound emissions, although this activity may take place either on the paper machine or in a separate coating operation.

Studies of paper machine VOC emissions have been performed by NCASI (NCASI 1994b, 1997b). Results indicate volatile organic compounds present in the pulp slurry being fed to the machine will be found in the roof vent and vacuum system exhaust gases. The most often detected compound is methanol, a byproduct of chemical and mechanical pulping and bleaching processes. However, methanol is also found in recycled fiber slurries, presumably as a result of residual lignin breakdown.

Trace amounts of particulate matter may be present in paper machine vents. However, measurement data for pulp mill paper machine TPM, PM_{10}, or $PM_{2.5}$ emissions are scarce. TPM emission data for five paper machines, two making linerboard and three making newsprint, are provided in Section 8.1.

Table 4.16 provides estimates of emissions for VOCs from two bleached and two unbleached kraft pulp mill paper machines. Detailed data including descriptions for each machine are provided in Appendix A, Table A16.

NATIONAL COUNCIL FOR AIR AND STREAM IMPROVEMENT, INC.
SOUTHERN REGIONAL CENTER
Mailing and Street Address:
402 SW 140th Terrace, Newberry, FL 32669
Phone (352) 331-1745
FAX (352) 331-1766

October 19, 2004

Report Summary for Particulate Testing Performed on the No. 5 Tissue Machine, Palatka, Florida

Source Description of Tissue Machine No. 5

The No. 5 tissue machine at Georgia Pacific's facility in Palatka, Florida produces 2-ply tissue paper for towels and napkins. Furnish for the machine is 100 percent virgin softwood bleached pulp. Production capacity of this machine is 450 tons per day with daily production typically being around 230 tons per day. The weight basis for the products produced on this machine range from 12 to 32 pounds per 3000 square feet. Tissue machine No. 5 is a wet crepe machine with initial sheet moisture at the creping blade being around 20 percent by weight and final sheet moisture being around 4.5 percent by weight. The former section for this machine is a twin-wire former followed by a suction C-wrap. The former section is followed by an 18 foot diameter, steam heated Yankee dryer. Additional drying capacity at the Yankee dryer is provided by a natural gas fired air cap. The Yankee dryer is followed by ten steam-heated, 72 inch diameter dryer cans. The winder (reel) section follows the dryer cans.

Vents Tested and Methods Employed

A total of 20 vents are associated with the No. 5 tissue machine. Twelve of these vents are fan-driven area-ventilation exhausts. Four are vacuum system exhaust vents, one is a passive exhaust associated with the pulp silo at the wet end of the machine, and another is the Save-all hood exhaust. The Yankee dryer air cap has a single fan driven exhaust, as does the hood for the dryer can section following the Yankee dryer. EPA methods 1 through 4 were used to determine flow rates for the sources tested. EPA's draft method for determination of PM_{10} and $PM_{2.5}$ was used concurrently with EPA Method 202 for determination of PM, PM_{10}, $PM_{2.5}$, and condensible particulate matter (CPM) emissions. Two of the sources tested were area exhaust vents that bracket the former section and are identified in this report as FM1 and FM2. Vents FM1 and FM2 are identified by the mill as TC7-14C2 and TC6-16C1 respectively. Other sources tested were the Yankee dryer air cap exhaust, dryer can hood exhaust, and the area exhaust vent over the winder section. The Yankee dryer air cap exhaust is identified in this report as YKD and as "Air Cap Exhaust" by the mill. The dryer can hood exhaust is identified in this report as MND and by the mill as the "After Dryer Exhaust". The winder area vent is identified in this report as WND and by the mill as TC6-16B1.

Extended run times were employed to increase the probability of collecting a sample size above the Limit of Qantitation (LOQ) for the respective methods. All run times were four hours, with the exception of the former area vents FM1 and FM2. Run times on the former area vents were eight hours. Testing was accomplished during the period from August 10, 2004 to August 26, 2004.

Cyclonic flow was a concern on vents FM1, FM2, and WND. A stack extension was used for testing these sources. The stack extension was constructed with straightening vanes, according the guidelines in EPA Method 5D. A stack extension was also used to vent YKD. The purpose of this stack extension was to provide sampling ports above the insulated portion of the stack and to provide a duct run of two diameters downstream from the sampling ports.

Former Area Exhausts

Two vents were tested in the former area. Vent FM1 is located over the stock preparation area at the north end of the paper machine and vent FM2 is located over the transition from the former section to the Yankee dryer section. Both of these vents are fan driven area ventilation units. The intake for these units is located at ceiling level inside the building and the exhaust is located approximately seven feet above the roof line, with flow orientation being vertical. The annular shrouds on the exhausts were removed during testing to allow installation of the stack extension. Two eight-hour runs were performed on vent FM1. However, due to equipment malfunction, the first run was voided. Two eight-hour runs were also performed on vent FM2. Table 1 summarizes the test and emissions data for vents FM1 and FM2.

Table 1
Particulate Data for Former Area Exhausts (FM1, FM2), Tissue Machine No. 5

Run No.	FM1 Run2	FM2 Run1	FM2 Run2	FM2 Average
Date	8/26/2004	8/10/2004	8/11/2004	
Elapsed Time (min.)	480	480	480	
Stack Press. (in.Hg)	29.51	29.69	29.58	
Stack Temp. (°F)	107	128	146	
Stack Velocity (fps)	50.69	15.92	15.44	
Stack Flow Rate (acfm)	64801	20356	19473	
Stack Flow Rate (dscfm)	55838	16306	14823	
Percent O_2	20.9	20.9	20.9	
Percent CO_2	0.05	0.05	0.05	
Percent Moisture	6	10	13	
Sample Volume (dscf)	181.122	156.829	172.358	
Percent Isokinetic	84.4	88.1	106.5	
Cut Point Cyclone I (microns)	12.5	13.1	11.6	
Cut Point Cyclone IV (microns)	2.3	2.6	2.3	
Product ID	502	504	504	
Production Rate (tph)	11.7	11.0	10.0	
PM (grains/dscf)	[illegible]	0.0018	0.0015	0.00165
PM_{10} (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
$PM_{2.5}$ (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
CPM (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
PM (lb/hr)	0.20	0.25	0.19	0.22
PM_{10} (lb/hr)	0.098	0.0605	0.0466	0.054

Shaded values are based on gravimetric quantities that are below the Limit of Quantitation (LOQ).

The intake grill for vent FM2 was approximately 70 percent occluded and accounts for the discrepancy in the flow rates between the identical vents FM1 and FM2.

Yankee Dryer Air Cap Exhaust

The Yankee dryer air cap provides additional drying capacity and is fired with natural gas. The induced draft fan for the air cap is located on the mezzanine level and is a squirrel cage design. The square cross-section ductwork runs vertically from the mezzanine level for six equivalent diameters before exiting five feet above the roof line. Four test runs were performed on this source, with the first test run being of 16 hours duration. Due to overloading of the cyclone, the first run was voided, and it was determined that a four-hour test run was more appropriate. Table 2 summarizes the test and emissions data for vent YKD.

Table 2

Particulate Data for Yankee Dryer Air Cap Exhaust (YKD), Tissue Machine No. 5

Run No.	2	3	4	Average
Date	8/12/2004	8/17/2004	8/18/2004	
Elapsed Time (min.)	240	240	240	
Stack Press. (in.Hg)	29.60	29.70	29.68	
Stack Temp. (°F)	281	274	277	
Stack Velocity (fps)	71.04	69.91	71.42	
Stack Flow Rate (acfm)	61280	60302	61606	
Stack Flow Rate (dscfm)	35981	36214	36862	
Percent O_2	19.1	20.0	20.9	
Percent CO_2	1.0	0.5	0.5	
Percent Moisture	17	16	16	
Sample Volume (dscf)	83.002	83.610	83.488	
Percent Isokinetic	99.1	99.0	97.3	
Cut Point Cyclone I (microns)	10.5	10.7	10.7	
Cut Point Cyclone IV (microns)	2.4	2.4	2.4	
Product ID	504	504	504	
Production Rate (tph)	10.0	11.0	11.0	
PM (grains/dscf)	0.0040	0.0078	0.0067	0.0062
PM_{10} (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
$PM_{2.5}$ (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
CPM (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
PM (lb/hr)	1.23	2.43	2.12	1.93
PM_{10} (lb/hr)	0.41	0.40	0.38	0.39

Shaded values are based on gravimetric quantities that are below the Limit of Quantitation (LOQ).

After Dryer Hood Exhaust

The after dryer hood removes waste heat from the dryer can section, which follows the Yankee dryer. The induced draft fan is of similar design to that on the Yankee air cap, and is located on the mezzanine level. The ductwork is of circular cross-section and runs vertically six diameters before exiting five feet above the roof line. Three test runs, of four-hour duration each, were performed on this vent. Table 3 summarizes the test and emissions data for vent MND.

Table 3

Particulate Data for After Dryer Hood Exhaust (MND), Tissue Machine No. 5

Run No.	1	2	3	Average
Date	8/24/2004	8/25/2004	8/25/2004	
Elapsed Time (min.)	240	240	240	
Stack Press. (in.Hg)	28.65	29.47	29.51	
Stack Temp. (°F)	156	156	159	
Stack Velocity (fps)	66.27	66.62	67.35	
Stack Flow Rate (acfm)	38253	38456	38877	
Stack Flow Rate (dscfm)	30154	30846	31137	
Percent O_2	20.9	20.9	20.9	
Percent CO_2	0.05	0.05	0.05	
Percent Moisture	4	5	5	
Sample Volume (dscf)	84.237	92.946	92.985	
Percent Isokinetic	95.2	102.7	101.9	
Cut Point Cyclone I (microns)	12.7	12.0	12.0	
Cut Point Cyclone IV (microns)	2.6	2.3	2.4	
Product ID	159	502	502	
Production Rate (tph)	10.0	10.5	10.5	
PM (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
PM_{10} (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
$PM_{2.5}$ (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
CPM (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
PM (lb/hr)	0.51	0.59	0.44	0.51
PM_{10} (lb/hr)	0.142	0.193	0.115	0.150

Shaded values are based on gravimetric quantities that are below the Limit of Quantitation (LOQ).

Winder Area Exhaust

One vent was tested over the winder (reel) area of the paper machine. This vent is of the same design as vents FM1 and FM2. The stack extension used during testing of FM1 and FM2 was also used during testing of vent WND. Three four-hour test runs were performed on this vent. Table 4 summarizes the test and emissions data for vent WND.

Table 4
Particulate Data for Winder Area Exhaust (WND), Tissue Machine No. 5

Run No.	1	2	3	Average
Date	8/18/2004	8/18/2004	8/19/2004	
Elapsed Time (min.)	240	240	240	
Stack Press. (in.Hg)	29.62	29.63	29.59	
Stack Temp. (°F)	136	134	139	
Stack Velocity (fps)	20.64	22.23	23.27	
Stack Flow Rate (acfm)	26381	28416	29747	
Stack Flow Rate (dscfm)	21494	23356	24076	
Percent O_2	20.9	20.9	20.9	
Percent CO_2	0.05	0.05	0.05	
Percent Moisture	7	7	7	
Sample Volume (dscf)	82.173	89.191	88.882	
Percent Isokinetic	91.7	91.6	88.1	
Cut Point Cyclone I (microns)	13.0	12.4	12.3	
Cut Point Cyclone IV (microns)	2.6	2.4	2.4	
Product ID	504	504	502	
Production Rate (tph)	11.0	11.5	12.0	
PM (grains/dscf)	0.0156	0.0123	0.0077	0.0119
PM_{10} (grains/dscf)	0.0024	0.0026	0.0015	0.0022
$PM_{2.5}$ (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
CPM (grains/dscf)	[illegible]	[illegible]	[illegible]	[illegible]
PM (lb/hr)	2.86	2.46	1.59	2.31
PM_{10} (lb/hr)	0.44	0.53	0.30	0.42

Shaded values are based on gravimetric quantities that are below the Limit of Quantitation (LOQ).

EXECUTIVE SUMMARY:

On 17 January 2003 Ambient Air Services, Inc. performed the FDEP required permit compliance stack test for Particulate Matter, Sulfuric Acid Mist, Sulfur Dioxide, Total Reduced Sulfur Compounds, Carbon Monoxide, Oxides of Nitrogen, Volatile Organic Compounds, Visible Emissions and Oxygen on the Number 4 Recovery Boiler at Georgia-Pacific Corporation's Palatka, Florida Plant. During this test all required parameters were met. Table I summarizes the results of the test.

TABLE I

Georgia-Pacific Corporation
Palatka, Florida
Number 4 Recovery Boiler
Multiple Parameters
Compliance Test
17 January 2003

PARAMETER	TEST RESULTS			
	Permitted Limits Mass Emissions	**Test Results Mass Emissions**	**Permitted Limits Concentration**	**Test Results Concentration**
Total Reduced Sulfur Compounds (TRS)	10.9 lbs/hour	0.644 lbs/hour	11.2 12-hr ~~7.0~~ ppm by volume @ 8% Oxygen	0.52 ppm by volume @ 8% Oxygen
Sulfur Dioxide (SO_2)	109.9 lbs/hour	1.5 lbs/hour	37.5 ~~75~~ ppm by volume @ 8% Oxygen	1.19 ppm by volume @ 8% Oxygen
Sulfuric Acid Mist (H_2SO_4)	3.2 lbs/hour	0.318 lbs/hour	0.81 ppmvd	0.141 ppmvd
Volatile Organic Compounds (VOC)	31.5 lbs/hour	3.677 lbs/hour	0.3 lb/ton BLS	0.057 lb/ton BLS
Oxides of Nitrogen (NO_x)	168.5 lbs/hour	93.3 lbs/hour	80 ppm by volume @ 8% Oxygen	74.26 ppm by volume @ 8% Oxygen
Carbon Monoxide (CO)	512.7 lbs/hour	~~221~~ 442 ~~36.3~~ lbs/hour	400 ppm by volume @ 8% Oxygen	~~28.07~~ 178 ppm by volume @ 8% Oxygen
Particulate Matter (PM)	75.6 lbs/hour	15.42 lbs/hour	0.03 gr/dscf @ 8% Oxygen	0.006 gr/dscf @ 8% Oxygen
Visible Emissions (VE)	20%		5%	

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EMISSION TEST REPORT EXECUTIVE SUMMARY
NO. 4 RECOVERY BOILER (EU NO. 018)
MARCH 2, 2004

Emission testing was performed on the above-referenced Emissions Unit as required by Permit No. 1070005-014-AV. This testing fulfills the State of DEP annual test requirement for the parameters listed in the table below.

The results of the testing are summarized in the tables below. During the testing, the Recovery Boiler burned at an average rate of 4.69 million lb of black liquor solids /day. This is 93 percent of the permitted 24 hour average operating rate of 5.04 million lb/day.

Parameter	Reporting Units	Permit Limit	Test Value	Compliance Demonstrated
Particulate Matter (PM)	gr/dscf @ 8% O_2	0.030	0.022	Yes
	lb/hr	75.6	52.7	Yes
Visible Emissions (VE)	percent Opacity	20	0	Yes
Total Reduced Sulfur (TRS)	ppm @ 8% O_2	11.2	1.4	Yes
	lb/hr	17.5	2.2	Yes
Sulfur Dioxide (SO_2)	ppm @ 8 % O_2	75	<2.0	Yes
	lb/hr	109.9	<4.3	Yes
Nitrogen Oxides (NO_x)	ppm @ 8 % O_2	80	68	Yes
	lb/hr	168.5	115	Yes
Carbon Monoxide (CO) (24-hr average limit)	ppm @ 8 % O_2	400	311	Yes
	lb/hr	512.7	318	Yes
Volatile Organic Compounds (VOC)	lb as C/ ton BLS	0.3	<0.01	Yes
	lb as C/hr	31.5	<0.3	Yes
Sulfuric Acid Mist (SAM)	ppm @ 8 % O_2	0.81	0.31	Yes
	lb/hr	3.2	<0.6	Yes

Table 1. **Particulate Emission Summary**
Recovery Boiler Number 4 (EU018)
Georgia-Pacific Corporation
Palatka, Florida
August 26, 2004

Run Number	Time	Actual Flow Rate acfm	Dry Standard Flow Rate dscfm	Stack Temperature F	Oxygen %	Particulate Emissions		
						gr/dscf	gr/dscf @ 8% O2	lbs/hr
1	0751-0857	457988	218933	397	4.66	0.0195	0.0155	36.6
2	0925-1031	459974	216554	400	4.70	0.0136	0.0108	25.2
3	1055-1200	458529	215295	399	4.70	0.0172	0.0137	31.8
Average	–	458830	216927	399	4.69	0.0168	0.0133	31.2

EXECUTIVE SUMMARY:

On 17 January 2003 Ambient Air Services, Inc. performed the FDEP required permit compliance stack test for Particulate Matter, Sulfur Dioxide, Total Reduced Sulfur Compounds, Carbon Monoxide, Oxides of Nitrogen, Volatile Organic Compounds, and Oxygen on the Lime Kiln at Georgia-Pacific Corporation's Palatka, Florida Plant. During this test all required parameters were met. Table I summarizes the results of the test.

TABLE I

Georgia-Pacific Corporation
Palatka, Florida
Lime Kiln
Multiple Parameters
Compliance Test
14 January 2003

PARAMETER	**TEST RESULTS**			
	Permitted Limits Mass Emissions	**Test Results Mass Emissions**	**Permitted Limits Concentration**	**Test Results Concentration**
Total Reduced Sulfur Compounds (TRS)	4 lbs/hour	0.556 lbs/hour	20.0 ppm by volume @ 10% Oxygen	2.53 ~~3.113~~ ppm by volume @ 10% Oxygen
Sulfur Dioxide (SO_2)	10.9 lbs/hour	4.3 lbs/hour	0.3 lb/ton (ADUP)	0.11 lb/ton (ADUP)
Volatile Organic Compounds (VOC)	17.2 lbs/hour	0.609 lbs/hour	185 ppm by volume @ 10% Oxygen	2.35 ppm by volume @ 10% Oxygen
Oxides of Nitrogen (NO_x)	50.3 lbs/hour	32.0 lbs/hour	290 ppm by volume @ 10% Oxygen	116.42 ppm by volume @ 10% Oxygen
Carbon Monoxide (CO)	7.3 lbs/hour	1.8 lbs/hour	69 ppm by volume @ 10% Oxygen	10.45 ppm by volume @ 10% Oxygen
Particulate Matter (PM)	26 lbs/hour	11.94 lbs/hour	0.081 gr/dscf @ 10% Oxygen	0.033 gr/dscf @ 10% Oxygen

MACT II IPT
Aug 26, 2004

Table 3. Particulate Emission Summary
Lime Kiln Number 4 (EU017)
Georgia-Pacific Corporation
Palatka, Florida
August 26, 2004

Run Number	Time	Actual Flow Rate acfm	Dry Standard Flow Rate dscfm	Stack Temperature F	Oxygen %	Particulate Emissions		
						gr/dscf	gr/dscf @ 10% O2	lbs/hr
1	1435-1536	71548	38429	167	6.28	0.0361	0.0269	11.9
2	1605-1707	70650	37957	167	5.94	0.0333	0.0243	10.8
3	1735-1836	69294	37220	167	6.03	0.0373	0.0274	11.9
Average	–	70497	37869	167	6.08	0.0356	0.0262	11.5

EMISSION TEST REPORT EXECUTIVE SUMMARY
NO. 4 LIME KILN (EU NO. 017)
FEBRUARY 26 AND MARCH 3-4, 2004

Emission testing was performed on the above-referenced Emissions Unit as required by Permit No. 1070005-014-AV. This testing fulfills the State of DEP annual test requirement for the parameters listed in the table below. Due to unforeseen problems with some TRS stack testing equipment, all parameters except TRS were tested on February 26. The stack test was continued six days later and TRS testing was performed on March 3-4.

The results of the testing are summarized in the tables below. During the TRS testing (March 3-4), the Lime Kiln processed an average of 40.3 tons of lime mud per hour. The production rate during all other testing (February 26) was 39.3 tons of lime mud per hour.

Parameter	Reporting Units	Permit Limit	Test Value	Compliance Demonstrated	DATE
Particulate Matter (PM)	gr/dscf @ 10% O_2	0.081	0.010	Yes	2/26
	lb/hr	26.0	4.2	Yes	
Total Reduced Sulfur (TRS)	ppm @ 10% O_2	20	2.2	Yes	3/3 & 3/4
	lb/hr	4.0	0.6	Yes	
Sulfur Dioxide (SO_2)	ppm @ 10 % O_2	None	–		2/26
	lb/hr	10.9	<0.1	Yes	
Nitrogen Oxides (NO_x)	ppm @ 10 % O_2	290	93	Yes	↓
	lb/hr	50.3	33.7	Yes	
Carbon Monoxide (CO)	ppm @ 10 % O_2	69	7	Yes	
	lb/hr	7.3	1.4	Yes	
Volatile Organic Compounds (VOC)	ppm @ 10 % O_2	185	4	Yes	
	lb as C/hr	17.2	0.6	Yes	

NUMBER 4 LIME KILN TEST RESULTS FEBRUARY 26 AND MARCH 3-4, 2004

Parameter	Units	Run 1	Run 2	Run 3	Mean
Gas Temperature	°F	164	164	163	164
Moisture Content	%	34	32	30	32[1]
Oxygen Content	%	5.1[2]	6.7	6.8	6.2
CO_2 Concentration	%	9.0[3]	18.0	18.0	18[4]
Volumetric Flow Rate	X 10^3 acfm	64.1	65.2	65.2	64.8
	X 10^3 dscfm	35.0	37.6	38.6	37.1
PM Concentration	gr/dscf	0.002[5]	0.016	0.011	0.014[6]
TRS Concentration	ppm	3.1	3.1	2.9	3.0
SO_2 Concentration	ppm, dry	<1	<1	<1	<1
NO_x Concentration	ppm, dry	112	89	78	93
CO Concentration	ppm, dry	7	6	7	7
VOC Concentration	ppm, wet	4	4	4	4

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[1] Moisture values appear to be low. The stack gas is saturated, and at 164°F, the moisture content should be ~36 %

[2] Value appears to be low.

[3] Value appears too low for a lime kiln and is not representative.

[4] Does not include Run 1, which appears abnormally low for the kiln.

[5] Value appears much too low for a venturi scrubber.

[6] Does not include Run 1, which appears to be low.

EXECUTIVE SUMMARY:

On 16 January 2003 Ambient Air Services, Inc. performed the FDEP required permit compliance stack test for Particulate Matter and Total Reduced Sulfur Compounds on the North and South Smelt Tanks at Georgia-Pacific Corporation's Palatka, Florida Plant. During this test all required parameters were met. Table I summarizes the results of the test.

TABLE I

Georgia-Pacific Corporation
Palatka, Florida
North and South Smelt Tanks
Compliance Test
16 January 2003

PARAMETER	TEST RESULTS			
	Permitted Emission Limits (Pounds per Hour)	Test Results	Permitted Emission Limits	Test Results
Particulate Matter (PM)	12.6 lbs/hour	9.15 lbs/hour	0.12 lb/ton BLS	0.094 lb/ton BLS
Total Reduced Sulfur	3.4 lbs/hour	1.5 lbs/hour	0.048 lb/3000 lbs BLS	0.023 lb/3000 lbs BLS

Table 2. Particulate Emission Summary
Smelt Dissolving Tank Vent North and South Number 4 (EU019)
Georgia-Pacific Corporation
Palatka, Florida
August 27, 2004

Run Number	Time	Black Liquor tons/hr	Actual Flow Rate acfm	Dry Standard Flow Rate dscfm	Stack Temperature F	Particulate Emissions gr/dscf	Particulate Emissions lbs/hr	Particulate Emissions lbs/ton BLS
North Vent								
1	1011-1113	97	27845	15047	167	0.0388	5.00	0.0515
2	1126-1228	97	27357	15601	163	0.0310	4.03	0.0415
3	1513-1614	97	25880	14534	163	0.0235	2.93	0.0302
Average	--	97	27027	15061	164	0.0311	3.99	0.0411
South Vent								
1	0852-0953	97	29150	14421	173	0.0510	6.30	0.0649
2	1241-1342	97	27309	12966	174	0.0542	6.03	0.0621
3	1355-1456	97	29008	14338	175	0.0516	6.34	0.0654
Average	--	97	28489	13908	174	0.0523	6.22	0.0642
Total Average Emissions							**10.21**	**0.105**

EMISSION TEST REPORT EXECUTIVE SUMMARY
NO. 4 SMELT DISSOLVING TANK VENTS (EU NO. 019)
MARCH 5, 2004

Emission testing was performed on the above-referenced Emissions Unit as required by Permit No. 1070005-014-AV. This testing fulfills the State of DEP annual test requirement for the parameters listed in the table below. All parameters except TRS were tested on March 5, 2004.

The results of the testing are summarized in the tables below. During the testing, the Recovery Boiler burned at an average rate of 4.57 million lb black liquor solids per day (190,416 lbs/hr). This is 90.6 percent of the permitted 24-hour average operating rate of 5.04 million lb black liquor solids per day (210,000 lbs/hour).

Parameter	Reporting Units	Permit Limit	Test Value	Compliance Demonstrated
Particulate Matter (PM)	lb/ton BLS	0.12	0.05	Yes
	lb/hr	12.6	5.3	Yes
Total Reduced Sulfur (TRS)	lb as H_2S/3000 lb BLS	0.048	0.023	Yes
	lb/hr	3.4	1.5	Yes

Both vents were tested concurrently for total reduced sulfur and particulate matter. The mean volumetric flow rate measured on each vent during the particulate testing was used to calculate the mass emission rate from the mean measured TRS concentration measured on each vent. The sum of the mass emission rates from both vents was used to demonstrate compliance.

Number 4 Smelt Dissolving Tank Vents

Emission Test Results
March 5, 2004

North Vent

Parameter	Units	Run 1	Run 2	Run 3	Mean
Gas Temperature	°F	164	163	165	164
Moisture Content	%	33	31	32	32
Volumetric Flow Rate	X 10^3 acfm	24.2	21.4	20.8	22.1
	X 10^3 dscfm	13.9	12.7	12.2	12.9
Scrubber Flow Rate	Gpm	123	124	122	123
Scrubber Differential pressure	Inches	7 7.49	8 7.58	8 7.68	7 (*)
PM Concentration	gr/dscf	0.015	0.011	0.026	0.017
TRS Concentration	ppm	8.7	8.8	12.3	9.9

(*) Based on the average of all data, rounded to one significant figure.

South Vent

Parameter	Units	Run 1	Run 2	Run 3	Mean
Gas Temperature	°F	171	173	171	172
Moisture Content	%	38	40	37	38
Volumetric Flow Rate	X 10^3 acfm	28.9	26.6	26.2	27.2
	X 10^3 dscfm	15.3	13.6	13.9	14.3
Scrubber Flow Rate	Gpm	122	121	121	121
Scrubber Differential pressure	Inches	6 5.69	5 5.43	5 4.72	5 (*)
PM Concentration	gr/dscf	0.026	0.043	0.015	0.028
TRS Concentration	ppm	9.9	10.6	10.9	10.5

(*) Based on the average of all data, rounded to one significant figure.