DEPARTMENT OF
ECOLOGY
State of Washington

# Washington Regional Haze Reasonably Available Control Technology Analysis for Pulp and Paper Mills

November 2016
Publication no. 16-02-023

## Publication and Contact Information

This report is available on the Department of Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/1602023.html

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# Washington Regional Haze
# RACT Analysis for Pulp and Paper Mills

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# Acknowledgements

The authors of this report would like to thank the following individuals for their contribution and assistance in preparing this RACT analysis:

- Brian Lamb, Washington State University
- Ravi Vikram, Washington State University
- Serena Chung, Washington State University
- Joseph Vaughan, Washington State University
- Steven J. Gorg, Minnesota Pollution Control Agency (MPCA)
- Eric Kennedy, Maine Department of Environmental Protection (MDEP)
- Gerry Pade, Puget Sound Clean Air Agency (PSCAA)
- Brian Renninger, Puget Sound Clean Air Agency (PSCAA)
- Ann Ingram, Lockheed Martin, EPA Contractor, Info Clearinghouse for Inventories & Emissions Factors (CHIEF) Help Desk Supporting EPA's Measurement Policy Group

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# Abstract/Executive Summary

This report is a follow-up as required in the 2010 Washington Regional Haze State Implementation Plan. Ecology evaluated emission controls applicable to recovery processes at pulp mills. This report also analyzed visibility improvement in federal Class I areas (national parks and certain wilderness areas) that might occur if additional emission controls were required at pulp mills.

Ecology performed the following:

- Evaluated emission limitations and control technologies used worldwide on pulp mills (recovery furnaces/boilers and lime kilns). We found several promising add-on control technologies. We also looked at emission limits in Washington and found that some emission limits were less protective compared to other pulp mills in Washington and in other states.
- Analyzed revised emission limits for each pulp mill.
- Provided achievable visibility improvements based on the revised emission rates. Modeling indicates that if Reasonably Available Control Technology (RACT – additional air pollution controls) were required, visibility would potentially be improved at the Alpine Lakes and Goat Rocks Wildernesses (0.13 deciview and 0.12 deciview, respectively). No other Class I area showed a cumulative improvement of more than 0.1 deciview.

Ecology concluded that the actual emission reductions from the individual pulp mills and the industry as a whole would be relatively costly to implement and visibility improvements in the federal Class I areas would not be observable.

We do not recommend further work to evaluate or require additional air pollution controls for pulp mills in Washington.

# Acronyms, Abbreviations, and Terms

| | |
|---|---|
| A | Stack Area |
| Acf | Actual Stack Gas Flow Rate |
| ACFM | Actual Cubic Feet per Minute |
| acfs | Actual Cubic Feet per Second |
| ADT | Air Dried Pulp |
| AIRNOW | Non-IMPROVE sites; a website which provide visual depictions of current and forecast air quality nationwide. |
| AIRPACT | AIRPACT is a computerized system for predicting air quality (AQ) for the immediate future of one to three days for ID, OR and WA. |
| An | Sample Nozzle Cross Section |
| APTI | Air Pollution Training Institute |
| ATM | Atmosphere (unit of pressure) |
| BACT | Best Available Control Technology |
| BART | Best Available Retrofit Technology |
| BAT | Best Available Techniques in the [Kraft] Pulp and Paper Industry, December 2001, European Commission. BATs are not permit limits, but are based on guidance documents called BREFs (BAT Reference document) |
| BLS | Black Liquor Solids |
| BPT | Best Practical Treatment |
| Bray | Rayleigh Extinction Coefficient |
| BREF | BAT Reference document |
| Btu | British thermal unit |
| Bws | Stack Gas Moisture Fraction |
| CAA | Clean Air Act |
| $CaCO_3$ | Calcium Carbonate |
| CALMET | California Meteorological Model; a diagnostic 3-dimensional meteorological model |
| CALPUFF | California Puff Model; an air quality dispersion model |
| CAMx | Comprehensive Air Quality Model with Extensions |
| CEMS | Continuous Emissions Monitoring Systems |

| | |
|---|---|
| CFR | Code of Federal Regulations |
| CM | Coarse Matter |
| CM | Coarse Matter |
| CMAQ | Community Multi-Scale Air Quality Model |
| CO | Carbon Monoxide |
| COGO1 | Local Air Monitor Site Abbreviation for Columbia River Gorge at Mt Zion |
| CORI1 | Local Air Monitor Site Abbreviation for Columbia River Gorge at Wishram |
| Cp | Pitot tube calibration coefficient |
| D | Diameter of stack |
| DBA | Doing Business As |
| Delta dv | Change in deciview |
| dH | Meter Orifice Pressure |
| dP | Differential Pressure |
| dP | Stack Gas Velocity Head |
| dP^.5 | Stack Gas Velocity Head |
| dv | Deciview; a measure of light extinction |
| EC | Elemental Carbon |
| EGF | Electrified Gravel Bed Filter |
| EI | Emission Inventory |
| EPA | Environmental Protection Agency |
| ESP | Electrostatic Precipitator |
| F1 | Conversion Factor |
| F2 | Conversion Factor |
| F3 | Conversion Factor |
| F4 | Conversion Factor |
| F5 | Conversion Factor |
| FB | Fractional Bias |
| FE | Fractional Error |
| FGD | Flue Gas Desulferization |

| | |
|---|---|
| FIP | Federal Implementation Plan |
| FLM | Federal Land Manager |
| FNA | Formerly Known As |
| FS | Forest Service |
| ft2 | Square Feet |
| g | Gram |
| GED | Good Equipment Design |
| GPM | Gallons Per Minute |
| gr/dscf | Grains per dry standard cubic feet |
| $H_20$/gm | $H_20$ per gram |
| $H_20_2$ | Hydrogen Peroxide |
| $H_2S$ | Hydrogen Sulfide |
| HAP | Hazardous Air Pollutant |
| HAPs | Hazardous Air Pollutants |
| HERB | High Energy Recovery Boiler |
| HG | Mercury |
| Ht | Stack Height |
| HVLC | High Volume Low Concentration |
| I | Isokinetic percent |
| ICCP | Integrated Pollution Prevention Control (ICCP), a reference document on Best Available Techniques [BAT] in the [kraft] Pulp and Paper Industry, December 2001, European Commission |
| IMPROVE | Interagency Monitoring of Protected Visual Environments |
| in | Inches |
| Kg | Kilogram |
| Kp | Pitot tube constant |
| KPa | Kilo Pascal |
| Kraft | Type of chemical pulp and paper mill processes using sulfate. Can be divided into three areas: the making of pulp, recovery of cooking materials, the bleaching of pulp |
| LAER | Lowest Achievable Emission Rate |

| | |
|---|---|
| Lb/hr | Pounds per hour |
| Lbmol | Pound Mole |
| LCPD | Large Combustion Plant Directive of the European Commission. |
| LEA | Low Excess Air |
| LK | Lime Kiln |
| LKEU | Lime Kiln Emission Unit |
| LNB | Low $NO_X$ Burner |
| M3 | Cubic Meters |
| MACT | Maximum Achievable Control Technology |
| MCIP | Meteorology-Chemistry Interface Processor |
| Md | Stack Gas Mole weight dry |
| Mf | Mass of particulate: filter |
| MFB | Mean Fractional Bias |
| MFE | Mean Fractional Error |
| mg | milligram |
| mg/dscf | Milligrams per dry standard cubic feet |
| MH20 | MW of water |
| MM | Million |
| Mm-1 | Inverse mega meter; a measure of particle extinction |
| MM5 | Meteorological Mesoscale 5 |
| Mn | Mass of particulate: combined samples |
| MORA1 | Local Air Monitor Site Abbreviation for Mt. Rainier National Park |
| Mp | Mass of particulate: probe wash |
| Ms | Stack Gas Mole weight wet |
| MW | Megawatt |
| MW | Molecular Weight |
| $N_2$ | Nitrogen |
| N/A | Not Applicable or Not Available |
| NCAC | North Carolina Administrative Code |

| | |
|---|---|
| NCASI | National Council of Air and Stream Improvement |
| NCG | Non Condensable Gases |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NG | Natural Gas |
| $NH_3$ | Ammonia |
| $(NH_4)_2SO_4$ | Ammonium Sulfate |
| $NH_4$ | Ammonium |
| Nm3 | Newton – Meters cubed |
| NO | Nitric oxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_3$ | Ammonium Nitrate or $NH_4NO_3$ |
| NOCA1 | Local Air Monitor Site Abbreviation for Glacier Peak Wilderness and North Cascades National Park |
| $NO_X$ | Nitrogen Oxides |
| NPS | National Park Service |
| NSCR | Non-Selective Catalytic Reduction |
| NSPS | New Source Performance Standards |
| NSR | New Source Review |
| NW AIRQUEST | A virtual air quality science center made up of various air quality agencies, tribes, and universities of the Pacific Northwest |
| NWCAA | Northwest Clean Air Agency |
| O&M | Operations and Maintenance |
| O/R | Oxidation/Reduction |
| $O_2$ | Oxygen |
| $O_3$ | Ozone |
| OBS | Observed |
| OC | Organic Carbon |
| OLYM1 | Local Air Monitor Site Abbreviation for Olympic National Park |
| OM | Organic Matter |
| OMC | Organic Mass Carbon |

| | |
|---|---|
| Pa | Pascal |
| Pa | Pressure (stack) |
| PAN | Peroxyacetylnitrate |
| PASA1 | Local Air Monitor Site Abbreviation for Pasayten Wilderness |
| Pbar | Pressure (barometric) |
| PCT | Proper Combustion Techniques |
| PICs | Products of Incomplete Combustion |
| PKA | Previously Known As |
| PM | Particulate Matter |
| $PM_{10}$ | Coarse Particle Matter or Particulate Matter; with an aerodynamic diameter of 10 micrometers or less |
| $PM_{2.5}$ | Fine Particles or Particulate Matter; with an aerodynamic diameter of 2.5 micrometers or less |
| PNW | Pacific Northwest |
| POA | Primary Organic Aerosol |
| ppm | parts per million |
| ppmv | parts per million by volume |
| ppmvd | parts per million by dry volume |
| PRP | Preliminary Reasonable Progress |
| PSAT | Particulate Matter Source Apportionment Technology |
| PSCAA | Puget Sound Clean Air Agency |
| PSD | Prevention of Significant Deterioration |
| Pstd | Pressure at STP |
| PTPC | Port Townsend Paper Company |
| Qstd | Dry Stack gas flow rate at STP |
| R | Ideal gas constant |
| RACT | Reasonably Available Control Technology |
| RAVI | Reasonably Attributable Visibility Impairment |
| RF | Recovery Furnace |
| RFEU | Recovery Furnace Emission Unit |

| | |
|---|---|
| RH | Regional Haze |
| RHR | Regional Haze Rule |
| RMC | WRAP's Regional Modeling Center |
| RPG | Reasonable Progress Goal |
| RRF | Relative Response Factors |
| S Content | Sulfur Content |
| sat vap press | Saturation Vapor Pressure |
| SBws | Saturation Moisture Fraction at STP |
| SCFM | Standard Cubic Feet per Minute |
| SCR | Selective Catalytic Reduction |
| SIP | State Implementation Plan |
| SMOKE | Sparse Matrix Operator Kernel Emissions |
| SNCR | Selective Non-Catalytic Reduction |
| SNPA1 | Local Air Monitor Site Abbreviation for Alpine Lakes Wilderness |
| $SO_2$ | Sulfur Dioxide |
| SO4 | Ammonium Sulfate or (NH4)2SO4 |
| SOIL | Fine Soil |
| $SO_X$ | Sulfur Oxides |
| STP | Standard Temperature and Pressure |
| Sulfite chemical pulp and paper process | Similar to Kraft process except that sulfurous acid is used as cooking chemicals instead of sodium hydroxide and sodium sulfide, and a cooking buffer of bisulfite is used with one of four bases (ammonium, calcium, magnesium, or sodium). |
| Tabs | Temperature absolute |
| TAPs | Toxic Air Pollutants |
| TCaO/day | Tons Calcium Oxide per Day |
| Tm | Dry Gas Meter Temperature |
| TPH | Tons Per Hour |
| TPY | Tons Per Year |
| TRS | Total Reduced Sulfur |

| | |
|---|---|
| Ts | Stack gas temp |
| TSP | Total Suspended Particulate |
| Tstd | Temperature at STP |
| USDA | U.S. Department of Agriculture |
| USDA – FS | U.S. Department of Agriculture – Forest Service |
| USDI | U.S. Department of the Interior |
| USDI – FWS | U.S. Department of the Interior – Fish & Wildlife Service |
| USDI – NPS | U.S. Department of the Interior – National Park Service |
| USGS | U.S. Geological Survey |
| UW | University of Washington |
| Vi | Impinger 1 |
| VIEWS | Visibility Information Exchange Web System |
| Vii | Impinger 2 |
| Viii | Impinger 3 |
| Visibility SIP | Visibility Protection |
| Viv | Impinger 4 |
| Vm | Sample Volume from meter |
| Vmstd | Sample Volume |
| VOC | Volatile Organic Content |
| Vs | Stack Gas Velocity |
| Vw | Total Water Volume Condensed |
| Vwstd | Total Water Volume Condensed at STP |
| WA | Washington |
| WAC | Washington Administrative Code |
| WEP | Weighted Emissions Potential |
| WESP | Wet Electrostatic Precipitator |
| WESTAR | Western States Air Resources Council |
| WHPA1 | Local Air Monitor Site Abbreviation for Goat Rocks Wilderness and Mt. Adams Wilderness areas |

| | |
|---|---|
| WHR | Wet Heat Recovery |
| WRAP | Western Regional Air Partnership |
| WRF Smoke SMAQ | Weather Research and Forecasting Model Sparse Matrix Operator Kernel Emissions (SMOKE) Modeling System Satellite-Assisted Management Of Air Quality |
| WSU | Washington State University |
| Y | Dry Gas Meter Calibration factor |

# 1. Overview

## 1.1. Background

This Reasonably Available Control Technology (RACT) analysis addressing regional haze (RH), is prepared to fulfill a commitment in the Washington State Department of Ecology (Ecology) Regional Haze State Implementation Plan (SIP) prepared in December of 2010.

Ecology was required to prepare a RH SIP as part of EPA's phase II 1999 visibility rules called the Regional Haze Rule (RHR). This rule focuses on improving visibility in mandatory Class I federal areas. These lands are identified in the Clean Air Act Amendments of 1977, and afforded the highest level of protection from air pollutants. There are 156 of these Class I areas nationwide and include national parks, wilderness areas, and wildlife refuges. All other federal lands in the nation are designated as Class II areas. Washington's eight mandatory federal Class I areas are shown in Figure 1 and listed in Table 2.

One element of the RHR required the state to include a Four-Factor Analysis of emission reduction potential from non-Best Available Retrofit Technology (BART) sources to be used in developing the Reasonable Progress Goals (RPGs) for each Class I area. The four factors to be considered in these analyses are:

- Cost of compliance
- Time necessary for compliance
- Energy and non-air quality impacts of compliance
- Remaining useful life of any potential affected sources

Ecology and the Western Regional Air Partnership (WRAP) developed analyses for point sources of pollutants in Washington to meet the Four-Factor Analysis requirement for non-BART sources in the RHR. This analysis and its result were included in the state's RH SIP.

The analyses in the RH SIP identified specific industries including "pulp and paper and wood products" (pulp & paper mills), as significant emitters of pollutants known to contribute to RH and that have opportunities for emission reductions that could improve visibility in Class I areas.

The pollutants emitted by the pulp and paper and wood products industry in Washington includes sulfur dioxide ($SO_2$) and oxides of nitrogen ($NO_X$) (including nitric oxide (NO) and nitrogen dioxide ($NO_2$) compounds), volatile organic compounds (VOCs), and directly emitted particulate matter (PM). These air pollutants contribute to RH in the following ways:

- Both $SO_2$ and $NO_X$ gases can form sulfate and nitrate particulate matter, which, as with particulate matter in general, impair visibility.

- VOCs can either condense to form PM or can react with $NO_X$.

- $NO_X$ is a precursor chemical for peroxyacetyl nitrate (PAN), which is a secondary pollutant present in photochemical smog.

Of the air pollutants emitted from the pulp, paper, and wood products industry, $SO_2$ and $NO_X$ are the dominant pollutants that contribute to RH in Washington's Class I areas.

As noted in the RH SIP, by identifying individual sources of $SO_2$ and $NO_X$ (and PM) that impair visibility, the RH SIP sets the stage for assessing the effects of potential new emissions limitations for those sources. One of the mechanisms that can be used for assessing emission limits, includes determining and implementing RACT to potentially provide further progress toward meeting the visibility goal.

This RH RACT analysis focuses emissions from pulp and paper mill recovery furnaces and lime kilns. These combustion units emit $SO_2$, $NO_X$, and PM. At the time of this analysis, there are seven chemical pulp and paper mills in operation in Washington: six sulfate (Kraft) mills and one sulfite mill. The current names of the mills at the time of this analysis, as well as the abbreviated facility names that will be used throughout this analysis are listed in Table 1.

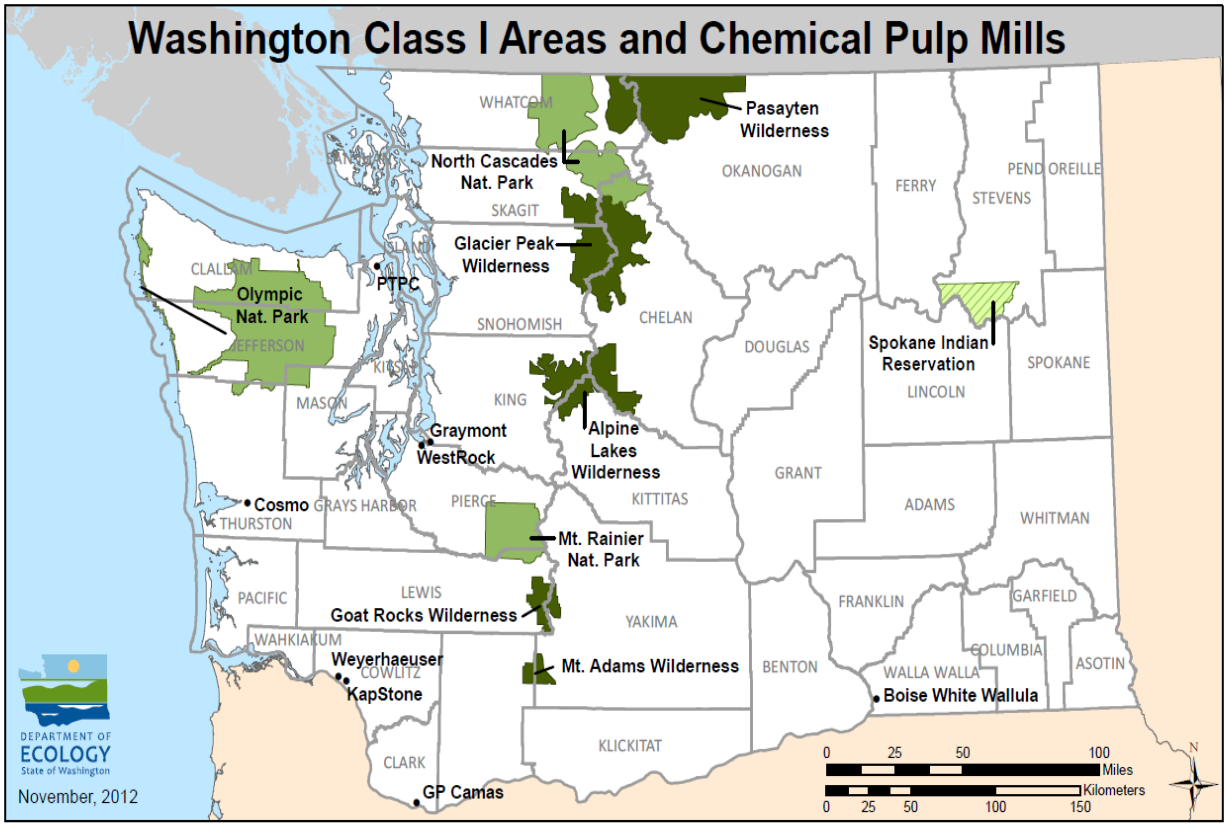
**Table 1. Washington State Chemical Pulp and Paper Mills**

| Full Name | Mill Type | Abbreviated Name for this Analysis |
|---|---|---|
| Longview Fibre Paper and Packaging, Inc. dba KapStone Kraft Paper Corporation | Kraft | KapStone |
| Weyerhaeuser Longview Liquid Packaging | Kraft | Weyerhaeuser |
| WestRock CP, LLC | Kraft | WestRock |
| Port Townsend Paper Corporation | Kraft | PTPC |
| Boise White Paper, LLC | Kraft | Boise White Wallula |
| Georgia Pacific Consumer Products (Camas) LLC | Kraft | GP Camas |
| Cosmo Specialty Fibers Inc. | Sulfite | Cosmo |

While not at a pulp and paper mill, the lime kiln at the Graymont Western U.S. Inc., (Tacoma Division) (Graymont) facility is included in this analysis due to its similarity to the pulp mill lime kilns. Graymont consists of a lime manufacturing plant and two precipitated calcium carbonate plants. Both of these products are utilized in the manufacture of paper.

A definition of RACT, and how it is implemented in Washington State is included in Section 1.2.

The Class I areas in Washington are shown on Figure 1 and additional details for the mandatory federal Class I areas is included in Table 2. Figure 1 also shows the locations of Graymont and the seven chemical pulp and paper mills currently in operation in Washington.




| | |
|---|---|
| | Native American Class I Areas (1),(2) |
| | National Park Service Class I Areas(1),(2),(3) |
| | U.S. Forest Service Class I Areas(1),(2),(3) |

1. Class I areas are granted special air quality protection under the federal Clean Air Act and state rules. National parks and certain wilderness areas are designated as mandatory Class I federal areas under the federal Clean Air Act. EPA may designate other areas as Class I areas upon request. The Spokane Indian Reservation was designated a Class I area in 1991 based on a request from the Spokane Tribal Council. The operator of any new major stationary source or major modification that may affect air quality in a Class I area should contact the Ecology's Air Quality Program (AQP) for further information.
2. These areas receive special air quality considerations under the Prevention of Significant Deterioration (PSD) Permit Program.
3. These areas are mandatory federal Class I areas that receive visibility protection under the RH Program.

**Figure 1. Class I areas in Washington State**

**Table 2. Mandatory Federal Class I Areas in Washington State[1]**

| Mandatory Class I Area[2] | Site Abbreviation (local air monitor)[3] | Acreage | FLM |
|---|---|---|---|
| Alpine Lakes Wilderness | SNPA1 | 303,508 | USDA-FS |
| Glacier Peak Wilderness | NOCA1 | 464,258 | USDA-FS |
| North Cascades National Park | NOCA1 | 503,277 | USDI-NPS |
| Goat Rocks Wilderness | WHPA1 | 82,680 | USDA-FS |

**Table 2. Mandatory Federal Class I Areas in Washington State[1]**

| Mandatory Class I Area[2] | Site Abbreviation (local air monitor)[3] | Acreage | FLM |
|---|---|---|---|
| Mt. Adams Wilderness | WHPA1 | 32,356 | USDA-FS |
| Mt. Rainier National Park | MORA1 | 235,239 | USDI-NPS |
| Pasayten Wilderness | PASA1 | 505,524 | USDA-FS |
| Olympic National Park | OLYM1 | 892,578 | USDI-NPS |
| **Total Acres** | | **3,019,420** | |

[1] The USFS is the federal land manager for national wildlife refuges. However, of the 23 national wildlife refuges in Washington State, none of them are part of the group of 21 national wildlife refuges located throughout the other 49 states, which are designated as Class I areas. <http://www.fws.gov/refuges/refugeLocatorMaps/washington.html> and <http://www.fws.gov/refuges/AirQuality/areas.html>

[2] Columbia River Gorge, managed by the forest service, is not a Class I area, but is included in regional haze considerations by request of the FLMs. Another Class I area in the state, the Spokane Indian Reservation, is not included in this table because it is not a mandatory Class I area.

[3] The two monitoring sites near the Columbia River Gorge are at Wishram and Mt. Zion and are referred to as CORI1 and COGO1, respectively.

# 1.2. RACT in Washington State

RACT is defined in the Revised Code of Washington (RCW) 70.94.030(20) as:

> "…the lowest emission limit that a particular source or source category is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. RACT is determined on a case-by-case basis for an individual source or source category taking into account:
>
> - The impact of the source upon air quality,
> - The availability of additional controls,
> - The emission reduction to be achieved by additional controls,
> - The impact of additional controls on air quality, and
> - The capital and operating costs of the additional controls.
>
> RACT requirements for a source or source category shall be adopted only after notice and opportunity for comment are afforded."

While RACT, the acronym, includes the words "control technology," RACT is defined in RCW 70.94.030(20) as an "emission limit" based on the application of additional controls.

Other states and the federal Clean Air Act (CAA) may implement RACT differently from the state of Washington (such as limiting it to nonattainment areas). As noted in the RH SIP, however, "a provision of Washington's CAA (RCW 70.94.154) requires existing sources to use

RACT." This requirement then applies to existing sources in attainment areas, nonattainment, and unclassifiable areas.

RACT is implemented in Washington State according to the process described in Section 1.2.1, which lists verbatim key portions from RCW 70.94.154.

### 1.2.1. RACT implementation in Washington State

RCW 70.94.154 contains the implementing provisions for the RACT process in Washington. Specific to determining RACT, this section of law says:

> (1) RACT as defined in RCW 70.94.030 is required for existing sources except as otherwise provided in RCW 70.94.331(9).
>
> (2) RACT for each source category containing three or more sources shall be determined by rule except as provided in subsection (3) of this section.
>
> (3) Source-specific RACT determinations may be performed under any of the following circumstances:
>
> (a) As authorized by RCW 70.94.153;
> (b) When required by the federal clean air act;
> (c) For sources in source categories containing fewer than three sources;
> (d) When an air quality problem, for which the source is a contributor, justifies a source-specific RACT determination prior to development of a categorical RACT rule; or
> (e) When a source-specific RACT determination is needed to address either specific air quality problems for which the source is a significant contributor or source-specific economic concerns.

RCW 70.94.154(5) contains additional procedural requirements to be followed when determining RACT.

> (5) In determining RACT, ecology and local authorities shall utilize the factors set forth in RCW 70.94.030 and shall consider RACT determinations and guidance made by the federal environmental protection agency, other states and local authorities for similar sources, and other relevant factors. In establishing or revising RACT requirements, ecology and local authorities shall address, where practicable, all air contaminants deemed to be of concern for that source or source category.

Although there are some similarities between a RACT analysis and a Best Available Control Technology (BACT) analysis, the two analyses are defined differently. Per RCW 70.94.030(6), BACT means "an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under this chapter emitted from or that results from any new or modified stationary source, that the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such a source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such a pollutant. In no event shall application of BACT result in emissions of any pollutants that will exceed the emissions allowed by any applicable standard under 40 *C.F.R.* Part 60 [NSPS] and Part 61 [NESHAP], as they existed on July 25, 1993, or their later enactments as adopted by reference by the director by rule."

The RACT process includes an economic component that is generally less stringent than BACT in that it applies a reasonableness test for the application of emission limitations based on specific control technologies to a group of existing separate sources constructed of varying age. In contrast, BACT addresses the cost and removal efficiency of emission controls to be included in the construction of new or modified sources. The RACT economic analysis looks at the costs of adding or replacing controls on existing equipment.

We determined and ranked potential emission limitations reflecting the capabilities of different control technologies using a BACT-style approach. This approach provided helpful information to assess potential RACT options for addressing RH. In assessing what constitutes "reasonable" for this RACT analysis, Ecology performed both a quantitative and qualitative analysis. Specifically, a quantitative review of RH impacts using a top-level emission limit allowed Ecology to perform a qualitative analysis of less stringent emission limits as presented in Chapters 4 and 5 of this analysis.

## 1.3. Source impacts on visibility

This RH RACT analysis is organized as follows:

- Chapter 2 reviews the availability of additional control options for recovery furnaces and lime kilns at pulp and paper mills.
- Chapter 3 presents demonstrated emission limits for recovery furnaces and lime kilns in Washington State, other states, Canada, and Europe.
- Chapter 4 documents a comparison of emission reductions and lower emission limits demonstrated to be reasonably available at pulp and paper mills.
- Chapter 5 documents modeling analyses which estimate impacts of pulp mills upon visibility in Washington Class I areas (and also on Class I areas in surrounding states and provinces), before and after implementing additional controls.
- Chapter 6 provides a survey of general estimated capital and operating costs of the additional controls.
- Chapter 7 presents conclusions of this RH RACT analysis considering the information presented in Chapters 1 through 6.

# 2. Availability of Additional Controls

This chapter lists control options currently available for recovery furnaces and lime kilns. Available control technologies for PM, $SO_2$, and $NO_X$ are presented in Tables 3, 4, and 5, respectively. As noted in the table notes, the only criteria for including the listed control options is the availability of the control option. Other considerations are presented in following chapters.

**Table 3. PM Control Technologies Available for Recovery Furnaces and Lime Kilns**

| Control Technology | Brief Description | Available for RFs (Yes/No)[1] | Available for LKs (Yes/No)[1] |
|---|---|---|---|
| High Energy Recovery Boiler (HERB)[2] | HERBs (furnaces) focus on effective air mixing and staging of air injection in the furnace for improved chemical recovery efficiency. This allows the furnace to run with less excess air resulting in less flue gas (less PM emissions) and also lowers the power consumption by the fans. | Yes | N/A |
| Fabric filters | A fabric filter (baghouse) consists of several fabric filters, typically configured in long, vertically suspended sock-like configurations. Dirty gas enters from one side, often from the outside of the bag, passing through the filter media and forming a particulate cake. The cake is removed by shaking or pulsing the fabric, which loosens the cake from the filter, allowing it to fall into a bin at the bottom of the baghouse. A variety of fabrics is available to cover fuel gas temperatures up to about 650°F. Baghouses are unsuitable for use on water saturated gas streams. | Yes | Yes |
| Cyclone separator(s) | Cyclone separators remove solids from the air stream by application of centrifugal force. In solid fuel combustion devices like hog fuel boilers, they are commonly used to remove large particles prior to the flue gas entering smaller particle control devices such as baghouses or ESPs. Multi-cyclones are capable of effectively removing particles down to approximately 3 micrometers.[3] | Yes | Yes |
| Settling chambers | Similar to cyclone separators, settling chambers are used to remove large particles prior to the flue gas entering smaller particle control devices. However, whereas cyclone separators use centrifugal force, settling chambers use gravitational force and are limited to removal of particles larger than about 40-60 micrometers.[3] | Yes | Yes |
| Wet scrubber | Wet scrubbers intercept dust particles using droplets of liquid (usually water). The larger, particle-enclosing water droplets are separated from the remaining droplets by gravity. The solid particulates are then separated from the water. | Yes | Yes |
| ESP (dry) | An electrostatic precipitator (ESP) removes particles from an air stream by electrically charging the particles, then passing them through a force field that causes them to migrate to an oppositely charged collector plate. An ESP generally refers to a dry ESP unless specifically noted otherwise. The dust from the collector plates falls into a collection hopper at the bottom of the ESP. The collection | Yes | Yes |

| Table 3. PM Control Technologies Available for Recovery Furnaces and Lime Kilns | | | |
|---|---|---|---|
| **Control Technology** | **Brief Description** | **Available for RFs (Yes/No)[1]** | **Available for LKs (Yes/No)[1]** |
| | efficiency of an ESP depends on particle diameter, electrical field strength, gas flowrate, and plate dimensions. A dry ESP is used for dry pollutants and uses a dry collecting surface. | | |
| Wet ESP (or WESP) | The operation is identical to a dry ESP except that a WESP has a wet collecting surface and can be used for both wet and dry pollutants. The water addition can perform a number of tasks. It can change the electrical properties of the fly ash and can improve (or reduce) removal efficiency. The water is also used to remove sticky ashes from the WESP collector plants or to condense and remove semi-volatile compounds like some high molecular weight organic compounds. Unlike a dry ESP which removes only dry pollutants, a WESP can potentially remove solid, liquid, and soluble gas pollutants. | Yes | Yes |
| Electrified gravel bed filters (EGFs) | EGFs are a technique that is no longer implemented in Washington State. It used electricity to generate an electrostatic charge on a moving bed of gravel to collect particulate from a wood-fired boiler. The last unit operating in Washington was recently replaced with a baghouse. | Yes | Yes |
| Good operating practices | A properly operated emission unit will minimize the formation of $PM_{10}$ emissions. Proper design of combustion units (e.g., boiler and recovery furnaces) concerns features such as the fuel and combustion air delivery system and the shape and size of the combustion chamber. Good operating practices for combustion units typically consist of controlling parameters such as fuel feed rates and air/fuel ratios. | Yes | Yes |

Note: RF = recovery furnace. LK = lime kilns.

[1] The only criteria for including the listed control option is availability. Other considerations are presented in Chapters 4 through 6.

[2] Andritz Pulp & Paper. Recovery boilers chemical recovery and green energy. The Andritz solution: High Energy Recovery Boiler (HERB) <www.andritz.com>. At least three HERB units have installed or are being installed in the U.S. per Andritz Pulp & Paper <www.andritz.com>. The three units are IP Valliant, Oklahoma; IP Campti, Louisiana; and PCA, Valdosta, Georgia. It is unclear if the OK and GA units have been included into the latest air permits at the time of this analysis. The Campti unit has been implemented, and permit limits are listed in Chapter 3.

[3] EPA APTI Course 413, 5th ed., v. 2: *Control of Particulate Matter Emissions Student Manual*, Crowder, J.W.; Smith, T., pp. 5-1, 6-24.

| Table 4. $SO_2$ Control Technologies Available for Recovery Furnaces and Lime Kilns | | | |
|---|---|---|---|
| **Control Technology** | **Brief Description** | **Available for RFs (Yes/No)[1]** | **Available for LKs (Yes/No)[1]** |
| HERB[2] | High energy recovery boilers (furnaces) focus on effective air mixing and air injection staging around the burning process for improved efficiency. This allows the furnace to run with less excess air resulting in less flue gas (less $SO_2$ emissions) and also lowers the power consumption by the fans. | Yes | N/A |
| Flue gas desulfurization (FGD) w/wet scrubber | In FGD with a wet scrubber, a solution of sodium or calcium hydroxide absorbs $SO_2$ from the flue gas forming sodium or calcium sulfite. The collected sulfite can be further oxidized to sulfate or left as the sulfite. Typically, large quantities of liquid or solid wastes are generated requiring disposal. Typical systems using sodium regenerate the sodium or re-use, while calcium based systems dispose of the calcium sulfate/sulfite. | Yes | Yes |
| Semi-dry lime hydrate slurry injection FGD w/fabric filter or ESP | For lime hydrate slurry injection, calcium hydroxide in the form of lime slurry is injected into the gas stream. Calcium hydroxide and $SO_2$ will react to form calcium sulfite. A fabric filter or ESP will be needed to remove the dry solid reaction products from the gas stream. | Yes | Yes |
| Dry lime powder injection FGD w/fabric filter or ESP | Dry lime powder injection FGD controls $SO_2$ using the same methods as lime hydrate slurry injection and depends on most of the same parameters. As with the lime slurry, a fabric filter or ESP is needed to remove the solid reaction products from the gas stream. | Yes | Yes |
| Spray dryer w/an ESP FGD | Spray dryer with an ESP FGD requires installation of a spray dryer and an ESP. Dry lime is injected by a spray dryer into the flue gas in the form of fine droplets under well controlled conditions such that the droplets will absorb $SO_2$ from the flue gas and then become dry particles because of the evaporation of water. The dry particles are captured by the ESP downstream of the dryer. The captured particles are then removed from the system and disposed. | Yes | Yes |
| Low sulfur fuel selection | $SO_2$ emissions are influenced by the sulfur content of the fuel as well as the sulfur content of the process material. For the recovery furnace, the black liquor solids are both the primary fuel and the material being processed. Fossil fuel is used to start a recovery furnace, and may be used to support the combustion process during operation. Selection of lower sulfur fuel can reduce $SO_2$ emissions from the furnace. For the lime kiln, the fuel is the dominant source of sulfur rather than the lime feed. | Yes | Yes |
| Increased oxygen levels at burner | Increased oxygen levels at the burner have been shown to decrease $SO_2$ emissions from lime kilns. This is best used with a scrubbing system where the increase in oxygen drives the $SO_2$ to $SO_3$ allowing the $SO_3$ to react with lime or sodium oxide to produce $CaSO_4$ or $Na_2SO_4$. | No | Yes |

| Table 4. $SO_2$ Control Technologies Available for Recovery Furnaces and Lime Kilns | | | |
|---|---|---|---|
| Control Technology | Brief Description | Available for RFs (Yes/No)[1] | Available for LKs (Yes/No)[1] |
| Wet heat recovery | Recirculating gasses through a wet heat recovery system before releasing through an exhaust stack. | Yes | No |
| Good operating practices | Good operating practices imply that the emission unit is operated within parameters that minimize emissions of air pollutants and maximize combustion efficiency. | Yes | Yes |

[1] The only criteria for including the listed control option is availability. Other considerations are presented in Chapters 4 through 6.

[2] Andritz Pulp & Paper. Recovery boilers chemical recovery and green energy. The Andritz solution: High Energy Recovery Boiler (HERB). <www.andritz.com> At least three HERB units have installed or are being installed in the U.S. per Andritz Pulp & Paper <www.andritz.com> The three units are IP Valliant, Oklahoma; IP Campti, Louisiana; and PCA, Valdosta, Georgia. It is unclear if the OK and GA units have been included into the latest air permits at the time of this analysis. The Campti unit has been implemented, and permit limits are listed in Chapter 3.

| Table 5. $NO_X$ Control Technologies Available for Recovery Furnaces and Lime Kilns | | | |
|---|---|---|---|
| Control Technology | Brief Description | Available for RFs (Yes/No)[1] | Available for LKs (Yes/No)[1] |
| HERB[2] | HERBs (furnaces) focus on effective air mixing around the burning process for improved efficiency. This allows the furnace to run with less excess air resulting in less flue gas (less emissions) and also lowers the power consumption by the fans. Less excess air results in potentially significant $NO_X$ reductions. | Yes | N/A |
| Low excess air (LEA) | LEA is a technique where combustion is optimized by reducing the excess air introduced to the unit to the minimum amount necessary for stable, efficient combustion. Excess air is the air supplied in addition to the quantity required for stoichiometric combustion. | Yes | No |
| Staged combustion[3] | Staged combustion technologies such as overfire air (OFA) reduce $NO_X$ emissions by creating a fuel-rich zone via air staging (diverting a portion of the total amount of air required through separate ports). The highest temperatures are reached in the primary zone, generating thermal $NO_X$. "The general concept is to burn the fuel with an insufficient amount of air in a primary combustion zone. With insufficient oxygen available for complete combustion, most of the $O_2$ is consumed by carbon and hydrogen, leaving less available to form $NO_X$. As a result the fuel nitrogen combines to form $N_2$ ($N+N=N_2$). During the few hundredths of a second it takes for combustion to occur, the flame cools slightly. Once this cooling has occurred, the rest of the air is added to complete | Yes | Yes |

| Table 5. $NO_X$ Control Technologies Available for Recovery Furnaces and Lime Kilns | | | |
|---|---|---|---|
| **Control Technology** | **Brief Description** | **Available for RFs (Yes/No)[1]** | **Available for LKs (Yes/No)[1]** |
| | combustion. Since the fuel nitrogen radicals have disappeared, and the flame is too cool to generate a lot of thermal $NO_X$, relatively little $NO_X$ will be formed in the secondary combustion zone." To determine which ports to divert air to, can be a trial and error process unique to each boiler. A successful setup will be accompanied by a smoky unclean looking fire, not a clear blue flame which operators sometimes misguidedly try to obtain. | | |
| Flue gas recirculation (FGR) | FGR reduces peak flame temperature by recirculating a portion of the flue gas back into the combustion zone as a replacement for combustion air. The recirculated gasses have a lower oxygen content that reduces the peak flame temperature in the combustion zone. | Yes | Yes |
| Low $NO_X$ burners (LNBs) | LNBs are a technique with limited applicability to pile burning wood-fired boilers and recovery furnaces. LNBs modify the initial combustion conditions to reduce the peak flame temperature, and thereby reduce $NO_X$ formation. They are often used in conjunction with modifications to overfire air systems, where a portion of combustion occurs through ports above or "over" the burners to complete combustion of other gases such as CO. They are most useful when using fuels like natural gas or distillate oil. | Yes | Yes |
| Fuel staging/reburning | Fuel staging is also known as "reburning" or "off-stoichiometric combustion." Fuel staging is a technique where ten to twenty percent of the total fuel input is diverted to a second combustion zone downstream of the primary zone. Again, this is a technique to reduce the peak flame temperature during combustion. | Yes | Yes |
| Water/steam injection | Water/steam injection into the main flame can reduce the flame temperature and the generation of $NO_X$. It is an older technique most often used on older burner designs in natural gas and oil-fired boilers and gas turbines. If the flame temperature is sufficiently quenched, the generation of CO can increase and the process efficiency will decrease. | No | Yes |
| Mixing air fan | For lime kilns, this technology is a method of staging combustion air through the use of a fan that is mounted on the rotating kiln shell. This can reduce $NO_X$ formation by decreasing peak flame temperatures. | No | Yes |
| Good operating practices and proper design | The formation of $NO_X$ can be minimized by proper operation and design practices. Operators can control the combustion stoichiometry to minimize $NO_X$ formation while achieving efficient fuel combustion. | Yes | Yes |

| Table 5. $NO_X$ Control Technologies Available for Recovery Furnaces and Lime Kilns | | | |
|---|---|---|---|
| **Control Technology** | **Brief Description** | **Available for RFs (Yes/No)[1]** | **Available for LKs (Yes/No)[1]** |
| | This is the most basic combustion modification technique available. | | |
| Selective Non-Catalytic Reduction (SNCR) | SNCR is an exhaust gas treatment process in which urea or ammonia is injected into the exhaust gas. High temperatures, normally between 1,600° and 1,900°F, promote the reaction between urea or ammonia ($NH_3$) and $NO_X$ to form $N_2$ and water. The effectiveness of SNCR systems depends upon inlet $NO_X$ concentration, temperature, mixing, residence time, reagent-to-$NO_X$ ratio, and fuel sulfur content. | Yes | Yes |
| Selective Catalytic Reduction (SCR) | SCR is an exhaust gas treatment process in which $NH_3$ or urea is injected into the exhaust gas upstream of a catalyst bed for exhaust temperatures between 450° and 750°F. In the SCR process, the urea or $NH_3$ injected into the exhaust is first stored in a liquid storage tank and vaporized before injection. The exhaust/ammonia mixture then passes over the catalyst. The function of the catalyst is to lower the activation energy of the NO decomposition reaction, therefore, lowering the temperature necessary to carry out the reaction. On the catalyst surface, $NH_3$ and NO or $NO_2$ reacts to form diatomic nitrogen ($N_2$) and water. When operated within the optimum temperature range, the reaction can result in removal efficiencies between 70 and 90 percent. The rate of $NO_X$ removal increases with temperature up to a maximum removal rate at a temperature between 700° and 750°F. As the temperature increases above the optimum temperature, or decreases below the optimum range for a conventional vanadium pentoxide catalyst, the $NO_X$ removal efficiency begins to decrease. Depending on the temperatures involved, low temperature and higher temperature catalyst formulations are available. The effectiveness of an SCR system depends upon the same factors as the SNCR system and the condition of the catalyst. The catalyst can degrade over time due to poisoning, fouling, thermal stress, and erosion by particulates, reducing $NO_X$ removal efficiency. | Yes | Yes |
| Non-Selective Catalytic Reduction (NSCR)[3] | This technology uses a catalyst without a reagent and requires zero excess air. The catalyst causes $NO_X$ to give up its oxygen to products of incomplete combustion (PICs), CO, and hydrocarbons, causing the pollutants to destroy each other. However, if oxygen is present, the PICs will burn up without destroying the $NO_X$. | Yes | Yes |
| Oxidation/reduction scrubbing | Several proprietary oxidation/reduction (O/R) scrubbing $NO_X$ removal processes are commercially available. The basic elements of a typical process include cooling of the combustion gas stream below | Yes | Yes |

**Table 5. $NO_X$ Control Technologies Available for Recovery Furnaces and Lime Kilns**

| Control Technology | Brief Description | Available for RFs (Yes/No)[1] | Available for LKs (Yes/No)[1] |
|---|---|---|---|
| | its dew point to condense water, treat with ozone or sodium chlorite to oxidize $NO_X$ and $SO_2$ to their highest oxidized forms, then absorb these oxides as acids in a scrubber. It has been reported that O/R scrubbing has a theoretical $NO_X$ removal efficiency of 95 percent. | | |

Notes: RF = recovery furnace. LK = lime kiln.

1 The only criteria for including the listed control option is availability. Other considerations are presented in Chapters 4 through 6.

2 ANDRITS Pulp & Paper. Recovery boilers chemical recovery and green energy. The Andritz solution: High Energy Recovery Boiler (HERB). <www.andritz.com> At least three HERB units have installed or are being installed in the U.S. per Andritz Pulp & Paper <www.andritz.com> The three units are IP Valliant, Oklahoma; IP Campti, Louisiana; and PCA, Valdosta, Georgia. It is unclear if the OK and GA units have been included into the latest air permits at the time of this analysis. The Campti unit has been implemented, and permit limits are listed in Chapter 3.

3 Source: *$NO_X$ Emissions Control from Stationary Sources, APTI Course 418*, Reorganized 2012 by Brian W. Doyle, PhD, PE, presented February 26-28, 2013, Boise, ID, Department of Environmental Quality.

# 3. Demonstrated Emission Limits for Recovery Furnaces and Lime Kilns

This chapter presents a survey of demonstrated emission limits for recovery furnaces and lime kilns at existing mills in Washington State. The emission limits are presented in Sections 3.1–3.3, and provide a basis for estimating the potential emission reductions presented in Chapter 4. April 14, 2014, New Source Performance Standards (NSPS) applicable to U.S. Kraft mill recovery furnaces and lime kilns equipped with electrostatic precipitators (ESPs) are also listed in the tables of Sections 3.1–3.3.

The provisions for RACT analysis provided in Sections 1.2 and 1.3 do not restrict consideration of emission limits that are being achieved to only those pulp and paper mills in Washington State. Therefore, while this survey emphasized emission limits that have been demonstrated in Washington State, it also includes information about various pulp and paper mills in other states and also in Canada and Europe. This survey does not include all pulp and paper mills currently in operation, but provides a general framework for emission limits that are being achieved by the individual mills listed based on facility permit information and technical support documents. During this analysis some mills may have discontinued operations or have changed names. This analysis has tried to provide the latest information and includes updated name changes or mill closure information where known.

Concentration based limits in grains per dry standard cubic feet (gr/dscf) and also parts per million (ppm), where provided, were used to compare emission limits between facilities. In some cases, Ecology had to convert units for facilities that use different units.

European Kraft pulp and paper mill information was obtained from the Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques [BAT] in the [Kraft] Pulp and Paper Industry, December 2001, European Commission. As noted in the ICCP report, “a direct comparison of the emission levels between countries is difficult due to uncertainties in the basis of data (lack of harmonization in the methods of analysis and calculating emissions).” Unit conversions that Ecology estimated from BAT information, are approximately similar to BAT unit conversions performed by the National Council of Air and Stream Improvement (NCASI).

Unit conversion calculations and facility permit limits are provided in Appendix A.

## 3.1. Demonstrated PM emission limits for recovery furnaces and lime kilns

Table 6 provides a survey of demonstrated recovery furnace emission limits in Washington State and at randomly selected facilities in the U.S., Canada, and Europe. Canadian and European units have been converted to the listed unit for each limit. In most cases it is not known if the units in Section 3.1 are new, rebuilt, or modified, but information is provided where known. If a limit is required by a rule, the rule is listed under the column titled “Limit Reference.”

| Table 6. Demonstrated PM Emission Limits at Recovery Furnaces | | | | |
|---|---|---|---|---|
| Location | Facility (RF unit if specified) | Limit: gr/dscf[1,2] @ 8% $O_2$ (daily) [annual] | Limit Reference | Control Technology |
| Europe | LCPDs:[3] low range | (0.011) | IPPC[3] | BAT[3] options[4] |
| USA | New/reconstructed after 5/23/13 | 0.015[2] | NSPS (4/14/14) | ESP |
| Louisiana[5] | Int'l Paper CAMTI (No. 3) | 0.015 | BACT | [HERB], ESP[5] |
| Minnesota | Boise Cascade Int'l Falls (EU320) | 0.0165 | MACT bubble | ESP (8-fields on) |
| Europe | LCPDs[3]: high range | (0.019) | IPPC[3] | BAT[3] options[4] |
| Arkansas | Georgia Pacific Crossert (8R) | 0.02 | BACT | ESP (wet bottom) |
| Georgia | Int'l Paper AM (No. 3) | 0.021 | MACT bubble | ESP |
| North Carolina | KapStone (No. 7) | 0.021 | BACT | ESP: Single stage, cold side 140k ft2 plate area |
| Mississippi | Weyerhaeuser NR PW (AA-100) | 0.023 | BACT | ESP |
| Georgia | GP Cedar Springs (No. 3) | 0.021 | MACT bubble | ESP |
| Louisiana | Port Hudson (No. 1) | 0.025 | BACT | ESP |
| Louisiana | Port Hudson (No. 2) | 0.025 | BACT | ESP |
| Alabama | Alabama River Cellulose (No. 1) | 0.025 | BACT | ESP (two in parallel) |
| Alabama | Alabama River Cellulose (No. 2) | 0.025 | BACT | ESP |
| Minnesota | Sappi Cloquet LLC (No. 10) | 0.025 | BACT | ESP – Envirotech/Buell |
| British Columbia | Prince George Vancouver (RB) | 0.026 | Permit PA2762 | ESP |
| Washington | Weyerhaeuser (No. 10) | 0.027 [0.020] | BART = BACT | ESP |
| Washington | Boise White Wallula (No. 3) | 0.027 [0.021] | LAER | ESP |
| Washington | KapStone (22) | 0.027 | BACT | ESP |
| Maine | Red Shield (# 4) | 0.028 | MACT alternative | ESP (Flakt dry bottom two fields - compliance w/one field) |
| Georgia | GP Cedar Springs (No. 1) | 0.030 | BACT=MACT | ESP |
| Georgia | GP Cedar Springs (No. 2) | 0.030 | BACT=MACT | ESP |
| Idaho | Clearwater Lewiston (No. 5) | 0.03 | BACT | ESP |
| Florida | Palatka (No. 4) | 0.030 | BACT | ESP: (2 chambers w/6 fields each). |
| Washington | GP Camas (No. 3) | 0.033 | BACT | ESP = 2 chamber, 3 fields; scrubber = packed bed, cross-flow AirPol |

| Table 6. Demonstrated PM Emission Limits at Recovery Furnaces | | | | |
|---|---|---|---|---|
| Location | Facility (RF unit if specified) | Limit: gr/dscf[1,2] @ 8% $O_2$ (daily) [annual] | Limit Reference | Control Technology |
| Washington | GP Camas (No. 4) | 0.033 | BACT | ESP; scrubber (Teller) |
| Idaho | Clearwater Lewiston (No. 4) | 0.040 | BACT | ESP |
| Washington | KapStone (19) | 0.040 | BACT | ESP |
| USA | Modified RFs after 5/23/2013 | 0.044[2] | NSPS (4/14/14) | ESP |
| Georgia | Weyerhaeuser PWM (No. 3) | 0.044 | NSPS/NESHAP | ESP (east and west units) |
| Kentucky | Wycliffe Paper (03) | 0.044 | NSPS/NESHAP | wet bottom ESP+scrubber |
| Oregon | GP Consumer Products (EU24) | 0.044 | NSPS/NESHAP | ESP |
| Oregon | Boise White St Helens (2 & 3)[6] | 0.044 | NSPS/NESHAP | ESP |
| Oregon | Cascade Pacific (RFEU) | 0.044 | NSPS/NESHAP | ESP 2 chamber, 4 field |
| Washington | Boise White Wallula (No. 2) | 0.044 | NSPS/NESHAP | ESP |
| Washington | KapStone (18) | 0.044 | BACT | ESP |
| Washington | PTPC (RF) | 0.044 | NSPS/NESHAP | ESP |
| Washington | WestRock (No. 4) | 0.044 | NSPS/NESHAP | ESP |
| British Columbia | Catalyst PC Vancouver (#3, w#4 on) | 0.051 | Permit | Scrubber |
| British Columbia | Catalyst PC Vancouver (#4, w#3 on) | 0.051 | Permit | Scrubber |
| British Columbia | Catalyst PC Vancouver (#4, w#3 out) | 0.062 | Permit | Scrubber |
| Georgia | International Paper AM (No. 2) | 0.055 | MACT bubble | ESP |
| British Columbia | Howe Sound Vancouver (E218529) | 0.057 | Permit | ESP |
| Washington | Cosmo (No. 1,2 & 3 common stk) | 0.10 | WAC 173-410-040 | Multiclones & scrubber[7] |

Notes: RF = recovery furnace. LK = lime kiln.

1 gr/dscf = grains per dry standard cubic feet. Where needed, listed values were converted from metric units to these US units and to Standard conditions of 293.15 K. Standard pressure (1 atm) is the same at all facilities and therefore no conversion was needed. Where needed, oxygen content was converted to 8% (from 6% at some Canadian facilities; from 5% at European facilities).

2 NSPS = New Source Performance Standards for Kraft pulp mills http://www.gpo.gov/fdsys/pkg/FR-2014-04-04/pdf/2014-06719.pdf . Because the April 14, 2014, NSPS limits are defined to be for filterable PM only, therefore for comparison purposes, the other limits in this table are assumed to be for filterable PM. However, please note the following regarding TSP vs $PM_{10}$ and filterable vs condensable: particulate limits are listed as total suspended particulate (TSP) even though some facilities have PM10 limits. Other facilities in this table such as for International Paper CAMPTI (No. 3) in LA note updated emission factors (October 2012 permit) to include both filterable plus condensable particulate matter. Yet, the emission limits (at least for the CAMPTI unit) appear to be only for filterable particulate based on an October 22, 2013 (method 5 or 201a only) stack test. Available test data

| Location | Facility (RF unit if specified) | Limit: gr/dscf[1,2] @ 8% $O_2$ (daily) [annual] | Limit Reference | Control Technology |
|---|---|---|---|---|

**Table 6. Demonstrated PM Emission Limits at Recovery Furnaces**

showing compliance for the Boise Cascade Int'l Falls, MN (EU320) limit included both filterable and condensable particulate matter.

3 Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques [BAT] in the [kraft] Pulp and Paper Industry, December 2001, European Commission. LCPD = Large Combustion Plant Directive of the European Commission.

4 General ICCP BAT approach: "In kraft pulp mills, emission of particulates are controlled by electrostatic precipitators and sometimes also in SO2 scrubbers." Specific BAT options for recovery furnaces: The BAT emission levels listed in this table "can generally be achieved by more modern recovery boilers by use of ESP only. Old recovery boilers achieve this (these) levels when they apply ESP and scrubbers. However, scrubbers are mainly applied for removal of SO2." ICCP BAT range for sulfite mills is 0.002 to 0.008 with "electrostatic precipitators and multi-stage scrubbers."

5 At least three HERB units have been or are being installed in the United States per Andritz Pulp & Paper www.andritz.com. The three units are IP Valliant, Oklahoma; IP CAMPTI, Louisiana; and PCA, Valdosta, Georgia. It is unclear if the Oklahoma and Georgia units have been included into the latest air permits at the time of this analysis. The Campti unit has been implemented, and permit limits are listed in this table.

6 Mill recently closed (~late 2012/early 2013).

7 MACT rule dated February 18, 2003; effective May 19, 2003: HAP emissions (via MACT particulate rule) controlled through hog fuel boiler particulate matter per MACT II site specific rule 40CFR63.862(d).

Of the facilities surveyed, the lowest demonstrated emissions for the units in Table 6 are the BAT limit range of European facilities that have demonstrated daily emission limits within the range of 0.011 gr/dscf and 0.019 gr/dscf. BATs are not permit limits, but are based on guidance documents called BREFs (BAT Reference document). Of the U.S. facilities surveyed, two had units with emission limits within this range: 0.015 gr/dscf hourly limit [International Paper CAMPTI, LA - new high energy recovery boiler (No. 3)] and 0.0165 gr/dscf hourly limit [Boise Cascade Int'l Falls MN, - existing unit: (EU320)].

In addition, U.S. Kraft recovery furnaces equipped with ESPs that are new or reconstructed after May 23, 2013, are required to meet an NSPS emission limit of 0.015 gr/dscf for filterable PM, and units built before May 23, 2013, must meet an emission limit of 0.044 gr/dscf for filterable PM. (Note: This NSPS requires that all recovery furnace sampling must also measure condensable PM, but condensable particulates are not to be included with filterable emissions when compared against the NSPS limits).

Ecology retains the option of adopting the lowest emission limit in Washington State as a reasonably achievable emission limit for this RACT analysis. The lowest demonstrated emission limit in Washington is 0.027 gr/dscf (hourly limit). This limit has been demonstrated at Weyerhaeuser (No. 10), Boise White Wallula (No. 3), and KapStone (22).

Table 7 provides a survey of demonstrated lime kiln emission limits in Washington State and at randomly selected facilities in the U.S., Canada, and Europe. Canadian and European units have been converted to the listed unit for each limit.

| Table 7. Demonstrated PM Emission Limits at Lime Kilns | | | | |
|---|---|---|---|---|
| **Location** | **Facility (LK unit if specified)** | **Limit: gr/dscf[1,2] at 10% $O_2$ (daily)** | **Limit Reference** | **Control Technology** |
| USA | New/reconstructed after 5/23/13 | 0.010[2] | NSPS (4/14/14) | ESP |
| Europe | LCPDs:[3] low range | (0.01) | IPPC[3] | BAT[3] options[4] |
| Europe | LCPDs:[3] high range | (0.02) | IPPC[3] | BAT[3] options[4] |
| Washington | KapStone (3) | 0.030 | BACT | venturi scrubber |
| Washington | KapStone (4) | 0.030 | BACT | modified scrubber |
| Louisiana | Port Hudson (No. 2) | 0.033 | BACT | ESP+scrubber |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 0.033 | BACT | ESP |
| Alabama | Alabama River Cellulose (No. 1) | 0.035 | BACT | venturi scrubber |
| Alabama | Alabama River Cellulose (No. 2) | 0.035 | BACT | ESP |
| Minnesota | Sappi Cloquet LLC (#10) | 0.035 | BACT | ESP |
| Washington | KapStone (5) | 0.035 ng/0.060 oil | BACT | ESP |
| Washington | Weyerhaeuser (No. 4) | 0.035 ng/0.07 oil | BACT | ESP |
| British Columbia | Howe Sound Vancouver (E218529) | 0.044 | Permit | ESP |
| Washington | Graymont | 0.05 (coal or ng) | Permit | Baghouse |
| Louisiana | Port Hudson (No. 1) | 0.050 | BACT | High dP scrubber (replaced AirPol H-K scrubber for pet coke fuel) |
| Georgia | GP Cedar Springs (No. 2) | 0.056 | BACT=MACT | venturi scrubber |
| USA | Modified LKs after 5/23/13 | 0.064[2] | NSPS (4/14/14) | ESP |
| Arkansas | Georgia Pacific Crossert (#4) | 0.064 | BACT | scrubber |
| Georgia | GP Cedar Springs (No. 1) | 0.064 | BACT=MACT | venturi scrubber & mist eliminator |
| Georgia | Int'l Paper AM (No. 2) | 0.064 | MACT bubble | venturi scrubber & cyclone |
| Idaho | Clearwater Lewiston (No. 3) | 0.064 | BACT | ESP |
| Idaho | Clearwater Lewiston (No. 4) | 0.064 | BACT | ESP & packed bed scrubber |
| Kentucky | Wycliffe Paper (03) | 0.064 | NSPS/NESHAP | scrubber |
| Louisiana | Int'l Paper CAMPTI | 0.064 | BACT | wet scrubber |
| Oregon | GP Consumer Products (EU21) | 0.064 | NSPS/NESHAP | wet scrubber |
| Oregon | Boise White St. Helens[5] | 0.064 | NSPS/NESHAP | scrubber |
| Oregon | Cascade Pacific (LKEU) | 0.064 | NSPS/NESHAP | scrubber |
| Washington | Boise White, Wallula | 0.064 ng/0.12 oil | NSPS/NESHAP | scrubber (baghouse @ hot end of lime kiln) |
| Washington | PTPC (LK) | 0.064 | BACT | scrubber |
| Washington | WestRock (No. 1) | 0.064 | NSPS/NESHAP | scrubber |
| Washington | WestRock (No. 2) | 0.064 | NSPS/NESHAP | scrubber |
| British Columbia | Catalyst PC Vancouver (1,2 cmb stk) | 0.066 | Permit | ESP |
| Minnesota | Boise Cascade Int'l Falls (EU340) | 0.066 | MACT Bubble | wet scrubber |

| Table 7. Demonstrated PM Emission Limits at Lime Kilns | | | | |
|---|---|---|---|---|
| **Location** | **Facility (LK unit if specified)** | **Limit: gr/dscf[1,2] at 10% $O_2$ (daily)** | **Limit Reference** | **Control Technology** |
| Washington | GP Camas (No. 4) | 0.067 ng/0.13 oil | NESHAP (NG) | Ducon rectangular cross-section variable throat venturi scrubber |
| Maine | Red Shield | 0.130 | MACT alternative | venturi scrubber |
| North Carolina | Kapstone | 0.140 | BACT | venturi scrubber |
| Georgia | International Paper AM (No. 1) | 0.176 | MACT bubble | venturi scrubber & cyclone |
| British Columbia | Prince George Vancouver | (0.101) | Permit PA2762 | Scrubber |
| Florida | Palatka (No. 4) | N/A | BACT | cyclone and micromist style scrubber |

Note: LK = lime kiln.

1 gr/dscf = grains per dry standard cubic feet. Where needed, listed values were converted from metric units to these US units and to Standard conditions of 293.15 K. Standard pressure (1 atm) is the same at all facilities and therefore no conversion was needed. Where needed, oxygen content was converted to 10% (from 5% at European facilities).

2 Particulate limits are listed as total suspended particulate (TSP) even though some facilities have $PM_{10}$ limits. However, because the March 14, 2014, NSPS limits are defined to be for filterable PM only, therefore the other limits in this table are assumed to be for filterable PM.

3 Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques [BAT] in the [kraft] Pulp and Paper Industry, December 2001, European Commission. LCPD = Large Combustion Plant Directive of the European Commission.

4 General ICCP BAT approach: "In kraft pulp mills, emission of particulates are controlled by electrostatic precipitators and sometimes also in SO2 scrubbers." Specific BAT options for lime kilns: The BAT emission levels listed in this table "can generally be achieved when using an ESP."

5 Mill recently closed (~late 2012/early 2013).

Of the limits surveyed, the lowest demonstrated or required emission limit for the units in Table 7 are the April 14, 2014, NSPS for lime kilns. Lime kilns equipped with ESPs that are new or reconstructed after May 23, 2013, are required to meet an NSPS emission limit of 0.010 gr/dscf for filterable PM, and units built before May 23, 2013, must meet an emission limit of 0.064 gr/dscf for filterable PM. (Note: This NSPS requires that all lime kiln sampling must also measure condensable PM, but condensable particulate is not to be included with filterable emissions when compared against the NSPS limits).

BAT emissions of European facilities have demonstrated daily emissions within the range of 0.01 gr/dscf and 0.02 gr/dscf (for natural gas or oil). BATs are not permit limits, but are based on BREFs.

Ecology retains the option of adopting the lowest emission limit in Washington State as a reasonably achievable emission limit for this RACT analysis. The lowest demonstrated emission limit in Washington is 0.030 gr/dscf (hourly average limit). This limit has been demonstrated at two Washington lime kilns: KapStone (3) and KapStone (4).

# 3.2. Demonstrated $SO_2$ emission limits for recovery furnaces and lime kilns

Table 8 provides a survey of demonstrated $SO_2$ emission limits for recovery furnaces in Washington State and at randomly selected facilities in the U.S., Canada, and Europe. Canadian and European units have been converted to the listed unit for each limit. In most cases it is not known if the units in Section 3.2 are new, rebuilt, or modified, but information is provided where known. If a limit is required by a rule, the rule is listed under the column titled "Limit Ref."

**Table 8. $SO_2$ Emission Limits[1] Demonstrated at Recovery Furnaces**

| Location | Facility (RF unit if specified) | Limit: gr/dscf[1,2] ppm @ 8% $O_2$ | Limit Reference | Control Technology |
|---|---|---|---|---|
| Europe | LCPDs:[1] low range | 2-3[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Washington | GP Camas (No. 3) | 10 (24-hr avg.) | BACT | scrubber & wet heat recovery |
| Washington | GP Camas (No. 4) | 10 (24-hr avg.) | BACT | scrubber & wet heat recovery |
| Europe | LCPDs:[1] high range | 16-18[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Louisiana[5] | Int'l Paper CAMTI (No. 3) | 20 (3-hr avg.) | BACT | HERB, high solids liquor firing, proper design and operation[5] |
| Idaho | Clearwater Lewiston (No. 5) | 50 (3-hr avg.) | BACT | Good Operating Practices or none listed in permit |
| Washington | KapStone (18) | 60 (3-hr avg.) [switched to 94 lb/hr units] | WAC 173-405-040(11)(a) | Good Operating Practices |
| Washington | KapStone (19) | 60 (3-hr avg.) [switched to 149 lb/hr units] | WAC 173-405-040(11)(a) | Good Operating Practices |
| Washington | Weyerhaeuser (No. 10) | 75 (3-hr avg.) | BART=BACT | Good Operating Practices |
| Florida | Palatka (No. 4) | 100 (24-hr avg.) | BACT | Good Operating Practices or none listed in permit |
| Alabama | Alabama River Cellulose (No.1) | 100 | BACT | Good Operating Practices or none listed in permit |
| Maine | Red Shield (# 4) | 100 | BPT | Good Operating Practices, fuel sulfur std = 0.5% |
| North Carolina | Kapstone (No. 7) | 110 (3-hr avg.) | BACT | Good Operating Practices or |

| Table 8. $SO_2$ Emission Limits[1] Demonstrated at Recovery Furnaces | | | | |
|---|---|---|---|---|
| **Location** | **Facility (RF unit if specified)** | **Limit: gr/dscf[1,2] ppm @ 8% $O_2$** | **Limit Reference** | **Control Technology** |
| | | | | none listed in permit |
| Louisiana | Port Hudson (No. 1) | 120 | BACT | Good Operating Practices or none listed in permit |
| Louisiana | Port Hudson (No. 2) | 120 | BACT | Good Operating Practices |
| Washington | KapStone (22) | 120 (3-hr avg.) [switched to 295 lb/hr units] | WAC 173-405-040(11)(a) | Good Operating Practices |
| Mississippi | Weyerhaeuser NR PW (AA-100) | 153 (or 200 ppm at 4% $O_2$) | BACT | Good Operating Practices or none listed in permit |
| Oregon | Cascade Pacific (RFEU) | 180 | BACT | Good Operating Practices or none listed in permit |
| Washington | PTPC (RF) | 200 | BACT | Good Operating Practices |
| Georgia | Weyerhaeuser PWM (No. 3) | 200 | PSD Limit | Good Operating Practices or none listed in permit |
| Minnesota | Sappi Cloquet LLC (#10) | 250 | Minn R7007.3000 | Good Operating Practices or none listed in permit |
| Georgia | GP Cedar Springs (No. 1) | 300 | PSD Limit | Good Operating Practices or none listed in permit |
| Georgia | GP Cedar Springs (No. 2) | 300 | PSD Limit | Good Operating Practices or none listed in permit |
| Oregon | GP Consumer Products (EU24) | 300 (3-hr avg.) | OAR-340-234-0210(3) | Good Operating Practices or none listed in permit |
| Oregon | Boise White St. Helens (2&3)[6] | 300 (3-hr avg.) | BACT | Good Operating Practices or none listed in permit |
| Georgia | GP Cedar Springs (No. 3) | 350 (24-hr avg.) | BART | Good Operating Practices or none listed in permit |
| Washington | Cosmo (No. 1, 2 & 3 common stk)[7] | 360[7] | Order DE95AQ-1034 | multiclones (RFs 1,2&3), |

| Table 8. $SO_2$ Emission Limits[1] Demonstrated at Recovery Furnaces | | | | |
|---|---|---|---|---|
| Location | Facility (RF unit if specified) | Limit: gr/dscf[1,2] ppm @ 8% $O_2$ | Limit Reference | Control Technology |
| | | | | absorption tower (RF 1&2), evaporator & 3 $SO_2$ venturi absorbers in series (RF3)[7] |
| Washington | WestRock (No. 4) | 500 (150 30-day) | WAC 173-405-040(11)(a) | Good Operating Practices |
| Washington | Boise White Wallula (No. 2) | 500 | WAC 173-405-040(11)(a) | Good Operating Practices |
| Washington | Boise White Wallula (No. 3) | 500 | WAC 173-405-040(11)(a) | Good Operating Practices |
| Enocell, Finland | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Frövi, Sweden | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Joutseno, Finland | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Dynäs, Sweden | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Pöls AG, Austria | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Oulu, Finland | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Östrand, Sweden | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Varö, Sweden | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Stora Celbi, Portugal | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Vallvik, Sweden | Not specified in IPPC[2] | ≤ 2 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Mönsteras, Sweden | Not specified in IPPC[2] | 4 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Obbola, Sweden | Not specified in IPPC[2] | 4 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Skutskär, Sweden | Not specified in IPPC[2] | 5 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Bäckhammar, Sweden | Not specified in IPPC[2] | 5 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Skärblacka, Sweden | Not specified in IPPC[2] | 6 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Skoghall, Sweden | Not specified in IPPC[2] | 6 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Wisaforest, Finland | Not specified in IPPC[2] | 7 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Husum, Sweden | Not specified in IPPC[2] | 12 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Aspa, Sweden | Not specified in IPPC[2] | 15 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Ääneskoski, Finland | Not specified in IPPC[2] | 15 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Kaskinen, Finland | Not specified in IPPC[2] | 16 (annual avg) | IPPC[2] | BAT[2] options[4] |

| Table 8. $SO_2$ Emission Limits[1] Demonstrated at Recovery Furnaces | | | | |
|---|---|---|---|---|
| **Location** | **Facility (RF unit if specified)** | **Limit: gr/dscf[1,2] ppm @ 8% $O_2$** | **Limit Reference** | **Control Technology** |
| Iggesund, Sweden | Not specified in IPPC[2] | 16 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Huelva, Spain | Not specified in IPPC[2] | 17 (annual avg) | IPPC[2] | BAT[2] options[4] |
| Sunila, Finland | Not specified in IPPC[2] | 18 (annual avg) | IPPC[2] | BAT[2] options[4] |

Note: RF = recovery furnace.

1 Limit units are hourly unless listed otherwise.

2 Listed individual European facility emissions are not limits, but are annual average combined $SO_2$ and TRS emissions levels at "well performing existing pulp mills." Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques [BAT] in the [kraft] Pulp and Paper Industry, December 2001, European Commission. LCPD = Large Combustion Plant Directive of the European Commission. European low and high range BAT limits units are 24-hour averages. The 2001 report does not separate $SO_2$ and TRS individually, therefore the amount of $SO_2$ emissions is assumed to be less than the listed amount, but according to the report: "Gaseous sulphur is mainly $SO_2$-S. Usually only very small amounts of $H_2S$ is released."

3 NCASI calculated a BAT range of 1.8-18 ppm (calculations not shown): *NCASI 2009 Environmental Footprint Comparison Tool, Trade-Offs and Co-benefits accompanying SOx and NOx Control* (based on 2001 European BAT). Ecology calculated values similar to NCASI, with a range of 3.3 to 16.4 ppm (converting from 2001 BAT inputs in European units of mg/Nm3 at 273K, 101.3 kPa with dry gas and 5% oxygen).

4 General ICCP BAT approach: "If changes in the fuel or the operation do not give enough reduction of $SO_2$ emission, removing sulphur oxides from flue gases by absorption in alkaline liquid is considered BAT." Specific BAT options for recovery furnaces: "Recovery boilers with high dry solids content of black liquor release very low $SO_2$ emissions." BAT range for sulfite mills is 16 to 49 based on the following from ICCP: "reduction of $SO_2$ emission from flue gases by absorption in alkaline liquid is considered BAT. A removal efficiency for $SO_2$ of 95 + % is achievable. From recovery boilers equipped with multi-stage scrubber…."

5 At least three HERB units have been or are being installed in the United States per Andritz Pulp & Paper www.andritz.com. The three units are IP Valliant, Oklahoma; IP Campti, Louisiana; and PCA, Valdosta, Georgia. It is unclear if the Oklahoma and Georgia units have been included into the latest air permits at the time of this analysis. The Campti unit has been implemented, and permit limits are listed in this table.

6 Mill recently closed (~late 2012/early 2013).

7 $SO_2$ was not selected for further evaluation in the 2010 RH SIP for sulfite mills (2010 Regional Haze SIP, p. 10-8 Table 10-2).

The lowest demonstrated emissions (for 1- to 24-hr average ranges) for the units in Table 8 are from 2-3 ppm to 16-18 ppm (24-hr average BAT emission limit of European facilities). BATs are not permit limits, but are based on BREFs.

Ecology also retains the option of adopting the lowest emission limits in Washington State as a reasonably achievable emission limits for this RACT analysis. The lowest demonstrated emission limits in Washington (for 1- to 24-hr average ranges) are 10 ppm (24-hr average at GP Camas, WA units Nos. 3 and 4).

Table 9 provides a survey of demonstrated $SO_2$ emission limits for lime kilns in Washington State and at randomly selected facilities in the U.S., Canada, and Europe. Canadian and European units have been converted to the listed unit for each limit.

**Table 9. $SO_2$ Emission Limits[1] Demonstrated at Lime Kilns**

| Location | Facility (LK unit if specified) | Limit:[1,2] ppm @ 10% $O_2$ | Limit Reference | Control Technology |
|---|---|---|---|---|
| Europe | LCPDs:[1] low range (w/o NCG incineration) | 1-2[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Europe | LCPDs:[1] high range (w/o NCG incineration) | 8[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Florida | Palatka (No. 4) | 16.9 | BACT | scrubber |
| Alabama | Alabama River Cellulose (No. 1) | 50 | BACT | scrubber |
| Alabama | Alabama River Cellulose (No. 1) | 50 | BACT | scrubber |
| Alabama | Alabama River Cellulose (No. 2) | 50 | BACT | Good Operating Practices or none listed in permit |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 50 | BACT | Good Operating Practices or none listed in permit |
| Washington | KapStone (3) | 20 (3-hr avg.) | WAC 173-405-040(11)(a) | scrubber, Good Operating Practices |
| Washington | KapStone (4) | 20 (3-hr avg.) | WAC 173-405-040(11)(a) | scrubber, Good Operating Practices |
| Washington | KapStone (5) | 20 (3-hr avg.) | WAC 173-405-040(11)(a) | Good Operating Practices |
| Idaho | Clearwater Lewiston (No. 4) | 20 (3-hr avg.) | BACT | scrubber, Good Operating Practices |
| Europe | LCPDs:[1] low range (w/ NCG incineration) | 42[3] (24-hr avg.) | IPPC[1] | BAT[1] = scrubber and/or low sulfur fuel |
| Europe | LCPDs:[1] high range (w/ NCG incineration) | 83-105[3] (24-hr avg.) | IPPC[1] | BAT[1] = Scrubber and/or low sulfur fuel |
| Washington | GP Camas (No. 4) | 500 | WAC 173-405-040(11)(a) | Ducon rectangular cross-section variable throat venturi scrubber |
| Washington | Weyerhaeuser (No. 4) | 500 | BACT | low sulfur input (no pulp mill evaporator condensate in lime mud washing) |
| Washington | PTPC (RF) | 500 | WAC 173-405-040(11)(a) | scrubber |
| Washington | WestRock (No. 1) | 500 | WAC 173-405-040(11)(a) | scrubber, Good Operating Practices |
| Washington | WestRock (No. 2) | 500 | WAC 173-405-040(11)(a) | scrubber, Good Operating Practices |

| Table 9. $SO_2$ Emission Limits[1] Demonstrated at Lime Kilns | | | | |
|---|---|---|---|---|
| Location | Facility (LK unit if specified) | Limit:[1,2] ppm @ 10% $O_2$ | Limit Reference | Control Technology |
| Washington | Graymont | 1000 (coal or ng) | Permit (facility-wide limit) | baghouse for PM only |
| Oulu, Finland | Not specified in IPPC[1] | 2 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Husum, Sweden | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skoghall, Sweden | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Dynäs, Sweden | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Frövi, Sweden | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Obbola, Sweden | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Bäckhammar, Sweden | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Pöls AG, Austria | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Joutseno, Finland | Not specified in IPPC[1] | 3 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Washington | Boise White Wallula | 5 (annual avg.) | Order DE96AQ1078 | Scrubber & low sulfur content (1.55%) in oil, Good Operating Practices |
| Stora Celbi, Portugal | Not specified in IPPC[1] | 6 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Wisaforest, Finland | Not specified in IPPC[1] | 8 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Kaskinen, Finland | Not specified in IPPC[1] | 12-30 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Mönsteras, Sweden | Not specified in IPPC[1] | 14-31 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skärblacka, Sweden | Not specified in IPPC[1] | 14-31 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Ääneskoski, Finland | Not specified in IPPC[1] | 16-33 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Sunila, Finland | Not specified in IPPC[1] | 17-33 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Aspa, Sweden | Not specified in IPPC[1] | 28-41 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skutskär, Sweden | Not specified in IPPC[1] | 28-41 (annual avg.) | IPPC[1] | BAT[1] options[4] |

| Table 9. $SO_2$ Emission Limits[1] Demonstrated at Lime Kilns | | | | |
|---|---|---|---|---|
| **Location** | **Facility (LK unit if specified)** | **Limit:[1,2] ppm @ 10% $O_2$** | **Limit Reference** | **Control Technology** |
| Iggesund, Sweden | Not specified in IPPC[1] | 44 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Enocell, Finland | Not specified in IPPC[1] | 48 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Vallvik, Sweden | Not specified in IPPC[1] | 81 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Varö, Sweden | Not specified in IPPC[1] | 81 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Östrand, Sweden | Not specified in IPPC[1] | 104 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Huelva, Spain | Not specified in IPPC[1] | 160 (annual avg.) | IPPC[1] | BAT[1] options[4] |

Note: LK = lime kiln.

[1] Listed individual European facility emissions are not limits, but are annual average combined $SO_2$ and TRS emissions levels at “well performing existing pulp mills.” ICCP reference document on BAT in the [kraft] Pulp and Paper Industry, December 2001, European Commission. LCPD = Large Combustion Plant Directive of the European Commission. European low and high range BAT limits units are 24-hr averages. The 2001 report does not separate $SO_2$ and TRS individually. Therefore, the amount of $SO_2$ emissions is assumed to be less than the listed amount, but according to the report: "Gaseous sulphur is mainly SO2-S. Usually only very small amounts of H2S is released.” There are two possible values provided in the ICCP report depending on whether an oil fired lime kiln includes non-condensable gas (NCG) incineration or not. For facilities with listed $SO_2$ levels up to the maximum oil-fired range specified in the report for non-NCG incineration, non-NCG incineration was assumed. For facilities with listed emission levels in between the specified NCG or non-NCG oil fired emission levels of the report, a range of the two emission levels was provided. For facilities with listed $SO_2$ levels above the minimum oil-fired range for NCG incineration specified in the report, NCG incineration was assumed.

[2] Limit units are hourly unless listed otherwise.

[3] NCASI calculated a BAT range of 1.8-105 ppm (calculations not shown): *NCASI 2009 Environmental Footprint Comparison Tool, Trade-Offs and Co-benefits accompanying SOx and NOx Control* (based on 2001 European BAT). This range is assumed to include lime kilns that perform NCG incineration, as well as those lime kilns that do not perform NCG incineration. Ecology calculated values similar to NCASI, with a range of 1.4 to 83 ppm (converting from 2001 BAT inputs in European units of mg/Nm3 at 273K, 101.3 kPa with dry gas and 5% oxygen). [For lime kilns without NCG incineration, Ecology calculated a range of 1.4 – 8 ppm, and for lime kilns with NCG incineration, Ecology calculated a range of 42-83 ppm].

[4] General ICCP BAT approach: “If changes in the fuel or the operation do not give enough reduction of SO2 emission, removing sulphur oxides from flue gases by absorption in alkaline liquid is considered BAT.” Specific BAT options for lime kilns: “Depending on the amount of sulphur (NCG) applied to the lime kiln a scrubber may be required. Another option for $SO_2$ reduction would be to choose another location for the incinerations of NCG than the lime kiln or use less sulphur containing oil burned as fuel.”

The lowest demonstrated emission limits (for 1- to 24-hr average ranges) for the units in Table 9 are from 1-8 ppm (24-hr BAT) for lime kilns that do not incinerate NCGs to 42-105 ppm (24-hr BAT) for lime kilns with incineration of NCGs.

Ecology also retains the option of adopting the lowest emission limits in Washington State as a reasonably achievable emission limits for this RACT analysis. The lowest demonstrated emission limits (for 1-hr to 24-hr average ranges) in Washington are 20 ppm (3-hr average) for units with NCG incineration (KapStone, WA, units 3, 4, and 5).

## 3.3. Demonstrated $NO_X$ emission limits for recovery furnaces and lime kilns

Table 10 provides a survey of demonstrated $NO_X$ emission limits for recovery furnaces in Washington State and at randomly selected facilities in the U.S., Canada, and Europe. Canadian and European units have been converted to the listed unit for each emission limit. In most cases it is not known if the units in Section 3.3 are new, rebuilt, or modified, but information is provided where known. If a limit is required by a rule, the rule is listed under the column titled "Limit Ref."

**Table 10. $NO_X$ Emission Limits[1] Demonstrated at Recovery Furnaces**

| Location | Facility (RF unit if specified) | Limit:[1,2] ppm @ 8% $O_2$ | Limit Reference | Control Technology |
|---|---|---|---|---|
| Europe | LCPDs:[1] low range | 36-40[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Europe | LCPDs:[1] high range | 55-58[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Alabama | Alabama River Cellulose (No. 2) | 75 | BACT | proper design & operation, combustion control, or not listed |
| Louisiana[5] | International Paper CAMTI (No. 3) | 80 (3-hr avg.) | BACT | High Energy Recovery Boiler [HERB], Proper combustion control[5] |
| Mississippi | Weyerhaeuser NR PW (AA-100) | 80 (8-hr avg.) | BACT | proper design & operation, combustion control, or not listed |
| Alabama | Alabama River Cellulose (No. 1) | 90 | BACT | proper design & operation, combustion control, or not listed |
| Washington | KapStone (22) | 95 (3-hr avg.) | BACT | proper design & operation, combustion control, or not listed |
| Washington | KapStone (18) | 95 (24-hr avg.) | BACT | proper design & operation, combustion control, or not listed |
| Washington | KapStone (19) | 95 (24-hr avg.) | BACT | proper design & operation, combustion control, or not listed |
| Idaho | Clearwater Lewiston (No. 5) | 100 | BACT | proper design & operation, combustion control, or not listed |
| Arkansas | Georgia Pacific Crossert (8R) | 110 | BACT | BACT = ESP, boiler design, combustion control) |

| Table 10. $NO_X$ Emission Limits[1] Demonstrated at Recovery Furnaces | | | | |
|---|---|---|---|---|
| Location | Facility (RF unit if specified) | Limit:[1,2] ppm @ 8% $O_2$ | Limit Reference | Control Technology |
| Louisiana | Port Hudson (No. 1) | 112 | BACT | staged combustion, GED, PCT |
| Louisiana | Port Hudson (No. 2) | 112 | BACT | staged combustion, GED, PCT |
| Washington | Boise White Wallula(No. 3) | 112 (24-hr avg.) | BACT | proper design & operation, combustion control, or not listed |
| Washington | Weyerhaeuser (No. 10) | 140 (24-hr avg.) | BART = BACT | staged combustion system |
| Maine | Red Shield (# 4) | 150 (24-hr avg.) | RACT | proper design & operation, combustion control, or not listed |
| Minnesota | Boise Cascade Int'l Falls (EU320) | 80 (30-day avg.) | BACT | proper design & operation, combustion control, or not listed |
| Florida | Palatka (No. 4) | 80 (30-day avg.) | BACT | Four-level overfire air system |
| Washington | WestRock (No. 4) | 85 (30-day avg.) | BACT | proper design & operation, combustion control, or not listed |
| North Carolina | Kapstone (No. 7) | 100 (30-day avg.) | BACT | proper design & operation, combustion control, or not listed |
| Minnesota | Sappi Cloquet LLC | 115 (30-day avg.) | BACT | proper design & operation, combustion control, or not listed |
| Skärblacka, Sweden | Not specified in IPPC[1] | 35 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Oulu, Finland | Not specified in IPPC[1] | 41 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Wisaforest, Finland | Not specified in IPPC[1] | 44 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Huelva, Spain | Not specified in IPPC[1] | 45 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Mönsteras, Sweden | Not specified in IPPC[1] | 48 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Frövi, Sweden | Not specified in IPPC[1] | 51 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Joutseno, Finland | Not specified in IPPC[1] | 51 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Obbola, Sweden | Not specified in IPPC[1] | 51 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Stora Celbi, Portugal | Not specified in IPPC[1] | 51 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Sunila, Finland | Not specified in IPPC[1] | 51 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skoghall, Sweden | Not specified in IPPC[1] | 56 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Enocell, Finland | Not specified in IPPC[1] | 59 (annual avg.) | IPPC[1] | BAT[1] options[4] |

| Table 10. $NO_X$ Emission Limits[1] Demonstrated at Recovery Furnaces | | | | |
|---|---|---|---|---|
| Location | Facility (RF unit if specified) | Limit:[1,2] ppm @ 8% $O_2$ | Limit Reference | Control Technology |
| Husum, Sweden | Not specified in IPPC[1] | 60 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Bäckhammar, Sweden | Not specified in IPPC[1] | 60 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Dynäs, Sweden | Not specified in IPPC[1] | 61 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skutskär, Sweden | Not specified in IPPC[1] | 62 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Aspa, Sweden | Not specified in IPPC[1] | 63 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Östrand, Sweden | Not specified in IPPC[1] | 67 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Kaskinen, Finland | Not specified in IPPC[1] | 67 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Vallvik, Sweden | Not specified in IPPC[1] | 70 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Iggesund, Sweden | Not specified in IPPC[1] | 73 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Varö, Sweden | Not specified in IPPC[1] | 73 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Pöls AG, Austria | Not specified in IPPC[1] | 77 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Ääneskoski, Finland | Not specified in IPPC[1] | 84 (annual avg.) | IPPC[1] | BAT[1] options[4] |

Note: RF = recovery furnace.

1 Listed individual European facility emissions are not limits, but annual average emissions levels at "well performing existing pulp mills." Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques [BAT] in the [kraft] Pulp and Paper Industry, December 2001, European Commission. LCPD = Large Combustion Plant Directive of the European Commission. European low and high range BAT limits units are 24-hour averages.

2 Limit units are hourly unless listed otherwise.

3 NCASI calculated a BAT range of 40-58 ppm (calculations not shown): *NCASI 2009 Environmental Footprint Comparison Tool, Trade-Offs and Co-benefits accompanying SOx and NOx Control* (based on 2001 European BAT). Ecology calculated values similar to NCASI, with a range of 36 to 55 ppm (converting from 2001 BAT inputs in European units of mg/Nm3 at 273K, 101.3 kPa with dry gas and 5% oxygen).

4 General ICCP BAT approach: "The emission of nitrogen oxides can be controlled by burner design (low $NO_X$ burners) and modified combustion conditions (primary methods). Specific BAT options for recovery furnaces: "The design of the recovery boiler (staged air feed systems) can result in relatively low $NO_X$ concentrations." BAT range for sulfite mills is 91 to 137 based on the following from ICCP: "The emission of nitrogen oxides can be controlled by burner design (low $NO_X$ burners) and modified combustion conditions (primary methods). The design of the recovery boiler (staged air feed systems) can result in relatively low $NO_X$ concentrations.... Secondary methods as selective non-catalytic reduction (SNCR) are usually not in operation."

5 At least three HERB units have been or are being installed in the United States per Andritz Pulp & Paper www.andritz.com. The three units are IP Valliant, Oklahoma; IP Campti, Louisiana; and PCA, Valdosta, Georgia. It is unclear if the Oklahoma and Georgia units have been included into the latest

| Table 10. $NO_X$ Emission Limits[1] Demonstrated at Recovery Furnaces | | | | |
|---|---|---|---|---|
| Location | Facility (RF unit if specified) | Limit:[1,2] ppm @ 8% $O_2$ | Limit Reference | Control Technology |
| air permits at the time of this analysis. The Campti unit has been implemented, and permit limits are listed in this table. | | | | |

The lowest demonstrated emissions in Table 10 (for 1- to 24-hr average ranges) are from 36-58 ppm (24-hr average for the BAT emission limit range of European facilities). BATs are not permit limits, but are based on BREFs.

Ecology also retains the option of adopting the lowest emission limits in Washington State as a reasonably achievable emission limits for this RACT analysis. The lowest demonstrated emission limits (for 1- to 24-hr average ranges) in Washington are 95 ppm for both a 3-hr average limit (KapStone, WA, unit 22), and 24-hr average limits (KapStone, WA, units 18 and 19).

Table 11 provides a survey of demonstrated $NO_X$ emission limits for lime kilns in Washington State and at randomly selected facilities in the U.S., Canada, and Europe. Canadian and European units have been converted to the listed unit for each limit.

| Table 11. $NO_X$ Emission Limits[1] Demonstrated at Lime Kilns | | | | |
|---|---|---|---|---|
| Location | Facility (LK unit if specified) | Limit:[1,2] ppm @ 10% $O_2$ | Limit Reference | Control Technology |
| Europe | LCPDs:[1] low range (oil) | 39-49[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Europe | LCPDs:[1] high range (oil) | 77[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Alabama | Alabama River Cellulose (No. 2) | 100 | BACT | proper design & operation, combustion control, or none listed in permit |
| Oregon | Cascade Pacific (LKEU) | 112 | BACT | proper design & operation, combustion control, or none listed in permit |
| Europe | LCPDs:[1] low range (natural gas) | 146[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Maine | Red Shield (# 4) | 170 | RACT | proper design & operation, combustion control, or not listed |
| Alabama | Alabama River Cellulose (No. 1) | 175 | BACT | proper design & operation, combustion control, or none listed in permit |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 189 (or 300 ppm at 3.6% $O_2$) | BACT | proper design & operation, combustion control, or not listed |

| Table 11. $NO_X$ Emission Limits[1] Demonstrated at Lime Kilns | | | | |
|---|---|---|---|---|
| **Location** | **Facility (LK unit if specified)** | **Limit:[1,2] ppm @ 10% $O_2$** | **Limit Reference** | **Control Technology** |
| Minnesota | Sappi Cloquet LLC | 220 | BACT | proper design & operation, combustion control, or not listed |
| Europe | LCPDs:[1] high range (natural gas) | 231-292[3] (24-hr avg.) | IPPC[1] | BAT[1] options[4] |
| Oregon | Boise White St Helens[5] | 270 | BACT | proper design & operation, combustion control, or none listed in permit |
| Washington | KapStone (5) | 275 (24-hr avg.) | BACT | proper design & operation, combustion control, or none listed in permit |
| Washington | KapStone (3) | 340 (24-hr avg.) | BACT | proper design & operation, combustion control, or none listed in permit |
| Washington | KapStone (4) | 340 (24-hr avg.) | BACT | proper design & operation, combustion control, or none listed in permit |
| Florida | Palatka (No. 4) | 114 (30-day avg.) | BACT | proper design & operation, combustion control, or none listed in permit |
| Bäckhammar, Sweden | Not specified in IPPC[1] | 15 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Huelva, Spain | Not specified in IPPC[1] | 23 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Östrand, Sweden | Not specified in IPPC[1] | 31 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Ääneskoski, Finland | Not specified in IPPC[1] | 39 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Husum, Sweden | Not specified in IPPC[1] | 42 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Iggesund, Sweden | Not specified in IPPC[1] | 50 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skoghall, Sweden | Not specified in IPPC[1] | 58 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Kaskinen, Finland | Not specified in IPPC[1] | 62 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Joutseno, Finland | Not specified in IPPC[1] | 65 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Stora Celbi, Portugal | Not specified in IPPC[1] | 65 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Enocell, Finland | Not specified in IPPC[1] | 66 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Obbola, Sweden | Not specified in IPPC[1] | 69 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skutskär, Sweden | Not specified in IPPC[1] | 73 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Aspa, Sweden | Not specified in IPPC[1] | 77 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Mönsteras, Sweden | Not specified in IPPC[1] | 66-81 (annual avg.) | IPPC[1] | BAT[1] options[4] |

| Table 11. $NO_X$ Emission Limits[1] Demonstrated at Lime Kilns | | | | |
|---|---|---|---|---|
| **Location** | **Facility (LK unit if specified)** | **Limit:[1,2] ppm @ 10% $O_2$** | **Limit Reference** | **Control Technology** |
| Frövi, Sweden | Not specified in IPPC[1] | 66-81 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Vallvik, Sweden | Not specified in IPPC[1] | 70-85 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Dynäs, Sweden | Not specified in IPPC[1] | 70-85 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Skärblacka, Sweden | Not specified in IPPC[1] | 74-89 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Varö, Sweden | Not specified in IPPC[1] | 87-100 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Oulu, Finland | Not specified in IPPC[1] | 91-104 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Sunila, Finland | Not specified in IPPC[1] | 93-106 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Wisaforest, Finland | Not specified in IPPC[1] | 115-126 (annual avg.) | IPPC[1] | BAT[1] options[4] |
| Pöls AG, Austria | Not specified in IPPC[1] | 168 (annual avg.) | IPPC[1] | BAT[1] options[4] |

Note: LK = lime kiln.

1. Listed individual European facility emissions are not limits, but annual average emissions levels at "well performing existing pulp mills." Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques [BAT] in the [kraft] Pulp and Paper Industry, December 2001, European Commission. LCPD = Large Combustion Plant Directive of the European Commission. European low and high range BAT limits units are 24-hour averages. Individual facility fuel details are not provided in the 2001 IPPC report. For facilities with listed NOx levels up to the maximum oil-fired range specified in the report, oil was the assumed fuel. For facilities with listed NOx levels within the gas-fired range specified in the report, gas was the assumed fuel (Pöls AG, Austria). For facilities with listed emission levels in between the specified oil and gas fired emission levels of the report, a range consisting of both gas and oil fired kiln emission levels were provided.
2. Limit units are hourly and at 10% oxygen unless listed otherwise.
3. NCASI calculated a BAT range of 49-292 ppm (calculations not shown): *NCASI 2009 Environmental Footprint Comparison Tool, Trade-Offs and Co-benefits accompanying SOx and NOx Control* (based on 2001 European BAT). This range is assumed to include both gas-fired and oil-fired lime kilns. Ecology calculated values similar to NCASI, with a range of 39 to 231 ppm (converting from 2001 BAT inputs in European units of mg/Nm3 at 273K, 101.3 kPa with dry gas and 5% oxygen). [For lime kilns that are oil fired, Ecology calculated a range of 39–77 ppm, and for lime kilns that are gas fired, Ecology calculated a range of 146-231 ppm].
4. General ICCP BAT approach: "The emission of nitrogen oxides can be controlled by burner design (low NOx burners) and modified combustion conditions (primary methods). Specific BAT options for lime kilns: "The possibilities to decrease the NOx emissions by adjusting the kiln running parameters, the flame shape, the air distribution and the excess oxygen is limited but can lead to slight reduction of NOx formation (about 10-20%)."
5. Mill recently closed (~late 2012/early 2013).

The lowest demonstrated emissions (for 1- to 24-hr average ranges) for the units in Table 11 are 39-77 ppm for oil-fired kilns and 146-292 ppm BAT range for gas-fired kilns (24-hour average for the BAT emission limit range of European facilities). BATs are not permit limits, but are based on BREFs.

Ecology also retains the option of adopting the lowest emission limits in Washington State as reasonably achievable emission limits for this RACT analysis. The lowest demonstrated emission limits in Washington are 275 ppm (24-hr average limit at KapStone, WA, unit 5; unit uses oil and/or natural gas).

# 4. Estimated Emission Reductions Achievable

This section presents emission reductions that are estimated to be achieved for potential $SO_2$, $NO_X$, and PM RACT limits. Ecology interprets "reasonably available" control technology as defined in Section 1.2, to mean those control technologies that are currently demonstrating compliance with the $SO_2$, $NO_X$, and PM emission limits in Sections 3.1–3.3. There may be other control technologies listed in Chapter 2 which are capable of meeting the emission limits in Sections 3.1–3.3, but have not been demonstrated in practice. Potential emission reductions achievable using control technologies that have not been demonstrated in practice are not estimated as part of this RACT analysis.

## 4.1. Estimated emission reductions achievable (by facility)

In order to compare emission limits between facilities, units were converted to the extent possible given available facility information because some facility permits do not provide emission limits in comparable units. Concentration based limits in gr/dscf and also ppm, where provided, were used to compare emission limits between facilities. In addition, for Washington State pulp mills, recovery furnace and lime kiln compliance tests were compared to facility emission limits and also to potential RACT emission limits in order to estimated potential reductions from RACT options. Unit conversion and permit limit information is provided in Appendix A. Facility operating and emission information is provided in Appendix B and was the basis from which the estimated emission reductions listed in this chapter were calculated.

Estimated emission reductions are the difference between multi-year average annual emissions and the multi-year average annual emissions multiplied by the ratio of emission at the proposed RACT limit to measured emissions (if available) or calculated emissions (if measured emissions not available). This approach included the occasional need to convert mass per time units obtained from emission inventory data into concentration based limits for comparison purposes when compliance test results were unavailable. However, as noted in Section 5.2, the specific average pulp mill emission reductions from this section that are considered as RACT options in Chapter 5, are based on multi-year measured (compliance test) data, not on calculated data. For calculated data, multi-year average annual emission inventory units of tons per year (TPY) were divided by multi-year average annual flow rate units of dry standard cubic feet per minute to provide concentration-based units.

This RACT analysis assumed emission limits with averaging times of 24 hours or less, are to an extent, comparable. For example: a daily (24-hr) limit would need to meet a similar 1-hr or 3-hr limit (etc.) most of the time in order to meet the daily limit. Limits based on averaging periods over 24 hours long were avoided. For example: although the recovery furnace at WestRock has a 150 ppm $SO_2$ limit for a 30-day rolling average, that facility's 1-hr 500 ppm $SO_2$ limit was used for similarly shorter averaging period comparison purposes instead.

Recovery furnaces can experience short duration spikes in $SO_2$ ppm levels and, as a result, some facilities have difficulty meeting short-term recovery furnace concentration emissions limits. One facility in Washington State, KapStone, switched from 3-hr average $SO_2$ concentration based permit limits of 60 ppm (RFs 18 & 19) to mass emission rate permit limits. However, the facility in Washington State with the lowest permitted recovery furnace $SO_2$ concentration based emission limit (10 ppm at GP Camas), consistently meets that limit, which is based on a 24-hr averaging period. In addition, the facility in Washington State with the next lowest recovery furnace $SO_2$ concentration based emission limit (75 ppm at Weyerhaeuser), demonstrates compliance with that limit, which is based on a 3-hr averaging period, and constitutes Ecology's BART determination for that unit per the RH SIP (p. L-374). It should be noted that the 75 ppm $SO_2$ limit listed in that facility's air operating permit is for conditions when supplemental oil is not used; or, if it is used, the black liquour solids (BLS) firing rate must be greater than 150,000 lb/hr.

This RACT analysis was based on a snapshot of emission inventories between approximately 2003 and 2011 depending on available data and facility operations (i.e., Cosmo did not operate from 2007–2010). Specific facility details may have changed since 2011. For example, at the KapStone facility, this analysis was based on emission inventory information for three recovery furnaces (RF18, RF19, and RF22). However, based on information from Ecology's Industrial Section which manages compliance at pulp mills, it appears that RF18 has not been operated continuously since 2012, but as a possible backup recovery furnace while RF19 is being modified. Eventually it will be permanently shut down under Notice of Construction (NOC) Order 8429. It is required to be shut down once RF19 is placed into operation after it is modified. By including all three recovery furnaces, this RACT analysis conservatively overestimates emission reductions for that facility.

Estimated emission reductions for each individual pulp mill in Washington State are provided in the following subsections. Recovery furnace HERB limits are not included for consideration below because there are currently no HERB units in operation in Washington State.

### 4.1.1. PTPC estimated emission reductions

PTPC, located in Port Townsend, WA, operates a Kraft pulp and paper mill that manufactures unbleached Kraft pulp, Kraft papers, and lightweight linerboard. Emissions and estimated emission reductions are presented in Tables 12 and 13.

| Table 12. PTPC Recovery Furnace Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Recovery Furnace Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **206** | **105** | **116** | |
| | | | | | **Estimated Reductions (TPY)** | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.044 | 0.027 | --- | --- | 45 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.044 | 0.027 | --- | --- | 34 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.044 | 0.027 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 200 | 28 | --- | 67 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 200 | 28 | --- | 37 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 200 | 28 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | No limit | 51 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | No limit | 51 | 0 | --- | --- | 1,2 |

Notes: --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2003-2009 compliance tests or are calculated from 2003-2008 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 13. PTPC Lime Kiln Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **51** | **1** | **23** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.064 | 0.036 | --- | --- | 10 | (1),(2) |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.064 | 0.036 | --- | --- | 4 | (1),(2) |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG) | 3-hr | 500 | 4 | --- | 0 | --- | (1),(2) |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT w/NCG) | 24-hr | 500 | 4 | --- | 0 | --- | (1),(2) |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | No limit | 81 | 2 | --- | --- | (1),(2) |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 81 | 0 | --- | --- | (1),(2) |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | (3) | (3) | --- | --- | (1),(2) |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

(1) Measured/calculated emissions are averages of 2003-2009 compliance tests or are calculated from 2003-2008 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

(2) Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit).

(3) The lime kiln at PTPC burns oil exclusively.

## 4.1.2. WestRock estimated emission reductions

WestRock is located in Tacoma, WA, and operates a recovery furnace and two lime kilns. Emissions and estimated emission reductions are presented in Tables 14–16.

**Table 14. WestRock Recovery Furnace (No. 4) Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured Emissions | Annual Emission Averages (tons) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 285 | 286 | 26 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.044 | 0.005 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.044 | 0.005 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.044 | 0.005 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 500 | 221 | --- | 273 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 500 | 221 | --- | 263 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 500 | 221 | --- | 189 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | 85 | 50 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | 85 | 50 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2005-2011 compliance tests or are calculated from 2005-2009 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 15. WestRock Lime Kiln (No. 1) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **43** | **4** | **24** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.064 | 0.033 | --- | --- | 9 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.064 | 0.033 | --- | --- | 2 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 500 | 75 | --- | 3 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 500 | 75 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | No limit | 41 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 41 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | 41 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2005-2011 compliance tests or are calculated from 2005-2009 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 16. WestRock Lime Kiln (No. 2) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **2** | **1** | **5** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.064 | 0.042 | --- | --- | 3 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.064 | 0.042 | --- | --- | 1 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 500 | 73 | --- | 1 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 500 | 73 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | No limit | 6 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 6 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | 6 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2005-2011 compliance tests or are calculated from 2005-2009 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

### 4.1.3. Weyerhaeuser estimated emission reductions

Weyerhaeuser is located in Longview, WA, and operates a recovery furnace and a lime kiln. Emissions and estimated emission reductions are presented in Tables 17 and 18.

**Table 17. Weyerhaeuser Recovery Furnace (No. 10) Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured/ Calculated Emissions | Annual Emission Averages (tons) / Estimated Reductions (tpy) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 584 | 35 | 43 | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.027 | 0.004 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.027 | 0.004 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.027 | 0.004 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 75 | 2.9 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 75 | 2.9 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 75 | 2.9 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | 140 | 67 | 78 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | 140 | 67 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2011-2012 compliance tests or are calculated from 200-2007 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 18. Weyerhaeuser Lime Kiln (No. 4) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **129** | **6** | **20** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.035 | 0.002 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.035 | 0.002 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 500 | 5.2 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 500 | 5.2 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | No limit | 156 | 65 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 156 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | 156 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2011-2012 compliance tests or are calculated from 2003-2007 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

### 4.1.4. GP Camas estimated emission reductions

GP Camas is located in Camas, WA, and operates two recovery furnaces and a lime kiln. Emissions and estimated emission reductions are presented in Tables 19–21.

**Table 19. GP Camas Recovery Furnace (No. 3) Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured/ Calculated Emissions | Annual Emission Averages (tons) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 119 | 2 | 7 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.033 | 0.033 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.033 | 0.033 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.033 | 0.033 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 10 | 0.8 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 10 | 0.8 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 10 | 0.8 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | No limit | 57 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | No limit | 57 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2007-2009 compliance tests or are calculated from 2003-2007 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 75 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

**Table 20. GP Camas Recovery Furnace (No. 4) Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured/ Calculated Emissions | Annual Emission Averages (tons) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 207 | 3 | 65 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.033 | 0.020 | --- | --- | 11 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.033 | 0.020 | --- | --- | 3 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.033 | 0.020 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 10 | 1.6 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 10 | 1.6 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 10 | 1.6 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | No limit | 73 | 42 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | No limit | 73 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2007-2009 compliance tests or are calculated from 2003-2007 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 75 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 21. GP Camas Lime Kiln (No. 4) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **104** | **1** | **13** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.067 | 0.021 | --- | --- | 1 | (1),(2) |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.067 | 0.021 | --- | --- | 0 | (1),(2) |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG) | 3-hr | 500 | 2.0 | --- | 0 | --- | (1),(2) |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT w/NCG) | 24-hr | 500 | 2.0 | --- | 0 | --- | (1),(2) |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | No limit | (3) | (3) | --- | --- | (1),(2) |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 361 | 25 | --- | --- | (1),(2) |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | 367 | 20 | --- | --- | (1),(2) |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

(1) Measured/calculated emissions are averages of 2007-2009 compliance tests or are calculated from 2003-2007 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 75 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

(2) Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit).

(3) The LK (No. 4) at GP Camas does not burn oil. The fuel oil burner was decommissioned in early 2011.

### 4.1.5. KapStone estimated emission reductions

KapStone is located in Longview, WA, and operates three recovery furnaces and three lime kilns. Emissions and estimated emission reductions are presented in Tables 22–27.

**Table 22. KapStone Recovery Furnace (No. 18) Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured Emissions | Annual Emission Averages (tons) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 127 | 12 | 4 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.044 | 0.0014 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.044 | 0.0014 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.044 | 0.0014 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 60 (removed) | 30 | --- | 8 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 60 (removed) | 30 | --- | 5 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 60 (removed) | 30 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | 95 | 56 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | 95 | 56 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2010-2013 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 23. KapStone Recovery Furnace (No. 19) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Recovery Furnace Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **173** | **18** | **14** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.040 | 0.004 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.040 | 0.004 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.040 | 0.004 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 60 (removed) | 28 | --- | 11 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 60 (removed) | 28 | --- | 6 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 60 (removed) | 28 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | 95 | 61 | 8 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | 95 | 61 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2010-2013 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 24. KapStone Recovery Furnace (No. 22) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured Emissions | Annual Emission Averages (tons) | | | Notes |
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 268 | 60 | 8 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.027 | 0.001 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.027 | 0.001 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.027 | 0.001 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 120 (removed) | 86 | --- | 53 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 120 (removed) | 86 | --- | 47 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 120 (removed) | 86 | --- | 8 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | 95 | 66 | 32 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | 95 | 66 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2010-2013 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 25. KapStone Lime Kiln (No. 3) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **24** | **0** | **3** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.030 | 0.01 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.030 | 0.01 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 20 | 2.1 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 20 | 2.1 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | 340 | 84 | 2 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | 340 | 84 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | 340 | 84 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2010-2013 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 26. KapStone Lime Kiln (No. 4) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **54** | **2** | **8** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.030 | 0.015 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.030 | 0.015 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 20 | 3.3 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 20 | 3.3 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | 340 | 126 | 21 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | 340 | 126 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | 340 | 126 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2010-2013 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 27. KapStone Lime Kiln (No. 5) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lime Kiln Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured Emissions | Annual Emission Averages (tons) | | | Notes |
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 41 | 1 | 1 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.035 | 0.002 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.035 | 0.002 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 20 | 1.9 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 20 | 1.9 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | 275 | 98 | 9 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | 275 | 98 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | 275 | 98 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2010-2013 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 20 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

### 4.1.6. Boise White Wallula estimated emission reductions

Boise White Wallula is located in Wallula, WA, and operates two recovery furnaces and a lime kiln. Emissions and estimated emission reductions are presented in Tables 28–30.

**Table 28. Boise White Wallula Recovery Furnace (No. 2) Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured/ Calculated Emissions | Annual Emission Averages (tons) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ | $SO_2$ | PM | |
| | | | | | 67 | 294 | 9 | |
| | | | | | Estimated Reductions (tpy) | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.044 | 0.006 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.044 | 0.006 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.044 | 0.006 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 500 | 173 | --- | 277 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 500 | 173 | --- | 264 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 500 | 173 | --- | 167 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | No limit | 57 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | No limit | 57 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2005-2012 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 100 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 29. Boise White Wallula Recovery Furnace (No. 3) Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Recovery Furnace Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **285** | **496** | **15** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.027 | 0.003 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.019 (Europe BAT) | 24-hr | 0.027 | 0.003 | --- | --- | 0 | 1,2 |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.027 | 0.003 | --- | --- | 0 | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit: w/Whr | 24-hr | 500 | 49 | --- | 395 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 18 (Europe BAT: No Whr) | 24-hr | 500 | 49 | --- | 314 | --- | 1,2 |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 500 | 49 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 58 (Europe BAT) | 24-hr | 112 | 61 | 14 | --- | --- | 1,2 |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | 112 | 61 | 0 | --- | --- | 1,2 |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

[1] Measured/calculated emissions are averages of 2005-2012 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 100 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

| Table 30. Boise White Wallula Lime Kiln Emission Reductions | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lime Kiln Pollutant (units)** | **Potential RACT Limit (source)** | **Proposed Limit Avg Time** | **Current Permit Limit** | **Measured/ Calculated Emissions** | **Annual Emission Averages (tons)** | | | **Notes** |
| | | | | | **$NO_X$** | **$SO_2$** | **PM** | |
| | | | | | **59** | **3** | **48** | |
| | | | | | **Estimated Reductions (tpy)** | | | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT: oil or ng) | 24-hr | 0.064 | 0.047 | --- | --- | 28 | 1,2 |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit: oil or ng) | 1-hr | 0.064 | 0.047 | --- | --- | 18 | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 5/yr; 19 lb/day | 2.4 | --- | 0 | --- | 1,2 |
| $SO_2$ (ppm at 10% $O_2$) | 105 (Europe BAT: w/NCG) | 24-hr | 5/yr; 19 lb/day | 2.4 | --- | 0 | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 77 (Europe BAT: oil) | 24-hr | No limit | 67 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 67 | 0 | --- | --- | 1,2 |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | 67 | 0 | --- | --- | 1,2 |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

[1] Measured/calculated emissions are averages of 2005-2012 compliance tests or are calculated from 2005-2011 annual emission averages and other stack parameter information. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level w/in 100 ft). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

[2] Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit.)

### 4.1.7. Cosmo estimated emission reductions

Cosmo is located in Cosmopolis, WA, and operates a sulfite recovery furnace. The sulfite mill process does not include the use of lime kilns. Emissions and estimated emission reductions are presented in Table 31.

**Table 31. Cosmo Recovery Furnace Emission Reductions**

| Recovery Furnace Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured/ Calculated Emissions | Annual Emission Averages (tons) / Estimated Reductions (tpy) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ 348 | $SO_2$ 169 | PM 195 | |
| PM (gr/dscf at 8% $O_2$) | 0.0165 (lowest w/in BAT) | 1-hr | 0.10 | 0.054 | --- | --- | 135 | (1),(2),(3) |
| PM (gr/dscf at 8% $O_2$) | 0.008 (Europe sulfite BAT) | 24-hr | 0.10 | 0.054 | --- | --- | 166 | (1),(2),(3) |
| PM (gr/dscf at 8% $O_2$) | 0.027 (lowest WA limit) | 1-hr | 0.10 | 0.054 | --- | --- | 97 | (1),(2),(3) |
| $SO_2$ (ppm at 8% $O_2$) | 10 (lowest WA limit w/Whr) | 24-hr | 360 | 308 | --- | 164 | --- | (1),(2),(3) |
| $SO_2$ (ppm at 8% $O_2$) | 49 (Europe sulfite BAT: No Whr) | 24-hr | 360 | 308 | --- | 142 | --- | (1),(2),(3) |
| $SO_2$ (ppm at 8% $O_2$) | 75 (lowest WA limit: No Whr) | 3-hr | 360 | 308 | --- | 128 | --- | (1),(2),(3) |
| $NO_X$ (ppm at 8% $O_2$) | 137 (Europe sulfite BAT) | 24-hr | No limit | 86 | 0 | --- | --- | (1),(2),(3) |
| $NO_X$ (ppm at 8% $O_2$) | 95 (lowest WA limit) | 3-hr | No limit | 86 | 0 | --- | --- | (1),(2),(3) |

Notes: RF = recovery furnace. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration. Whr = wet heat recovery.

(1) Measured/calculated emissions are averages of 2011-2012 compliance tests or are calculated from emission inventory data. Because the facility did not operate from 2007 through 2010, emission inventories from 2005, 2006 and 2011 were evaluated and 2011 annual emissions were chosen for this evaluation. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

(2) Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit).

(3) Cosmo is currently the only sulfite mill in WA. Emission limits are compared between sulfate (kraft) mills and this sulfite mill, even though they are different processes. Sulfite mill BAT values were used where noted.

## 4.1.8. Graymont estimated emission reductions

Graymont is located in Tacoma, WA, and operates a calcining lime kiln. Emissions and estimated emission reductions are presented in Table 32.

**Table 32. Graymont Calcining Lime Kiln (CLK) Emission Reductions**

| Lime Kiln Pollutant (units) | Potential RACT Limit (source) | Proposed Limit Avg Time | Current Permit Limit | Measured/ Calculated Emissions | Annual Emission Averages (tons) / Estimated Reductions (tpy) | | | Notes |
|---|---|---|---|---|---|---|---|---|
| | | | | | $NO_X$ 56 | $SO_2$ 9 | PM 63 | |
| PM (gr/dscf at 10% $O_2$) | 0.02 (Europe BAT for any fuel) | 24-hr | 0.05 | 0.012 | --- | --- | 0 | (1),(2),(3) |
| PM (gr/dscf at 10% $O_2$) | 0.030 (lowest WA limit for ng) | 1-hr | 0.05 | 0.012 | --- | --- | 0 | (1),(2),(3) |
| $SO_2$ (ppm at 10% $O_2$) | 8 (Europe BAT w/o NCG) | 24-hr | 1000 | 12 | --- | 3 | --- | (1),(2),(3) |
| $SO_2$ (ppm at 10% $O_2$) | 20 (lowest WA limit w/or w/o NCG | 3-hr | 1000 | 12 | --- | 0 | --- | (1),(2),(3) |
| $NO_X$ (ppm at 10% $O_2$) | 275 (lowest WA limit: oil or ng) | 24-hr | No limit | 107 | 0 | --- | --- | (1),(2),(3) |
| $NO_X$ (ppm at 10% $O_2$) | 292 (Europe BAT: ng) | 24-hr | No limit | 107 | 0 | --- | --- | (1),(2),(3) |

Notes: LK = lime kiln. --- = not applicable. Ng = natural gas. NCG = non condensable gas incineration.

(1) Listed emissions are averages of, or calculated from, 2009 & 2011 compliance tests and 2006-2012 emission inventory emissions and other stack parameter information. Based on information from the Puget Sound Clean Air Agency (PSCAA), coal was the primary fuel for most of these years until approximately 2010. Ng was used in 2011-2012. Sea level pressure assumed for absolute stack pressure (facility is approximately at sea level). $NO_2$ molecular weight assumed for $NO_X$ (MW = 46).

(2) Assumes limits with averaging periods of 24 hours or less are comparable (i.e., a daily limit would need to meet a similar value hourly limit most of the time in order to meet the daily limit).

(3) Ecology could not find information indicating that the Graymont kiln performs incineration of NCG. Based on information from PSCAA, coal was the primary fuel used for the Graymont lime kiln for most of 2006 through 2010. Ng was used in 2011-2012. PSCAA permit statement of basis indicates the kiln can burn coal or ng. Oil is not listed as fuel source for the kiln.

## 4.2. Estimated emission reductions for recovery furnaces achievable (cumulative data)

| Table 33. Tons of Potential Pollutant Reduction Based on Proposed RACT Limit Options for Recovery Furnaces | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Pollutant/ Avg Period:** | **PM 1-hr** | **PM 1-hr** | **PM 1-hr** | **$SO_2$ 24-hr[1]** | **$SO_2$ 24-hr** | **$SO_2$ 3-hr** | **$NO_X$ 24-hr** | **$NO_X$ 3-hr** |
| **Proposed RACT Limit for Recovery Furnace:** | **0.0165 gr/dscf at 8% $O_2$ (basis: BAT; sulfite BAT = 0.008 gr/dscf)** | **0.019 gr/dscf at 8% $O_2$ (basis: BAT; sulfite BAT = 0.008 gr/dscf)** | **0.027 gr/dscf at 8% $O_2$ (basis: WA)** | **10 ppm at 8% $O_2$ (basis: GP WA = w/in BAT)** | **18 ppm at 8% $O_2$ (basis: BAT; sulfite BAT = 49 ppm)** | **75 ppm at 8% $O_2$ (basis: lowest WA w/o Whr)** | **58 ppm at 8% $O_2$ (basis: BAT; sulfite BAT = 137 ppm)** | **95 ppm at 8% $O_2$ (basis: WA)** |
| Boise White Wallula No. 3 | 0 | 0 | 0 | 395 | 314 | 0 | 14 | 0 |
| Boise White Wallula No. 2 | 0 | 0 | 0 | 277 | 264 | 167 | 0 | 0 |
| WestRock No. 4 | 0 | 0 | 0 | 273 | 263 | 189 | 0 | 0 |
| Cosmo (1, 2,& 3) | 135 | 166 | 97 | 164 | 142 | 128 | 0 | 0 |
| PTPC RF | 45 | 34 | 0 | 67 | 37 | 0 | 0 | 0 |
| Weyerhaeuser No. 10 | 0 | 0 | 0 | 0 | 0 | 0 | 78 | 0 |
| GP Camas No. 4 | 11 | 3 | 0 | 0 | 0 | 0 | 42 | 0 |
| GP Camas No. 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| KapStone RF22 | 0 | 0 | 0 | 53 | 47 | 8 | 32 | 0 |
| KapStone RF19 | 0 | 0 | 0 | 11 | 6 | 0 | 8 | 0 |
| KapStone RF18 | 0 | 0 | 0 | 8 | 5 | 0 | 0 | 0 |
| **Total** | **191** | **203** | **97** | **1248** | **1078** | **491** | **176** | **0** |

Notes: RF = recovery furnace. Whr = wet heat recovery

[1] Based on GP Camas RF Nos. 3 and 4, which have wet heat recovery systems.

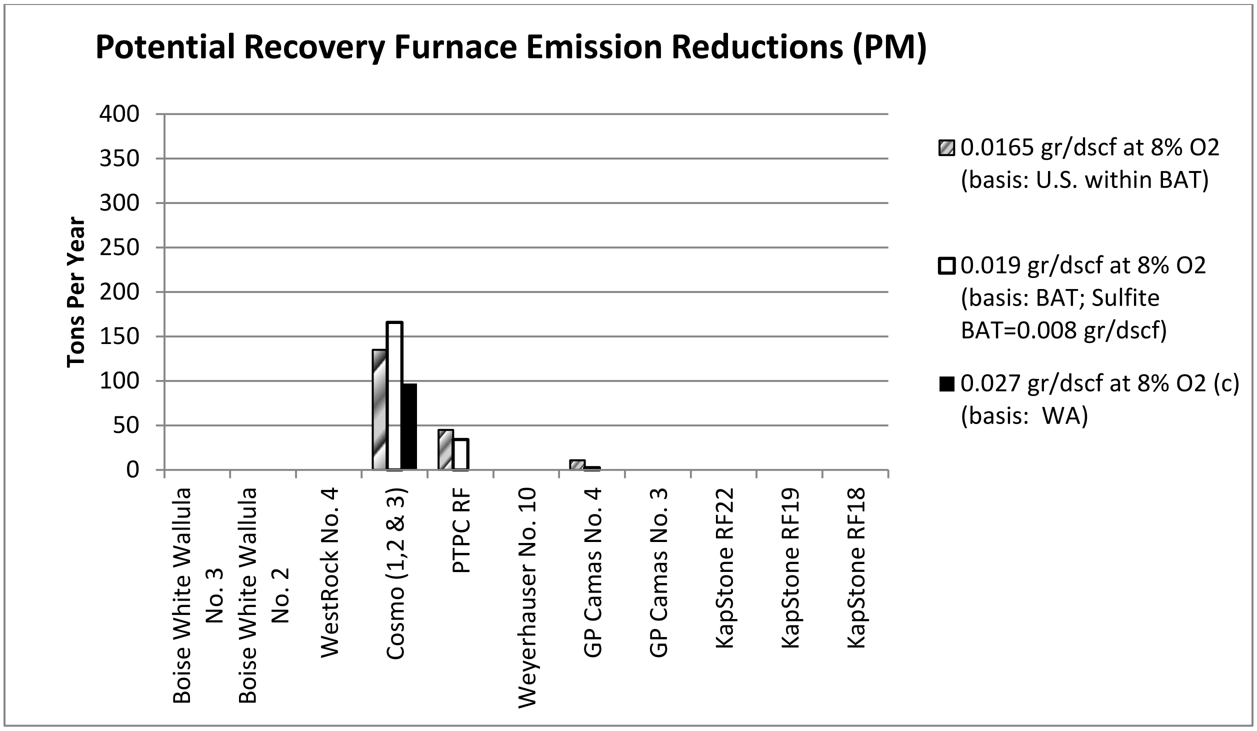



**Figure 2. Estimated potential PM emission reductions for recovery furnaces**

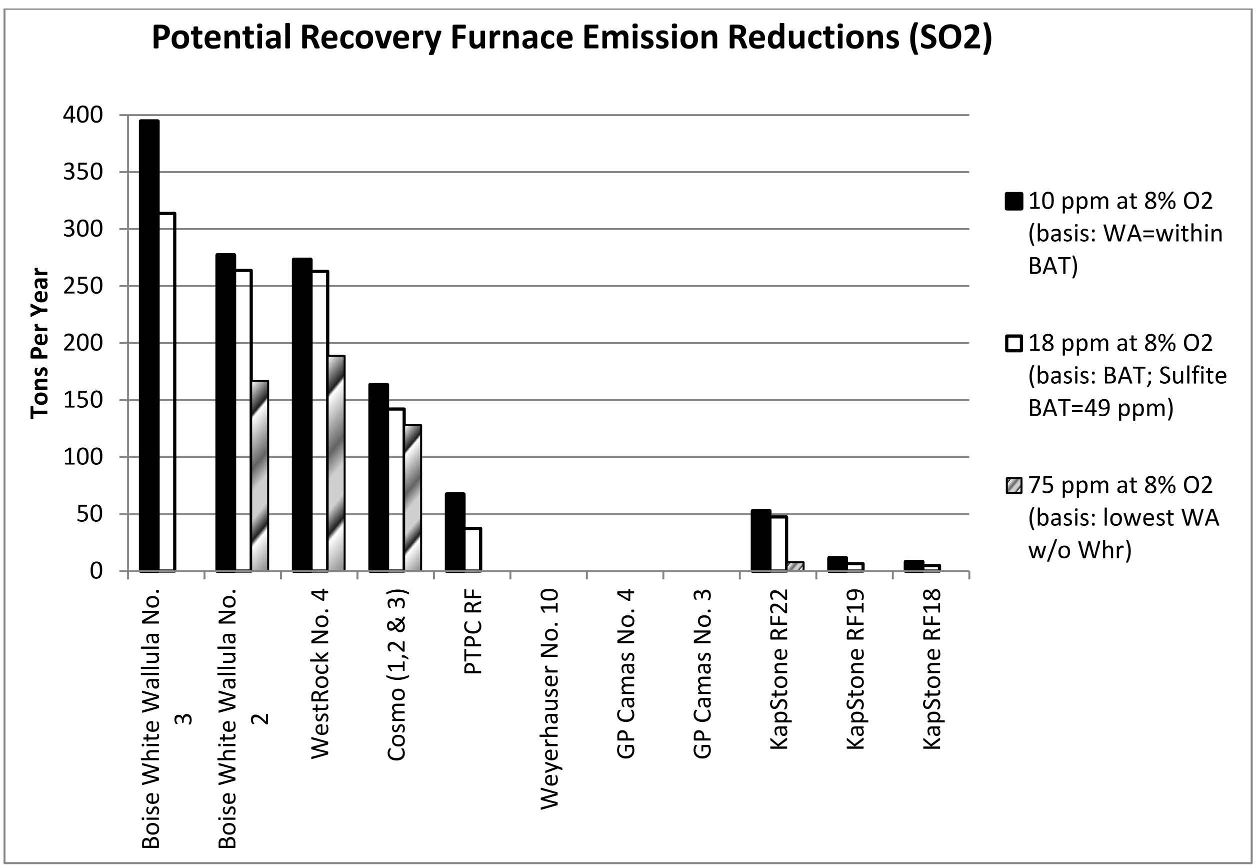



**Figure 3. Estimated potential $SO_2$ emission reductions for recovery furnaces**

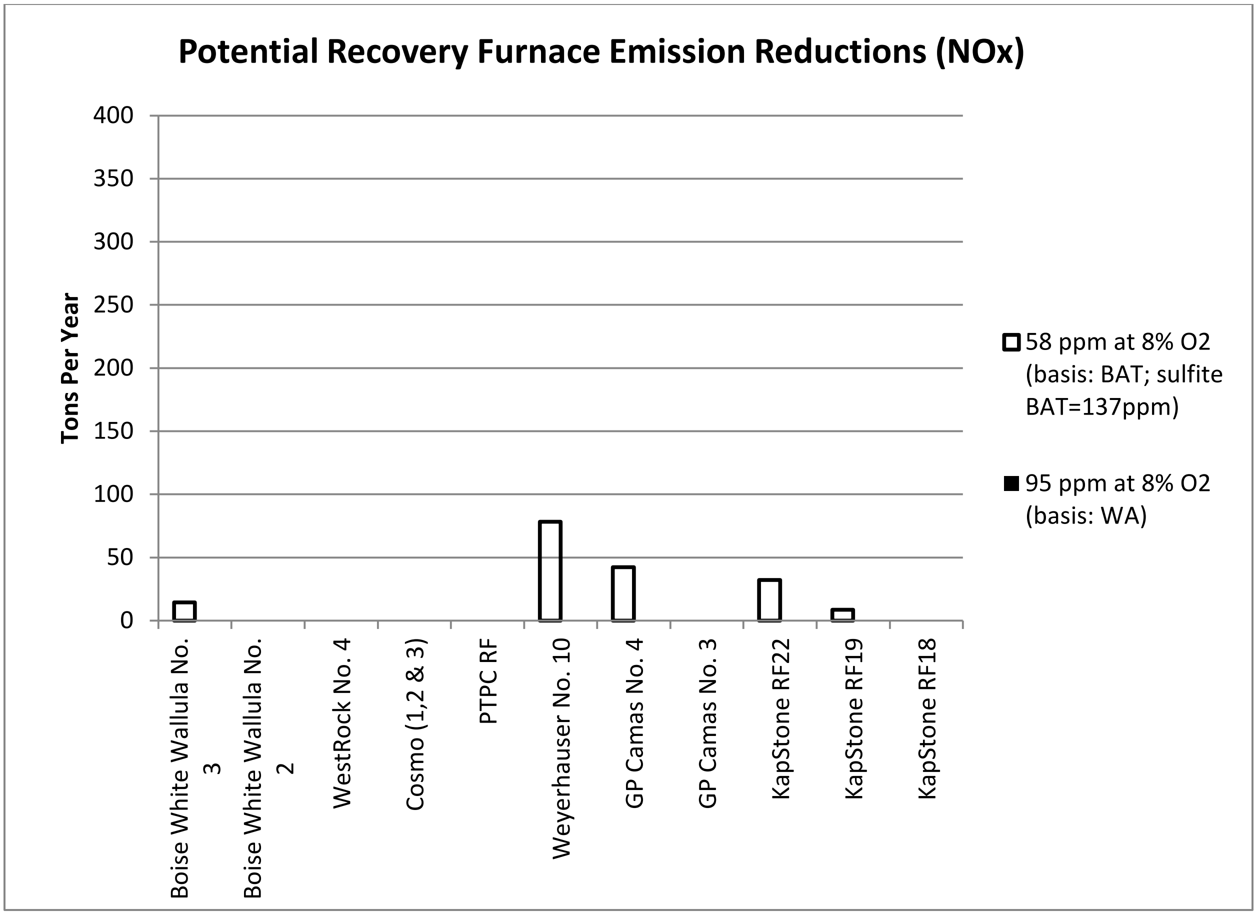



**Figure 4. Estimated potential $NO_X$ emission reductions for recovery furnaces**

## 4.3. Estimated emission reductions for lime kilns achievable (cumulative data)

| Table 34. Tons of Potential Pollutant Reduction Based on Proposed RACT Limit Options for Lime Kilns | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Pollutant/ Avg Period:** | **PM (ng or oil) 24-hr** | **PM (ng or oil) 24-hr** | **$SO_2$ (w/o NCG) 24-hr** | **$SO_2$ (w/or w/o NCG) 3-hr** | **$SO_2$ (w/NCG) 24-hr** | **$NO_X$ (oil) 24-hr** | **$NO_X$ (ng or oil) 24-hr** | **$NO_X$ (gas) 24-hr** |
| **Proposed RACT Limit for Lime Kiln:** | **0.02 gr/dscf at 10% $O_2$ (basis: BAT (ng or oil))** | **0.030 gr/dscf at 10% $O_2$ (basis: WA)** | **8 ppm at 10% $O_2$ (basis: BAT w/o NCG)** | **20 ppm at 10% $O_2$ (basis: GP WA = w/in BAT w/or w/o NCG)** | **105 ppm at 10% $O_2$ (basis: BAT w/NCG)** | **77 ppm at 10% $O_2$ (basis: BAT (oil))** | **275 ppm at 10% $O_2$ (basis: WA w/oil or ng)** | **292 ppm at 10% $O_2$ (basis: BAT (ng))** |
| Boise White Wallula LK[1] | 28 | 18 | N/A | 0 | 0 | 0 | 0 | 0 |
| WestRock No. 1[1] | 9 | 2 | N/A | 3 | 0 | 0 | 0 | 0 |
| WestRock No. 2[1] | 3 | 1 | N/A | 1 | 0 | 0 | 0 | 0 |
| PTPC LK[2] | 10 | 4 | N/A | 0 | 0 | 2 | 0 | N/A |
| Weyerhaeuser No. 4[1] | 0 | 0 | N/A | 0 | 0 | 65 | 0 | 0 |
| GP Camas No. 4[3] | 1 | 0 | N/A | 0 | 0 | N/A[3] | 25 | 20 |
| KapStone LK3[1] | 0 | 0 | N/A | 0 | 0 | 2 | 0 | 0 |
| KapStone LK4[1] | 0 | 0 | N/A | 0 | 0 | 21 | 0 | 0 |
| KapStone LK5[1] | 0 | 0 | N/A | 0 | 0 | 9 | 0 | 0 |
| Graymont CLK No. 1[4] | 0 | 0 | 3 | 0 | N/A[5] | N/A[4] | 0 | 0 |
| **Total** | **51** | **25** | **3** | **4** | **0** | **99** | **25** | **20** |

Notes: LK = lime kiln. N/A = not applicable or information not available or not found. NCG = non condensable gas incineration.

(1) Ecology found information indicating that the facility has the capability to burn oil or gas in the Lime Kilns.

(2) The LK at PTPC burns oil exclusively.

(3) The LK (No. 4) at GP Camas does not burn oil. The fuel oil burner was decommissioned in early 2011.

(4) Based on information from PSCAA, coal was the primary fuel used for the Graymont lime kiln for most of 2006 through 2010. Natural gas was used in 2011-2012. PSCAA permit statement of basis indicates the kiln can burn coal or natural gas. Oil is not listed as fuel source for the kiln.

(5) Ecology could not find information indicating that the Graymont kiln performs incineration of NCG.

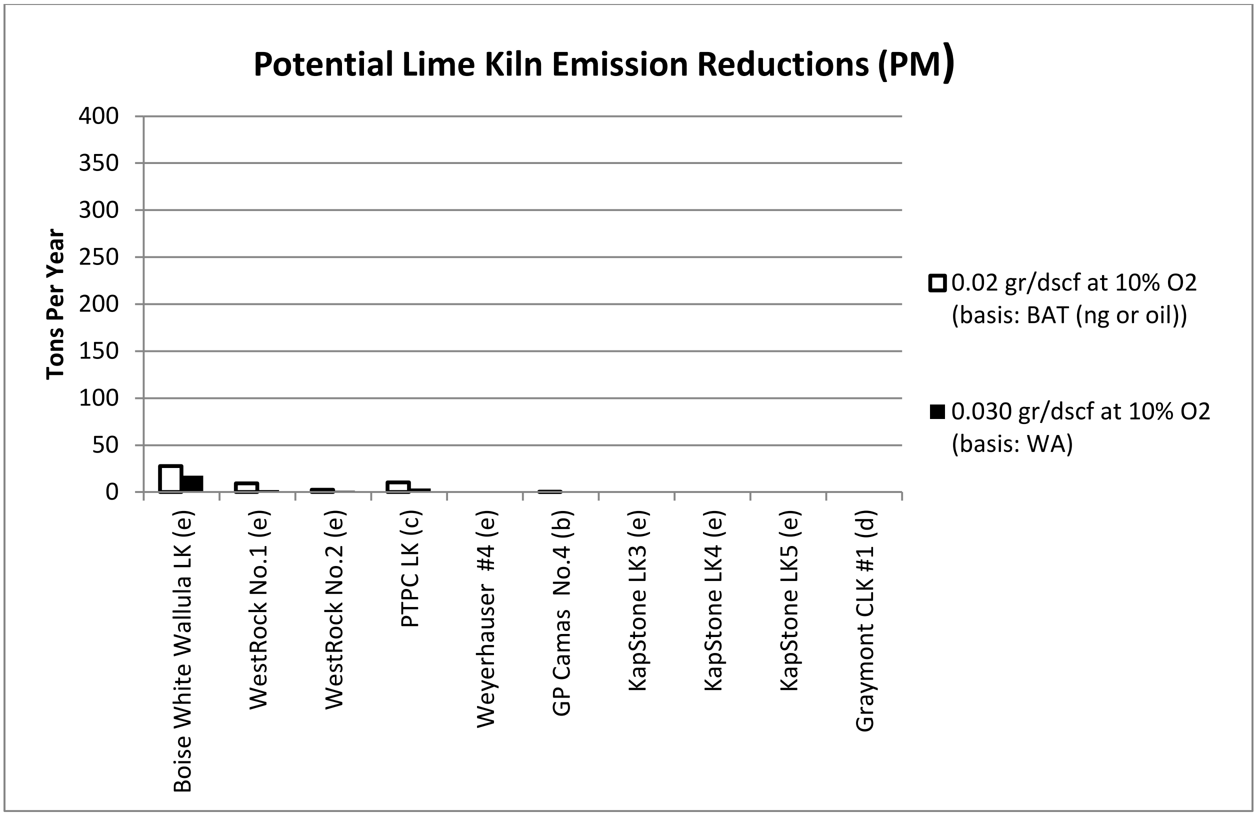



**Figure 5. Estimated potential PM emission reductions for lime kilns**

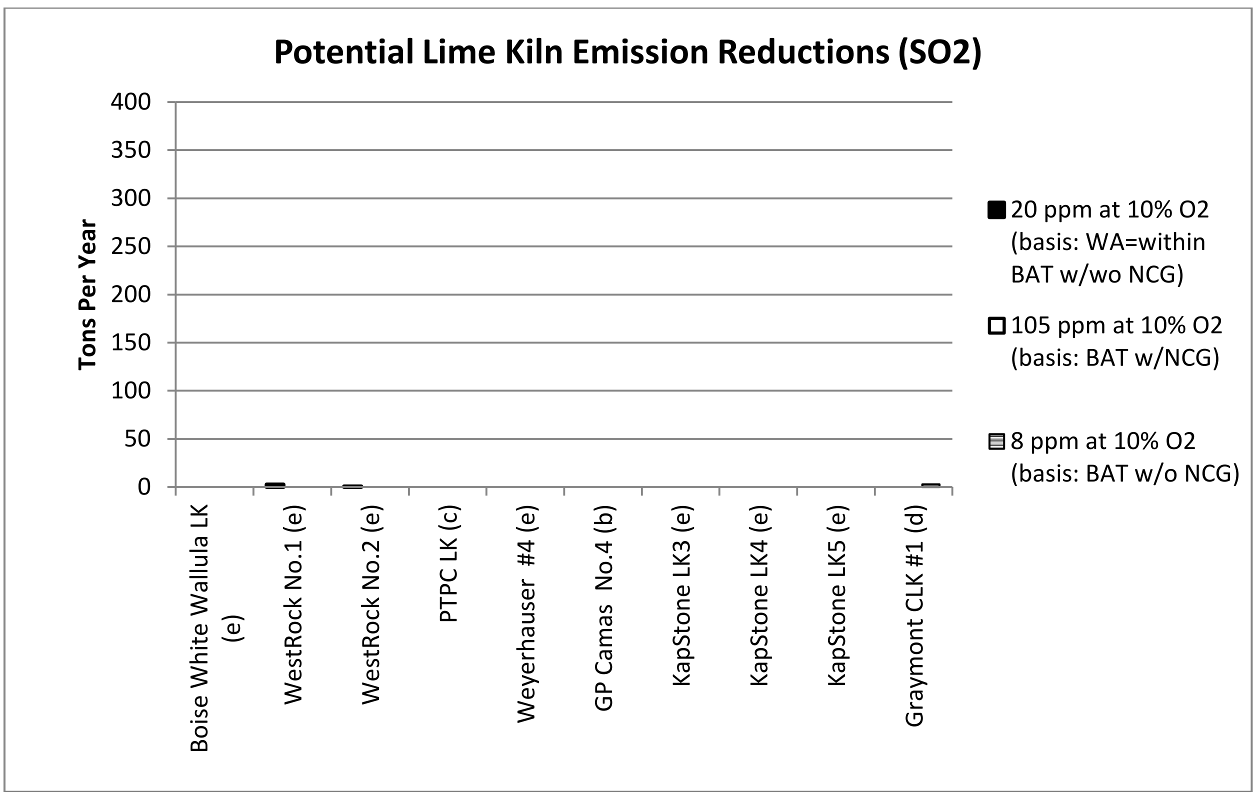



**Figure 6. Estimated potential $SO_2$ emission reductions for lime kilns**

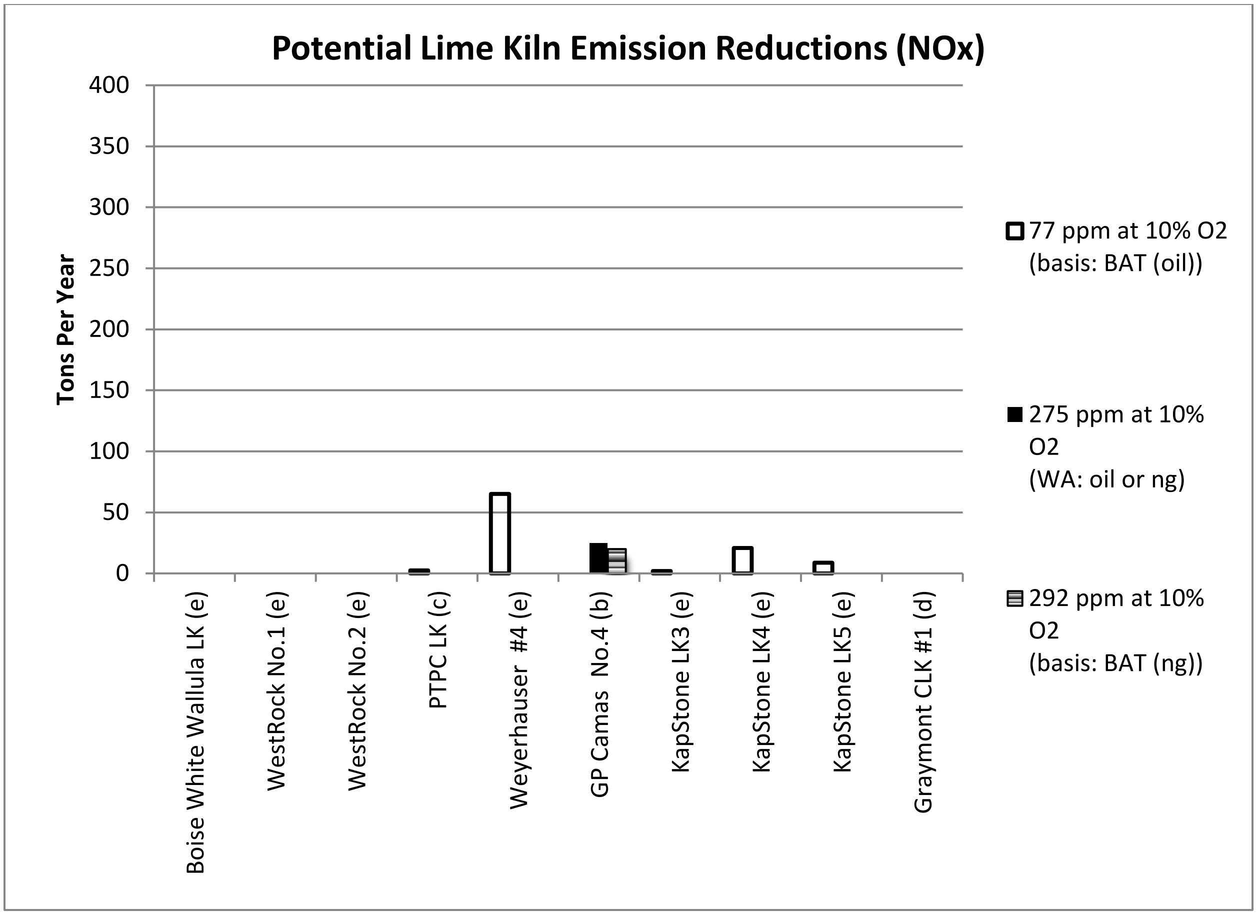



**Figure 7. Estimated potential $NO_X$ emission reductions for lime kilns**

# 4.4. Discussion of estimated potential emission reductions

This section discusses the potential of adopting the various emission levels presented in Sections 4.1–4.3. An evaluation of the potential actual emissions reductions possible if the option were to be implemented is given based on the calculations presented in Sections 4.2 and 4.3.

## 4.4.1. Discussion of estimated potential emission reductions for recovery furnaces

Based on the estimated potential emission reductions summarized in Sections 4.2 and 4.3, Ecology makes the following observations regarding the benefits of adopting these limits, and if further consideration is warranted:

- PM:
  - o According to Table 6, an HERB unit RF (No. 3), at the International Paper CAMTI facility in Louisiana, achieves an emission limit of 0.015 gr/dscf (at 8% $O_2$), which is

within European BAT ranges. Implementing the HERB process on an existing recovery furnace would be a significant reconstruction of the furnace. There are currently no HERB units in Washington State and the technology is not considered further.

- The other U.S. facility in Table 6 with emissions within European BAT ranges uses an ESP. According to Table 33 (and Figure 2), the potential benefit of adopting an emission limit of 0.0165 grains/dscf (at 8% $O_2$) would provide an estimated 191 tpy of pollutant reduction. This limit is based on the use of an ESP with eight fields online versus the more common ESP configuration with two or three fields online. The facility with this control technology implemented it as part of a MACT cumulative emission rate limit alternative covering three emission units (recovery boiler, lime kiln, smelt dissolving tank) as described in 40 CFR 862(a)(1). No recovery furnace controlled by an 8-field ESP is currently operating in Washington State.
- According to Table 33 (and Figure 2), adopting an emission limit of 0.019 grains/dscf (at 8% $O_2$) would provide an estimated 203 tpy of pollutant reduction. This limit is the upper limit range of the European BAT PM limits for recovery furnaces. [Note: a sulfite BACT limit of 0.008 grains/dscf (at 8% $O_2$) was used for emission reductions estimates for Washington's sulfite mill (Cosmo)].
- According to Table 33 (and Figure 2), the potential benefit of adopting an emission limit of 0.027 grains/dscf (at 8% $O_2$) would provide an estimated 97 tpy of PM reduction. This limit is currently demonstrated at three recovery furnaces in Washington State. This limit and control technology can be considered reasonable to adopt for the other recovery furnaces in Washington. This limit is considered for further analysis.

- $SO_2$:
  - According to Table 33 (and Figure 3), the potential benefit of adopting an emission limit of 10 ppm (at 8% $O_2$), would provide an estimated 1,248 tpy of pollutant reduction, primarily from one facility. The potential pollutant reductions achievable from adopting this limit, provides the greatest estimated pollutant reduction for the proposed recovery furnaces emission limits in Table 33. Based on the potential benefit of implementing this limit, and because this limit has already been demonstrated at two recovery furnaces in Washington State, this limit is considered for further analysis.
  - According to Table 33 (and Figure 3), the potential benefit of adopting an emission limit of 18 ppm (at 8% $O_2$), would provide an estimated 1,078 tpy of pollutant reduction. This limit is the upper limit range of the European BAT $SO_2$ limits for recovery furnaces. [Note: a sulfite BAT limit of 49 ppm (at 8% $O_2$) was used for emission reductions estimates for Washington's sulfite mill (Cosmo)]. These BAT limits have not been, but could be implemented in Washington State.
  - According to Table 33 (and Figure 3), the potential benefit of adopting an emission limit of 75 ppm (at 8% $O_2$), would provide an estimated 491 TPY of pollutant reduction. Based on the potential benefit of implementing this limit, and because this

limit has already been demonstrated at a recovery furnace in Washington State, this limit is considered for further analysis.

- $NO_X$:
  - According to Table 33 (and Figure 4), the potential benefit of adopting an emission limit of 58 ppm (at 8% $O_2$), would provide an estimated 176 TPY of pollutant reduction. This limit is the upper limit range of the European BAT $NO_X$ limits for recovery furnaces. [Note: a sulfite BAT limit of 137 ppm (at 8% $O_2$) was used for emission reductions estimates for Washington's sulfite mill (Cosmo)]. These BAT limits have not been implemented in Washington State.
  - According to Table 33 (and Figure 4), the potential benefit of adopting an emission limit of 95 ppm (at 8% $O_2$), would not provide pollutant reductions based on how recovery furnaces in Washington operated their units during the emission inventory evaluated as part of this analysis. However, adopting this limit could lower the potential to emit levels at some of these facilities, and therefore could be considered for further analysis. This limit has been implemented at three recovery furnaces in Washington State with limit averaging periods of three to 24 hours.

### 4.4.2. Discussion of estimated potential emission reductions for lime kilns

Based on the estimated potential emission reductions presented in this chapter, Ecology makes the following observations regarding the benefits of adopting these limits, and if further consideration is warranted:

- PM:
  - According to Table 34 (and Figure 5), the potential benefit of adopting an emission limit of 0.02 grains/dscf (at 10% $O_2$) would provide an estimated 51 TPY of pollutant reduction. This limit is the upper limit range of the European BAT PM limits for lime kilns. This specific limit has not been implemented in Washington State.
  - According to Table 34 (and Figure 5), the potential benefit of adopting an emission limit of 0.030 grains/dscf (at 10% $O_2$) would provide an estimated 25 TPY of pollutant reduction. This limit has been implemented at two lime kilns in Washington State. Adopting this limit could lower the potential to emit levels at other lime kilns in Washington State, and therefore could be considered for further analysis.

- $SO_2$:
  - According to Table 34 (and Figure 6), the potential benefit of adopting an emission limit of 8 ppm (at 10% $O_2$) would provide an estimated 3 TPY of pollutant reduction. This limit is the upper limit range of the European BAT PM limits for lime kilns that do not incinerate NCGs. This specific limit has not been implemented in Washington State.
  - According to Table 34 (and Figure 6), the potential benefit of adopting an emission limit of 20 ppm (at 10% $O_2$) would provide an estimated 4 TPY of pollutant

reduction. This limit has been implemented at three lime kilns in Washington State, and is therefore considered for further analysis.

  - According to Table 34 (and Figure 6), the potential benefit of adopting an emission limit of 105 ppm (at 10% $O_2$) would not provide pollutant reductions bases on how lime kilns in Washington operated their units during the emission inventory evaluated as part of this analysis.

- $NO_X$:
  - According to Table 34 (and Figure 7), the potential benefit of adopting an emission limit of 77 ppm (at 10% $O_2$), would provide an estimated 99 TPY of pollutant reduction. This limit is the upper limit range of the European BAT $NO_X$ limits for lime kilns that use fuel oil. This specific limit has not been implemented in Washington State.
  - According to Table 34 (and Figure 7), the potential benefit of adopting an emission limit of 275 ppm (at 10% $O_2$), would provide an estimated 25 TPY of pollutant reduction. This limit has been implemented at one lime kiln in Washington State, which can use either oil or natural gas fuel. Adopting this limit could lower the potential to emit levels at other lime kilns in Washington State, and therefore could be considered for further analysis.
  - According to Table 34 (and Figure 7), the potential benefit of adopting an emission limit of 292 ppm (at 10% $O_2$), would provide an estimated 20 TPY of pollutant reduction. This limit is the upper limit range of the European BAT $NO_X$ limits for lime kilns that use natural gas. Not all lime kilns in Washington have access to natural gas. This specific limit has not been implemented in Washington State.

# 5. Impacts of Controls on Visibility

The impacts of additional controls are presented in the following subsections. A previous similar study (BART modeling analysis) is included below in Section 5.1 as background information, as it was used in the 2010 RH SIP. Section 5.2 concludes with more current impacts analysis modeling results using the emission reduction estimates in Section 4 of this analysis.

## 5.1. Impacts of pulp and paper mills on visibility (BART modeling analysis)

This section addresses the impact of pulp and paper mill sources upon visibility in Class I areas in Washington State. Details describing how visibility is measured using units of dv was provided in the RH SIP.

Available visibility modeling results from Chapter 11 of the RHSIP BART analysis, performed for five of the seven pulp mills, is provided in Table 35. The other facilities evaluated and modeled for this RACT review did not meet one or more of the technical criteria to require

BART modeling. The values in Table 35 are the 22nd highest (98th percentile) delta dv and are based on 2003-2005 emissions using the CALPUFF model as described in the BART modeling protocol in Appendix H of the 2010 RH SIP. The results include BART-eligible units at each individual facility and are not necessarily recovery furnaces and/or lime kilns.

As explained in Appendix H of the 2010 RH SIP, the BART modeling protocol including two types of modeling analysis:

- BART Exemption Analysis: to ascertain BART eligible sources, and,
- BART Determination Analysis: to determine visibility impacts for the pre-BART control and post-BART control scenarios on individual BART-eligible units at individual (BART-eligible) sources. (Note: a BART-eligible source refers to the entire facility that has BART-eligible emission units).

The results in Table 35 are from the BART Determination Analysis contained in the RH SIP.

**Table 35. Visibility Modeling Results: 22nd Highest Delta dv, 2003–2005 (98th Percentile)**

| WA Class I Areas (unless indicated otherwise) | GP Camas(1) | KapStone(1) | PTPC | WestRock | Weyerhaeuser | Boise White Wallula(2) | Cosmo(3) |
|---|---|---|---|---|---|---|---|
| Alpine Lakes Wilderness | 0.071 | 0.21 | 0.284 | 0.391 | 0.4 | Not modeled | Not modeled |
| Glacier Peak Wilderness | 0.045 | 0.128 | 0.251 | 0.256 | 0.248 | Not modeled | Not modeled |
| Goat Rocks Wilderness | 0.101 | 0.228 | 0.137 | 0.21 | 0.457 | Not modeled | Not modeled |
| Mt. Adams Wilderness | 0.123 | 0.251 | 0.124 | 0.205 | 0.44 | Not modeled | Not modeled |
| Mt. Rainier National Park | 0.101 | 0.3 | 0.244 | 0.441 | 0.595 | Not modeled | Not modeled |
| North Cascades National Park | N/A | 0.111 | 0.236 | 0.22 | 0.218 | Not modeled | Not modeled |
| Olympic National Park | 0.086 | 0.29 | 1.306(4) | 0.383 | 0.583 | Not Modeled | Not Modeled |
| Pasayten Wilderness | N/A | N/A | 0.125 | 0.126 | NA | Not Modeled | Not Modeled |
| Columbia River Gorge (Class II) | 2.469 | 0.517 | 0.06 | 0.082 | 0.675 | Not Modeled | Not Modeled |
| Mt. Hood (Oregon) | 0.381 | 0.43 | N/A | 0.147 | 0.689 | Not Modeled | Not Modeled |
| Mount Jefferson Wilderness (Oregon) | 0.149 | 0.219 | N/A | 0.092 | 0.367 | Not Modeled | Not Modeled |
| Diamond Peak Wilderness Area (Oregon) | 0.044 | 0.115 | N/A | N/A | 0.192 | Not Modeled | Not Modeled |

| Table 35. Visibility Modeling Results: 22nd Highest Delta dv, 2003–2005 (98th Percentile) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **WA Class I Areas (unless indicated otherwise)** | **GP Camas[(1)]** | **KapStone[(1)]** | **PTPC** | **WestRock** | **Weyerhaeuser** | **Boise White Wallula[(2)]** | **Cosmo[(3)]** |
| Mount Washington Wilderness Area (Oregon) | 0.084 | 0.169 | N/A | N/A | 0.289 | Not Modeled | Not Modeled |
| Three Sisters Wilderness Area (Oregon) | 0.087 | 0.178 | N/A | N/A | 0.291 | Not Modeled | Not Modeled |
| Eagle Cap Wilderness (Oregon) | N/A | N/A | N/A | N/A | N/A | Not Modeled | Not Modeled |
| Crater Lake National Park (Oregon) | 0.031 | N/A | N/A | N/A | N/A | Not Modeled | Not Modeled |
| Strawberry Mountain Wilderness (Oregon) | 0.044 | N/A | N/A | N/A | N/A | Not Modeled | Not Modeled |
| Hells Canyon (Idaho) | N/A | N/A | N/A | N/A | N/A | Not Modeled | Not Modeled |

(1) Visibility reduction values are based on a spatially-varying $O_3$ background modeling input.

(2) No BART-eligible equipment based on age and PTE.

(3) Sulfite pulp mills exempt from BART.

(4) Port Townsend used the NH3-limiting method to model impacts at Olympic NP. Their use of the new IMPROVE equation was undone by Ecology and impacts recalculated. See Table 11-9 of Regional Haze SIP page 11-11.

## 5.2. Impacts of pulp and paper mills on visibility (RACT modeling analysis)

As with the BART analysis, modeling was used to determine potential improvements in RH based on the proposed RACT options described in this section. However, modeling for this RACT analysis was not bound to the procedures described in the BART modeling protocol in Appendix H of the 2010 RH SIP. Whereas the CALPUFF model was chosen as part of the protocol developed for the BART analysis, a different modeling approach was used for this RACT analysis. Ecology contracted with Washington State University (WSU) for the modeling potion of this analysis. See Appendix C for the full WSU RACT modeling protocol.

The pre-RACT baseline and post-RACT limit control results of the WSU modeling are based on the following:

- For the pre-RACT baseline analysis: a baseline emission inventory using emissions from the year 2007 based on an aggregation of emissions from a comprehensive list of emitting facilities in Washington State (not just pulp mills).
- Post-RACT:[1] Based on Table 33, Figures 2 and 3, and Section 4.4.1, the following maximum potential emission reductions using the lowest demonstrated limits in Washington State were used in this first post-RACT scenario:
  - For recovery furnaces, the lowest $SO_2$ emission limit demonstrated in Washington State is 10 ppm.
  - For recovery furnaces, the lowest PM emission limit demonstrated in Washington State is 0.027 gr/dscf @ 8% $O_2$.

Recovery furnace $NO_X$ emission reductions and lime kiln emission reductions for $SO_2$, PM, and $NO_X$ were estimated to be considerably less than these two emission reductions and, therefore, were set aside as part of potential future post-RACT modeling scenarios depending on the results of the first post-RACT modeling scenario (see Section 5.2.2).

As detailed in Chapter 4, measured or calculated emissions are averages of multi-year compliance tests or are calculated from averages of multi-year emission inventory emissions and other stack parameter information. Estimated emission reductions are the difference between average annual emissions and the average annual emissions multiplied by the ratio of emission at the proposed RACT limit to measured or calculated emission. Ecology's approach is based on a survey of average emission reductions using average emission inventory emissions from multiple years, so that average individual unit percent reductions are assumed to be applicable to approximately any given year that the facility operated around this timeframe.

As noted in Appendix C, emissions for modeling were taken from 2007 inventories provided by state agencies via NW-AIRQUEST. All of the facilities' multi-year emission inventory emissions that were averaged include the year 2007, except for Cosmo Specialty Fiber. Because the facility did not operate from 2007 through 2010, emission inventories from 2005, 2006, and 2011 were evaluated, and 2011 annual emissions were chosen for this evaluation.

### 5.2.1. Modeling results

The RACT visibility modeling results from the 2014-2015 WSU RH modeling analysis are provided in Table 36 (See Appendix C for additional WSU RACT modeling results).

**Table 36. Visibility Modeling Results: 8th Highest Delta dv, (98th Percentile)**

| WA Class I Areas (unless indicated otherwise) | $\Delta$dv Visibility Impacts due to Potential RACT Limit |
|---|---|
| Alpine Lakes Wilderness | 0.127 |
| Glacier Peak Wilderness | 0.117 |
| North Cascades National Park | 0.080 |

[1] For the first post-RACT analysis, specific pulp mill emission reduction estimates developed in Chapters 2-4 were used, which were based on measured (compliance test) data only, not on calculated data.

| Table 36. Visibility Modeling Results: 8th Highest Delta dv, (98th Percentile) | |
|---|---|
| **WA Class I Areas (unless indicated otherwise)** | **∆dv Visibility Impacts due to Potential RACT Limit** |
| Mount Baker Wilderness | 0.057 |
| Selway Bitterroot Wilderness (Idaho, Montana) | 0.053 |
| Spokane Tribe Class I area | 0.053 |
| Pasayten Wilderness | 0.045 |
| Three Sisters Wilderness Area (Oregon) | 0.044 |
| Mount Washington Wilderness Area (Oregon) | 0.041 |
| Goat Rocks Wilderness | 0.038 |
| Mt. Rainier National Park | 0.037 |
| Hells Canyon Wilderness (Idaho) | 0.033 |
| Mount Jefferson Wilderness (Oregon) | 0.031 |
| Eagle Cap Wilderness (Oregon) | 0.030 |
| Mount Adams Wilderness | 0.030 |
| Columbia River Gorge (WA & Oregon) (Class II) | 0.029 |
| Olympic National Park | 0.023 |
| Mt. Hood Wilderness (Oregon) | 0.022 |
| Sawtooth Wilderness (Idaho) | 0.021 |
| Diamond Peak Wilderness Area (Oregon) | 0.018 |
| Crater Lake National Park (Oregon) | 0.017 |
| Yellowstone National Park (Wyoming) | 0.016 |
| Strawberry Mountain Wilderness (Oregon) | 0.015 |
| Craters of the Moon National Park (Idaho) | 0.011 |
| Mountain Lakes Wilderness (Oregon) | 0.009 |
| Craters of the Moon National Park (Idaho) | 0.011 |
| Mountain Lakes Wilderness (Oregon) | 0.009 |

The locations with the top three delta dv benefit are Alpine Lakes (0.127), Glacier Peak (0.117), and North Cascades (0.080). The modeled visibility data listed is for grid cells where at least half of the area of the cell was within any Class I wilderness area or national park (or Columbia River Gorge scenic area). In other words, these are the highest grid cell delta dv values. The rest of these areas, including their IMPROVE monitoring locations (if present) have less delta dv benefit. For example, the IMPROVE monitoring site at North Cascades National Park has an 8th highest delta dv benefit of only 0.0136, or about 1/6 the benefit of the grid cell of maximum delta dv benefit (0.080) listed in Table 36.

### 5.2.2. Additional modeling scenarios

Because the results obtained from the first post-RACT modeling analysis described in Sections 5.2 and 5.2.1 do not show sufficient delta dv benefit (less than 0.13 dv impacts at highest modeled grid cell), Ecology determined that additional post-RACT modeling scenarios using smaller RACT limited emission reductions would not be useful.

# 6. Estimated Costs

This chapter presents the estimated costs for facilities in Washington to achieve the emission reductions presented in Chapter 4.

Ecology is interpreting "reasonably available" control technology as defined in Section 1.2, to mean the best performing control technologies that are currently demonstrating compliance with the emission limits in Sections 3.1–3.3. There may be other control technologies listed in Chapter 2, which are capable of meeting the emission rates and estimated emission reductions presented in Chapter 4, which have not been demonstrated in practice. We have only estimated costs to implement control technologies that have been demonstrated in practice.

Prior to implementing a RACT limit, Ecology intended to work closely with the source category sources to develop a more accurate cost evaluation.[2] As the visibility improvement modeling presented in Chapter 5 and Appendix C shows minimal visibility improvement, Ecology does not believe that it is necessary to develop mill specific cost estimates for implementing the evaluated RACT limits. However, Ecology is providing the following general estimates of costs based on the cost references listed in Section 6.1.

## 6.1. Capital and operating costs

Estimated costs to implement control technologies that have been demonstrated in practice are presented in Tables 37 and 38 for recovery furnaces and lime kilns, respectively.

**Table 37. Recovery Furnace Estimated Control Costs**

| Control Technology Option | Capital Costs ($) [O&M Costs if Available] | Total Annual Costs ($) | Note(s) |
|---|---|---|---|
| HERB (PM, $SO_2$, $NO_X$) | 100 to ~300 million (250 million Euro) | 12–22 million | 1,2,,8 |
| Add scrubber to ESP (PM, $SO_2$) | 12 million | 3–9 million | 2,3 |
| WESP (PM) | 1.1–13.9 million [0.3–13.9 million] | 0.5–16.3 million | 4 |
| Good Operating Practices ($SO_2$) | Currently used | | |
| Staged combustion control [may include FGR, low excess air, overfire air, LNB, secondary, tertiary, quartenary combustion] ($NO_X$) | Currently used | | |
| Improve and/or rebuild ESP (PM) | Using ESP improvements, the BART analysis [August 2009-Appendix L] of the Ecology 2010 Regional Haze SIP for PTPC estimated a 53 ton per year reduction at $5,100 per ton. A similar BART analysis for Weyerhaeuser estimated a 33 ton per year reduction at $122,000 per ton if an additional ESP field was installed. | | 2,5,6 |

[2] Ecology memorandum: *The Five RACT Criteria and how Ecology Should Implement Them*, Wayne Wooster, June 14, 1993.

| Table 37. Recovery Furnace Estimated Control Costs | | | |
|---|---|---|---|
| **Control Technology Option** | **Capital Costs ($) [O&M Costs if Available]** | **Total Annual Costs ($)** | **Note(s)** |
| | The total installed cost for a typical ESP rebuild from reference (5) was 5.7 million. | | |
| Recovery boiler optimization [including wet heat recovery/secondary, tertiary, quaternary air /HVLC gas incineration] (PM, $SO_2$, $NO_X$) | The Kotka Mill in Finland recently (2013) invested 3 million euros ($3.8 million) into boiler optimization for its recovery boiler. Improvements include renewing the bottom of the boiler and implementing new air distribution technology. | | 1 |
| | Wet heat recovery has been demonstrated at GP Camas for its two RFs. Costs specific to the wet heat recovery portion of the recovery furnaces is difficult to isolate, but appears to have been part of an overall recovery furnace and smelt dissolver vent recovery modernization project with estimates as follows:<br>• $2.7 million ESP with total annual costs of $417,750;<br>• $1.7 million Cross-flow scrubber with total annual costs of $419,800;<br>• $175,000 Packed bed scrubber with total annual costs of $224,300. | | 7 |
| Fabric filters-baghouse (PM) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Cyclone separator (PM) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Electrified gravel bed filters (PM) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Flue gas desulfurization (FGD) w/wet scrubber ($SO^2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Semi-dry lime hydrate slurry injection FGD ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Dry lime powder injection FGD ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Spray dryer w/an ESP FGD ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Low sulfur fuel selection ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Selective non-catalytic reduction (SNCR) [NOx] | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Selective catalytic reduction (SCR) [$NO_X$] | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Oxidation/reduction scrubbing ($NO_X$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |

| Table 37.  Recovery Furnace Estimated Control Costs | | | |
|---|---|---|---|
| **Control Technology Option** | **Capital Costs ($) [O&M Costs if Available]** | **Total Annual Costs ($)** | **Note(s)** |

1 HERB annualized cost based on Andritz Pulp & Paper. Recovery boilers Chemical recovery and green energy. The Andritz solution: High Energy Recovery Boiler (HERB). www.andritz.com  Annual costs based on high energy boiler costs ranging from 80 to 150 million Euros converted to USD at $1.25/Euro: (approximate average of $/Euro from 2011 – 2015). Higher end costs of 250 million Euro found for Iggesund Paperboard's Swedish paperboard mill Published: Thu, 2014-06-19 10:07 www.pulpapernews.com).  Other references: June/July 2007 Enviro-Friendly.  Acuna & Associates webpages.  www.pulpapernews.com article dated June 13, 2012.  www.pressportal.ch press webpage regarding Andritz.   Boiler improvement information from www.pulpapernews.com article dated November 9, 2012. At least three HERB units have been or are installed in the United States per Andritz Pulp & Paper www.andritz.com. The three units are IP Valliant, Oklahoma; IP Campti, Louisiana; and PCA, Valdosta, Georgia.  It is unclear if the Oklahoma and Georgia units have been included into their latest air permits at the time of this analysis.  The Campti unit has been implemented, and permit limits for this facility are listed in chapter 3.

2 Cost estimates are based on the assumption that the listed control option is able to reduce emissions to the emission levels of facilities currently using those technologies.  However, unknown facility details and variable costs from different vendors could have a significant effect on estimated control technology costs.

3 Based on Ecology BART analysis [August 2009 (Appendix L of 2010 Regional Haze SIP] for PTPC, estimated annualized costs were approximately: $8.5 million ($20,383/ton) and for Weyerhaeuser, (annualized costs were approximately: 3.3 million ($28,000/ton).   Total costs (including installation) for retrofitting a recovery furnace ESP with a scrubber are listed in a 1/31/2007 EPA document as approximately $12 million (letter from EPA addressed to Division of Air Quality, North Carolina Department of Environment and Natural Resources). .

4 WESP costs obtained from EPA-452/F-03-030 Air Pollution Control Technology Fact Sheet based on capital costs of $20-$40 per scfm; O&M costs of $5-40 per scfm; annualized costs of $9-$47 per scfm; applied to each average scfm flow rate calculated from average dscfm flow rates and average water content for each facility.  See Appendix D.

5 The total installed cost estimates for base and most advanced ESP designs ranged from $9.6 to $12.2 million ("Advanced ESP Designs for Black Liquor Recovery Boilers", Grieco., et al other, August 12, 2012.  Griego indicated costs of $5.7 million for an assumed typical ESP rebuild. However, the PM reductions under this scenario would be less (based on 0.039 gr/dscf at 8% oxygen) than what was condisidered for this RACT analysis (based on 0.027 gr/dscf at 8% oxygen).

6 Annualized costs based on Ecology BART analysis [August 2009 (Appendix L of 2010 Regional Haze SIP] for Port of Port Townsend ($270,000) and Weyerhaeuser ($4,000,000) mills.

7 Letter to Alan Butler, Ecology from Candice Hatch, CH2M Hill., Camas Mill (GP Camas) Energy and Recovery Modernization PSD Permit Application., October 7, 1988, as part of Telecopy Transmittal from Alan Butler to Bill Powers dated April 6, 1989.

8 Cosmo is currently the only sulfite mill operating in Washington.  Pollutant reductions are based on emission limit comparisons between sulfate (kraft) and sulfite mills which are different processes.

| Table 38. Lime Kiln Estimated Control Costs | | | |
|---|---|---|---|
| **Control Technology Option** | **Capital Costs ($) [O&M Costs if Available]** | **Total Annual Costs ($)** | **Note(s)** |
| New scrubber or add scrubber after existing lime kiln ESP if present (PM, $SO_2$) | 12 million | | 1,2,5 |
| Add WESP (PM) | 0.2–2.6 million [0.04–2.6 million] | 0.08–3 million | 3 |
| Replace scrubber w/WESP (PM) | Estimated BART capital costs of 1.5 million/kiln for replacing a venture scrubber w/a WESP is considered a high capital cost. | | 4 |
| Replace scrubber w/dry ESP (PM) | Not recommended | | 4 |
| Fuel selection – use less gas and more oil ($NO_X$) | | | 5 |
| Low sulfur fuels, low sulfur lime mud ($SO_2$) | | | 5 |
| Fabric filters-baghouse (PM) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Cyclone separator (PM) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Electrified gravel bed filters (PM) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Flue gas desulfurization (FGD) w/wet scrubber ($SO^2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Semi-dry lime hydrate slurry injection FGD ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Dry lime powder injection FGD ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Spray dryer w/an ESP FGD ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Low sulfur fuel selection ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Increased oxygen levels at burner ($SO_2$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Water/steam injection ($NO_X$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Mid-kiln firing ($NO_X$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Mixing air fan ($NO_X$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |

| Table 38. Lime Kiln Estimated Control Costs | | | |
|---|---|---|---|
| **Control Technology Option** | **Capital Costs ($) [O&M Costs if Available]** | **Total Annual Costs ($)** | **Note(s)** |
| Selective non-catalytic reduction (SNCR) [NOx] | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Selective catalytic reduction (SCR) [$NO_X$] | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |
| Oxidation/reduction scrubbing ($NO_X$) | This technology has not been demonstrated in practice at the mills surveyed in Chapter 3 (due to technical or economic infeasibilities). Costs are not considered. | | |

[1] Cost estimates are based on the assumption that the listed control option is able to reduce emissions to the emission levels of facilities currently using those technologies. However, due to unknown facility details and variable costs from different vendors could have significant effect on costs.

[2] Assumes the costs of retrofitting a lime kiln ESP with a scrubber is approximately similar to retrofitting a recovery furnace ESP with a scrubber. Total costs (including installation) for retrofitting a recovery furnace ESP with a scrubber are listed in a 1/31/2007 EPA document as approximately $12 million (letter from EPA addressed to Division of Air Quality, North Carolina Department of Environment and Natural Resources)

[3] Wet electrostatic precipitator costs obtained from EPA-452/F-03-030 Air Pollution Control Technology Fact Sheet based on capital costs of $20-$40 per scfm; O&M costs of $5-40 per scfm; annualized costs of $9-$47 per scfm; applied to each average scfm flow rate calculated from average dscfm flowrates and average water content for each facility. See Appendix D.

[4] In Maine, the "replacement of the existing venture scrubbers with WESPs would result in high capital costs ($1.5 million per kiln)." Replacing existing venturi scrubbers with dry ESPs "could increase SO2 emissions from the lime kilns when compared to use of the venturi scrubbers." In Maine, "the use of the existing venturi scrubbers to control PM10 emissions from… (lime kilns)… represents BART." (73956 Federal Register / Vol. 76, No. 229 / Tuesday, November 29, 2011 / Proposed Rules 40 CFR Part 52 [EPA–R01–OAR–2010–1043; A–1–FRL–9496–5], Approval and Promulgation of Air Quality Implementation Plans; Maine; Regional Haze).

[5] Based on the results of Section 5, specific costs were not pursued for all control options.

# 7. Conclusions

An impact of 0.5 dv was considered the minimum visibility impact for a source to be subject to BART. While a potential visibility improvement of 0.5 dv or more would have clearly triggered a more in-depth evaluation of the RACT/Four-Factor reasonable progress factors, the significantly smaller annual visibility improvements that have been modeled were determined to be too small to pursue further at this time. As noted in Section 4, this RACT analysis was based on a snapshot of emission inventories between approximately 2003 and 2011. A conservative approach was used for this RACT analysis so that if specific facility details have changed since 2011, the following conclusions of this analysis are assumed to be the same.

These factors are discussed for each of the seven facilities in the subsections below.

## 7.1. PTPC conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that PTPC adopt the potential RACT limits considered in Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.2. WestRock conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that WestRock adopt the potential RACT limits considered Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.3. Weyerhaeuser conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that Weyerhaeuser adopt the potential RACT limits considered Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.4. GP Camas conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that GP Camas adopt the potential RACT limits considered Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.5. KapStone conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that KapStone adopt the potential RACT limits considered in Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.6. Boise White Wallula Mill conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that Boise White Wallula adopt the potential RACT limits considered in Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.7. Cosmo specialty fiber mill conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that Cosmo adopt the potential RACT limits considered in Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

## 7.8. Graymont lime kiln conclusions

Based on the modeling results presented in Chapter 5 and Appendix C, Ecology is not proposing that the Graymont lime kiln adopt the potential RACT limits considered in Chapter 4. Ecology believes that the potential visibility improvements are too minimal to justify the cost of implementing these RACT limits. Other RACT requirements are not being considered at this time.

# Appendices

# Appendix A.  Unit Conversions and Permit Limit Information

# Section A-1 Unit Conversions

## Recovery Furnace Particulate Matter Unit Conversions

| Location | Facility (RF Unit if specified) | Limit A: gr/dscf (at 8% O2) | Limit B: Daily avg: gr/dscf (at 8% O2) | Flow range (m3/Adt) | mg/dscm (at 8% O2) | mg/dscm (at 6% O2) | mg/Nm3 (at5%O2) | kg TSP/ ADt | m3/min |
|---|---|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range | NA | 0.011 | 7000-9000 | 26 | | 30 | 0.2 | |
| USA | New/reconstructed after 5/23/2013 | 0.015 | | | | | | | |
| Louisiana (e) | International Paper CAMTI (No. 3) | 0.015 | | | | | | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | 0.0165 | | | | | | | |
| Europe | LCPDs[b]: high range | NA | 0.019 | 7000-9000 | 44 | | 50 | 0.5 | |
| Arkansas | Georgia Pacific Crossert (8R) | 0.02 | | | | | | | |
| Georgia | International Paper AM (No. 3) | 0.021 | | | | | | | |
| North Carolina | Kapstone (No. 7) | 0.021 | | | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-100) | 0.023 | | | | | | | |
| Georgia | GP Cedar Springs (No. 3) | 0.024 | | | | | | | |
| Louisiana | Port Hudson (No. 1) | 0.025 | | | | | | | |
| Louisiana | Port Hudson (No. 2) | 0.025 | | | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 0.025 | | | | | | | |
| Alabama | Alabama River Cellulose (No. 2) | 0.025 | | | | | | | |
| Minnesota | Sappi Cloquet LLC (#10) | 0.025 | | | | | | | |
| British | Prince George Vancouver (RB) | 0.026 | | | 60 | | | | 5550 |
| Washington | Weyerhaeuser (No. 10) | 0.027 | | | | | | | |
| Washington | Boise White Wallula (No. 3) | 0.027 | | | | | | | |
| Washington | Kapstone (22) | 0.027 | | | | | | | |
| Maine | Red Shield (# 4) | 0.028 | | | | | | | |
| Georgia | GP Cedar Springs (No. 1) | 0.030 | | | | | | | |
| Georgia | GP Cedar Springs (No. 2) | 0.030 | | | | | | | |
| Idaho | Clearwater Lewiston (No. 5) | 0.03 | | | | | | | |
| Florida | Palatka (No. 4) | 0.030 | | | | | | | |
| Washington | GP Camas (No. 3) | 0.033 | | | 75 | | | | |
| Washington | GP Camas (No. 4) | 0.033 | | | 75 | | | | |
| Idaho | Clearwater Lewiston (No. 4) | 0.040 | | | | | | | |
| Washington | Kapstone (19) | 0.040 | | | | | | | |
| USA | Modified RFs after 5/23/2013 | 0.044 | | | | | | | |
| Georgia | Weyerhaeuser PWM (No. 3) | 0.044 | | | 0.10 | | | | |
| Kentucky | Wycliffe Paper (03) | 0.044 | | | | | | | |
| Oregon | GP Consumer Products (EU24) | 0.044 | | | | | | | |
| Oregon | Boise White St Helens (2 & 3) | 0.044 | | | | | | | |
| Oregon | Cascade Pacific (RFEU) | 0.044 | | | | | | | |
| Washington | Boise White Wallula (No. 2) | 0.044 | | | | | | | |
| Washington | Kapstone (18) | 0.044 | | | | | | | |
| Washington | PTPC (RF) | 0.044 | | | | | | | |
| Washington | WestRock (No. 4) | 0.044 | | | | | | | |
| British | Catalyst PC Vancouver (#3, w#4 on) | 0.051 | | | 117 | 135 | | | 7000 |
| British | Catalyst PC Vancouver (#4, w#3 on) | 0.051 | | | 117 | 135 | | | 7000 |
| British | Catalyst PC Vancouver (#4, w#3 out) | 0.062 | | | 143 | 165 | | | 9000 |
| Georgia | International Paper AM (No. 2) | 0.055 | | | | | | | |
| British | Howe Sound Vancouver (E218529) | 0.057 | | | 130 | 150 | | | 5950 |
| Washington | Cosmo (No. 1,2 & 3 common stk) | 0.10 | | | | | | | |
| Europe (sulphite) | LCPDs* for Paper Sector (low range) | NA | 0.002 | 6000-7000 | 4 | | 5 | 0.02 | |
| Europe (sulphite) | LCPDs* for Paper Sector (high range) | NA | 0.008 | 6000-7000 | 17 | | 20 | 0.15 | |

# Lime Kiln Particulate Matter Unit Conversions

| Location | Facility (LK Unit if specified) | Limit A: gr/dscf (at 10% O2) | Limit B: gr/dscf (at 10% O2) daily avg | Limit B Ref: | F: flow rate (m3/Adt) | mg/dscm (at 10% O2) | mg/Nm3 (at5%O2) | kg TSP/ ADt | m3/min |
|---|---|---|---|---|---|---|---|---|---|
| USA | New/reconstructed after 5/23/2013 | 0.010 | | | | | | | |
| Europe | LCPDs[b]: low range | NA | 0.01 | IPPC | 1000 | 22 | 30 | 0.03 | |
| Europe | LCPDs[b]: high range | NA | 0.02 | IPPC | 1000 | 37 | 50 | 0.05 | |
| Washington | Kapstone (3) | 0.030 | | | | | | | |
| Washington | Kapstone (4) | 0.030 | | | | | | | |
| Louisiana | Port Hudson (No. 2) | 0.033 | | | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 0.033 | | | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 0.035 | | | | | | | |
| Alabama | Alabama River Cellulose (No. 2) | 0.035 | | | | | | | |
| Minnesota | Sappi Cloquet LLC (#10) | 0.035 | | | | | | | |
| Washington | Kapstone (5) | 0.035 ng / 0.060 | | | | | | | |
| Washington | Weyerhaeuser (No. 4) | 0.035 ng / 0.07 | | | | | | | |
| British | Howe Sound Vancouver (E218529) | 0.044 | | | | 100 | | | 1035 |
| Washington | Graymont | 0.05 (coal or ng) | | | | | | | |
| Louisiana | Port Hudson (No. 1) | 0.05 | | | | | | | |
| Georgia | GP Cedar Springs (No. 2) | 0.056 | | | | | | | |
| USA | Modified LKs after 5/23/2013 | 0.064 | | | | | | | |
| Arkansas | Georgia Pacific Crossert (#4) | 0.064 | | | | | | | |
| Georgia | GP Cedar Springs (No. 1) | 0.064 | | | | | | | |
| Georgia | International Paper AM (No. 2) | 0.064 | | | | | | | |
| Georgia | Weyerhaeuser PWM (No. 2) | 0.064 | | | | | | | |
| Idaho | Clearwater Lewiston (No. 3) | 0.064 | | | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | 0.064 | | | | | | | |
| Kentucky | Wycliffe Paper (03) | 0.064 | | | | | | | |
| Louisiana | International Paper CAMPTI | 0.064 | | | | | | | |
| Oregon | GP Consumer Products (EU21) | 0.064 | | | | | | | |
| Oregon | Boise White St Helens | 0.064 | | | | | | | |
| Oregon | Cascade Pacific (LKEU) | 0.064 | | | | | | | |
| Washington | Boise White Wallula | 0.064 ng / 0.12 | | | | | | | |
| Washington | PTPC (LK) | 0.064 | | | | | | | |
| Washington | WestRock (No. 1) | 0.064 | | | | | | | |
| Washington | WestRock (No. 2) | 0.064 | | | | | | | |
| British | Catalyst PC Vancouver (1,2 cmb stk) | 0.066 | | | | 150 | | | 950 |
| Minnesota | Boise Cascade Int'l Falls (EU340) | 0.066 | | | | | | | |
| Washington | GP Camas (No. 4) | 0.067 ng/ 0.13 oil | | | | | | | |
| Maine | Red Shield | 0.13 | | | | | | | |
| North Carolina | Kapstone | 0.14 | | | | | | | |
| Georgia | International Paper AM (No. 1) | 0.176 | | | | | | | |
| British | Prince George Vancouver | 0.201 | 0.101 | | | 460 | | | 850 |
| Florida | Palatka (No. 4) | NA | | | | | | | |

# Recovery Furnace $SO_2$ Unit Conversions

| Location | Facility (RF Unit if specified) | Limit A: ppm (at 8% O2) | Limit C: 24-hr avg ppm (at 8% O2) | Limit E: Annual ppm (at 8% O2) | mg/dscm (at 8% O2) | mg/Nm3 (at5%O2) | kg S/ ADt |
|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range | 3.3 (24-hr avg) | 3.3 | | 9 | 10 | 0.1 |
| Washington | GP Camas (No. 3) | 10 (24-hr avg) | 10 | | | | |
| Washington | GP Camas (No. 4) | 10 (24-hr avg) | 10 | | | | |
| Europe | LCPDs[b]: high range | 16 (24-hr avg) | 16.4 | | 44 | 50 | 0.4 |
| Louisiana | International Paper CAMTI (No. 3) | 20 (3-hr avg) | | | | | |
| Idaho | Clearwater Lewiston (No. 5) | 50 (3-hr avg) | | | | | |
| Washington | Kapstone (18) | 60 (3-hr avg) [switched to lb/hr units] | | | | | |
| Washington | Kapstone (19) | 60 (3-hr avg) [switched to lb/hr units] | | | | | |
| Washington | Weyerhaeuser (No. 10) | 75 (3-hr avg) | | | | | |
| Florida | Palatka (No. 4) | 100 (24-hr avg) | | | | | |
| Alabama | Alabama River Cellulose (No.1) | 100 | | | | | |
| Alabama | Alabama River Cellulose (No.2) | 100 | | | | | |
| Maine | Red Shield (# 4) | 100 | | | | | |
| North Carolina | Kapstone (No. 7) | 110 (3-hr avg) | | 75 | | | |
| Louisiana | Port Hudson (No. 1) | 120 | | | | | |
| Louisiana | Port Hudson (No. 2) | 120 | | | | | |
| Washington | Kapstone (22) | 120 (3-hr avg) [switched to lb/hr units] | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-100) | 153 | | | | | |
| Oregon | Cascade Pacific (RFEU) | 180 | | | | | |
| Washington | PTPC (RF) | 200 | | | | | |
| Georgia | Weyerhaeuser PWM (No. 3) | 200 | | | | | |
| Minnesota | Sappi Cloquet LLC (#10) | 250 | | | | | |
| Georgia | GP Cedar Springs (No. 1) | 300 | | | | | |
| Georgia | GP Cedar Springs (No. 2) | 300 | | | | | |
| Oregon | GP Consumer Products (EU24) | 300 (3-hr avg) | 300 | | | | |
| Oregon | Boise White St Helens (2&3) | 300 (3-hr avg) | 300 | | | | |
| Georgia | GP Cedar Springs (No. 3) | 350 (24-hr avg) | 350 | | | | |
| Washington | Cosmo (No. 1,2 & 3 common stk) (c) | 360 (c) | | | | | |
| Washington | WestRock (No. 4) | 500 (150 30-day) | | | | | |
| Washington | Boise White Wallula (No. 2) | 500 | | | | | |
| Washington | Boise White Wallula (No. 3) | 500 | | | | | |
| Enocell, Finland | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 0.1 | 0.21 | 0.24 | (a) |
| Frövi, Sweden | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 0.2 | 0.6 | 0.7 | (a) |
| Joutseno, Finland | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 0.5 | 1.3 | 1.5 | (a) |
| Dynäs, Sweden | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 0.7 | 1.7 | 2.0 | (a) |
| Pöls AG, Austria | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 0.7 | 1.7 | 2.0 | (a) |
| Oulu, Finland | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 0.9 | 2.4 | 2.8 | (a) |
| Östrand, Sweden | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 1.5 | 4.1 | 4.7 | (a) |
| Varö, Sweden | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 1.5 | 4.1 | 4.7 | (a) |
| Stora Celbi, Portugal | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 1.5 | 4.1 | 4.7 | (a) |
| Vallvik, Sweden | Not specified in IPPC[b] | ≤ 2 (annual avg) | | 2.0 | 5.2 | 6.0 | (a) |
| Mönsteras, Sweden | Not specified in IPPC[b] | 4 (annual avg) | | 3.7 | 9.9 | 11.3 | (a) |
| Obbola, Sweden | Not specified in IPPC[b] | 4 (annual avg) | | 3.7 | 9.9 | 11.3 | (a) |
| Skutskär, Sweden | Not specified in IPPC[b] | 5 (annual avg) | | 5.0 | 13.4 | 15.3 | (a) |
| Bäckhammar, | Not specified in IPPC[b] | 5 (annual avg) | | 5.0 | 13.4 | 15.3 | (a) |
| Skärblacka, Sweden | Not specified in IPPC[b] | 6 (annual avg) | | 6.3 | 16.8 | 19.3 | (a) |
| Skoghall, Sweden | Not specified in IPPC[b] | 6 (annual avg) | | 6.3 | 16.8 | 19.3 | (a) |
| Wisaforest, Finland | Not specified in IPPC[b] | 7 (annual avg) | | 6.7 | 17.8 | 20.4 | (a) |
| Husum, Sweden | Not specified in IPPC[b] | 12 (annual avg) | | 12.0 | 31.9 | 36.7 | (a) |
| Aspa, Sweden | Not specified in IPPC[b] | 15 (annual avg) | | 14.6 | 38.9 | 44.7 | (a) |
| Äänekoski, Finland | Not specified in IPPC[b] | 15 (annual avg) | | 15.5 | 41.2 | 47.3 | (a) |
| Kaskinen, Finland | Not specified in IPPC[b] | 16 (annual avg) | | 16.0 | 42.6 | 48.9 | (a) |
| Iggesund, Sweden | Not specified in IPPC[b] | 16 (annual avg) | | 16.4 | 43.6 | 50.0 | (a) |
| Huelva, Spain | Not specified in IPPC[b] | 17 (annual avg) | | 16.8 | 44.7 | 51.3 | (a) |
| Sunila, Finland | Not specified in IPPC[b] | 18 (annual avg) | | 17.8 | 47.4 | 54.4 | (a) |
| British Columbia | Prince George Vancouver (RB) | 11 | | | 30 | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | NA | | | | | |
| Arkansas | Georgia Pacific Crossert (8R) | NA | | | | | |
| Georgia | International Paper AM (No. 3) | NA | | | | | |
| Georgia | International Paper AM (No. 2) | NA | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | NA | | | | | |
| Kentucky | Wycliffe Paper (03) | NA | | | | | |
| British Columbia | Catalyst PC Vancouver (#3, w#4 on) | "as specified in S content of fuel | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 on) | "as specified in S content of fuel | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 out) | "as specified in S content of fuel | | | | | |
| British Columbia | Howe Sound Vancouver (E218529) | NA | | | | | |
| Europe (sulphite) | LCPDs* for Paper Sector (low range) | 16 (24-hr avg) | 16.4 | | 44 | 50 | 0.3 |
| Europe (sulphite) | LCPDs* for Paper Sector (high range) | 49 (24-hr avg) | 49.1 | | 131 | 150 | 1.0 |

Notes:
(a) See European Mills Summary

# Lime Kiln $SO_2$ Unit Conversions

| Location | Facility (LK Unit if specified) | Limit A: ppm (at 10% O2) | Oil fired w/o NCG: Limit C:ppm 24-hr avg | Oil fired wNCG: Limit C:ppm 24-hr avg | Oil fired w/o NCG: Limit D: Annual ppm (at 10% O2) | Oil fired w NCG: Limit D: Annual ppm (at 10% O2) | Oil fired w/o NCG: g/dscm (at 10% O2) |
|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range (w/o NCG incineration) | 1.4 (24-hr avg) | 1.4 | | | | 4 |
| Europe | LCPDs[b]: high range (w/o NCG incineration) | 8 (24-hr avg) | 8.3 | | | | 22 |
| Florida | Palatka (No. 4) | 16.9 | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 50 | | | | | |
| Alabama | Alabama River Cellulose (No. 2) | 50 | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 50 | | | | | |
| Washington | Kapstone (3) | 20 (3-hr avg) | | | | | |
| Washington | Kapstone (4) | 20 (3-hr avg) | | | | | |
| Washington | Kapstone (5) | 20 (3-hr avg) | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | 20 (3-hr avg) | | | | | |
| Europe | LCPDs[b]: low range (w/ NCG incineration) | 42 (24-hr avg) | | 41.5 | | | |
| Europe | LCPDs[b]: high range (w/ NCG incineration) | 83 (24-hr avg) | | 83.0 | | | |
| Washington | GP Camas (No. 4) | 500 | | | | | |
| Washington | Weyerhaeuser (No. 4) | 500 | | | | | |
| Washington | PTPC (RF) | 500 | | | | | |
| Washington | WestRock (No. 1) | 500 | | | | | |
| Washington | WestRock (No. 2) | 500 | | | | | |
| Washington | Graymont | 1000 (coal or ng) | | | | | |
| Oulu, Finland | Not specified in IPPC[b] | 2 (annual avg) | | | 2 | 22 | 4.4 |
| Husum, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Skoghall, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Dynäs, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Frövi, Sweden | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Obbola, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Bäckhammar, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Pöls AG, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 7.4 |
| Joutseno, | Not specified in IPPC[b] | 3 (annual avg) | | | 3 | 23 | 8.8 |
| Washington | Boise White Wallula | 5 (annual avg) | | | | | |
| Stora Celbi, | Not specified in IPPC[b] | 6 (annual avg) | | | 6 | 25 | 14.7 |
| Wisaforest, | Not specified in IPPC[b] | 8 (annual avg) | | | 8 | 27 | 22.1 |
| Kaskinen, | Not specified in IPPC[b] | 12-30 (annual avg) | | | 12 | 30 | 32.4 |
| Mönsteras, | Not specified in IPPC[b] | 14-31 (annual avg) | | | 14 | 31 | 36.8 |
| Skärblacka, | Not specified in IPPC[b] | 14-31 (annual avg) | | | 14 | 31 | 36.8 |
| Ääneskoski, | Not specified in IPPC[b] | 16-33 (annual avg) | | | 16 | 33 | 43.5 |
| Sunila, Finland | Not specified in IPPC[b] | 17-33 (annual avg) | | | 17 | 33 | 44.9 |
| Aspa, Sweden | Not specified in IPPC[b] | 28-41 (annual avg) | | | 28 | 41 | 73.7 |
| Skutskär, | Not specified in IPPC[b] | 28-41 (annual avg) | | | 28 | 41 | 73.7 |
| Iggesund, | Not specified in IPPC[b] | 44 (annual avg) | | | 30 | 44 | 81.0 |
| Enocell, | Not specified in IPPC[b] | 48 (annual avg) | | | 37 | 48 | 98.0 |
| Vallvik, | Not specified in IPPC[b] | 81 (annual avg) | | | 80 | 81 | 213.7 |
| Varö, Sweden | Not specified in IPPC[b] | 81 (annual avg) | | | 80 | 81 | 213.7 |
| Östrand, | Not specified in IPPC[b] | 104 (annual avg) | | | 111 | 104 | 294.7 |
| Huelva, Spain | Not specified in IPPC[b] | 160 (annual avg) | | | 185 | 160 | 493.6 |
| Louisiana | International Paper CAMTI (No. 3) | NA | | | | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | NA | | | | | |
| North Carolina | Kapstone (No. 7) | NA | | | | | |
| British | Prince George Vancouver (RB) | NA | | | | | |
| Maine | Red Shield (# 4) | NA | | | | | |
| Louisiana | Port Hudson (No. 1) | NA | | | | | |
| Louisiana | Port Hudson (No. 2) | NA | | | | | |
| Minnesota | Sappi Cloquet LLC | NA | | | | | |
| Georgia | GP Cedar Springs (No. 1) | NA | | | | | |
| Georgia | GP Cedar Springs (No. 2) | NA | | | | | |
| Oregon | Cascade Pacific (LKEU) | TBD per permit | | | | | |
| Arkansas | Georgia Pacific Crossert (#4) | NA | | | | | |
| Georgia | Weyerhaeuser PWM (No. 2) | NA | | | | | |
| Georgia | International Paper AM (No. 1) | NA | | | | | |
| Georgia | International Paper AM (No. 2) | NA | | | | | |
| Idaho | Clearwater Lewiston (No. 3) | NA | | | | | |
| Kentucky | Wycliffe Paper (03) | NA | | | | | |
| Oregon | GP Consumer Products (EU21) | NA | | | | | |
| Oregon | Boise White St Helens | NA | | | | | |
| British Columbia | Catalyst PC Vancouver (#3, w#4 on) | "as specified in S content of fuel reg" | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 on) | "as specified in S content of fuel reg" | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 out) | "as specified in S content of fuel reg" | | | | | |
| British | Howe Sound Vancouver (E218529) | NA | | | | | |
| Notes:<br>(a) See European Mills Summary | | | | | | | |

# Lime Kiln $SO_2$ Unit Conversions (Continued)

| Location | Facility (LK Unit if specified) | Limit A: ppm (at 10% $O_2$) | Oil fired w NCG: g/dscm (at 10% $O_2$) | Oil fired w/o NCG: mg/Nm3 (at5%$O_2$) | Oil fired w/o NCG: kg S/ ADt | Oil fired w NCG: mg/Nmc (at5%$O_2$) | Oil fired w NCG: kg S/ ADt |
|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range (w/o NCG incineration) | 1.4(24-hr avg) | | 5 | 0.005 | | --- |
| Europe | LCPDs[b]: high range (w/o NCG | 8 (24-hr avg) | | 30 | 0.03 | | --- |
| Florida | Palatka (No. 4) | 16.9 | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 50 | | | | | |
| Alabama | Alabama River Cellulose (No. 2) | 50 | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 50 | | | | | |
| Washington | Kapstone (3) | 20 (3-hr avg) | | | | | |
| Washington | Kapstone (4) | 20 (3-hr avg) | | | | | |
| Washington | Kapstone (5) | 20 (3-hr avg) | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | 20 (3-hr avg) | | | | | |
| Europe | LCPDs[b]: low range (w/ NCG | 42 (24-hr avg) | 111 | | --- | 150 | 0.1 |
| Europe | LCPDs[b]: high range (w/ NCG | 83 (24-hr avg) | 221 | | --- | 300 | 0.3 |
| Washington | GP Camas (No. 4) | 500 | | | | | |
| Washington | Weyerhaeuser (No. 4) | 500 | | | | | |
| Washington | PTPC (RF) | 500 | | | | | |
| Washington | WestRock (No. 1) | 500 | | | | | |
| Washington | WestRock (No. 2) | 500 | | | | | |
| Washington | Graymont | 1000 (coal or ng) | | | | | |
| Oulu, Finland | Not specified in IPPC[b] | 2 (annual avg) | 58.6 | 6.0 | (a) | 79.5 | (a) |
| Husum, | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Skoghall, | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Dynäs, | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Frövi, Sweden | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Obbola, | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Bäckhammar, | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Pöls AG, | Not specified in IPPC[b] | 3 (annual avg) | 60.8 | 10.0 | (a) | 82.5 | (a) |
| Joutseno, | Not specified in IPPC[b] | 3 (annual avg) | 61.9 | 12.0 | (a) | 84.0 | (a) |
| Washington | Boise White Wallula | 5 (annual avg) | | | (a) | | (a) |
| Stora Celbi, | Not specified in IPPC[b] | 6 (annual avg) | 66.3 | 20.0 | (a) | 90.0 | (a) |
| Wisaforest, | Not specified in IPPC[b] | 8 (annual avg) | 71.8 | 30.0 | (a) | 97.5 | (a) |
| Kaskinen, | Not specified in IPPC[b] | 12-30 (annual avg) | 79.6 | 44.0 | (a) | 108.0 | (a) |
| Mönsteras, | Not specified in IPPC[b] | 14-31 (annual avg) | 82.9 | 50.0 | (a) | 112.5 | (a) |
| Skärblacka, | Not specified in IPPC[b] | 14-31 (annual avg) | 82.9 | 50.0 | (a) | 112.5 | (a) |
| Ääneskoski, | Not specified in IPPC[b] | 16-33 (annual avg) | 87.9 | 59.0 | (a) | 119.3 | (a) |
| Sunila, | Not specified in IPPC[b] | 17-33 (annual avg) | 89.0 | 61.0 | (a) | 120.8 | (a) |
| Aspa, Sweden | Not specified in IPPC[b] | 28-41 (annual avg) | 110.5 | 100.0 | (a) | 150.0 | (a) |
| Skutskär, | Not specified in IPPC[b] | 28-41 (annual avg) | 110.5 | 100.0 | (a) | 150.0 | (a) |
| Iggesund, | Not specified in IPPC[b] | 44 (annual avg) | 116.0 | 110.0 | (a) | 157.5 | (a) |
| Enocell, | Not specified in IPPC[b] | 48 (annual avg) | 128.8 | 133.0 | (a) | 174.8 | (a) |
| Vallvik, | Not specified in IPPC[b] | 81 (annual avg) | 215.5 | 290.0 | (a) | 292.5 | (a) |
| Varö, Sweden | Not specified in IPPC[b] | 81 (annual avg) | 215.5 | 290.0 | (a) | 292.5 | (a) |
| Östrand, | Not specified in IPPC[b] | 104 (annual avg) | 276.3 | 400.0 | (a) | 375.0 | (a) |
| Huelva, Spain | Not specified in IPPC[b] | 160 (annual avg) | 425.5 | 670.0 | (a) | 577.5 | (a) |
| Louisiana | International Paper CAMTI (No. 3) | NA | | | | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | NA | | | | | |
| North Carolina | Kapstone (No. 7) | NA | | | | | |
| British | Prince George Vancouver (RB) | NA | | | | | |
| Maine | Red Shield (# 4) | NA | | | | | |
| Louisiana | Port Hudson (No. 1) | NA | | | | | |
| Louisiana | Port Hudson (No. 2) | NA | | | | | |
| Minnesota | Sappi Cloquet LLC | NA | | | | | |
| Georgia | GP Cedar Springs (No. 1) | NA | | | | | |
| Georgia | GP Cedar Springs (No. 2) | NA | | | | | |
| Oregon | Cascade Pacific (LKEU) | TBD per permit | | | | | |
| Arkansas | Georgia Pacific Crossert (#4) | NA | | | | | |
| Georgia | Weyerhaeuser PWM (No. 2) | NA | | | | | |
| Georgia | International Paper AM (No. 1) | NA | | | | | |
| Georgia | International Paper AM (No. 2) | NA | | | | | |
| Idaho | Clearwater Lewiston (No. 3) | NA | | | | | |
| Kentucky | Wycliffe Paper (03) | NA | | | | | |
| Oregon | GP Consumer Products (EU21) | NA | | | | | |
| Oregon | Boise White St Helens | NA | | | | | |
| British Columbia | Catalyst PC Vancouver (#3, w#4 on) | "as specified in S content of fuel reg" | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 on) | "as specified in S content of fuel reg" | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 out) | "as specified in S content of fuel reg" | | | | | |
| British | Howe Sound Vancouver (E218529) | NA | | | | | |

Notes:
(a) See European Mills Summary

# Recovery Furnace NOx Unit Conversions

| Location | Facility (RF Unit if specified) | Limit A: ppmd (at 8% O2) | Limit C: 24-hr avg: ppm (at 8% O2) | Annual ppm (@8%O2) | mg/dscm (at 8% O2) | mg/Nm3 (at5%O2) | kg NOx/ ADt |
|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range | 36 (24-hr avg) | 36 | | 70 | 80 | 0.7 |
| Europe | LCPDs[b]: high range | 55 (24-hr avg) | 55 | | 105 | 120 | 1.1 |
| Alabama | Alabama River Cellulose (No. 2) | 75 | | | | | |
| Louisiana | International Paper CAMTI (No. 3) | 80 (3-hr avg) | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-100) | 80 (8-hr avg) | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 90 | | | | | |
| Washington | Kapstone (22) | 95 (3-hr avg) | | | | | |
| Washington | Kapstone (18) | 95 (24-hr avg) | 95 | | | | |
| Washington | Kapstone (19) | 95 (24-hr avg) | 95 | | | | |
| Idaho | Clearwater Lewiston (No. 5) | 100 | | | | | |
| Arkansas | Georgia Pacific Crossert (8R) | 110 | | | | | |
| Louisiana | Port Hudson (No. 1) | 112 | | | | | |
| Louisiana | Port Hudson (No. 2) | 112 | | | | | |
| Washington | Boise White Wallula (No. 3) | 112 (24-hr avg) | 112 | | | | |
| Washington | Weyerhaeuser (No. 10) | 140 (24-hr avg) | 140 | | | | |
| Maine | Red Shield (# 4) | 150 (24-hr avg) | | | | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | 80 (30-day avg) | | | | | |
| Florida | Palatka (No. 4) | 80 (30-day avg) | | | | | |
| Washington | WestRock (No. 4) | 85 (30-day avg) | | | | | |
| North Carolina | Kapstone (No. 7) | 100 (30-day avg) | | | | | |
| Minnesota | Sappi Cloquet LLC | 115 (30-day avg) | | | | | |
| Skärblacka, Sweden | Not specified in IPPC[b] | 35 (annual avg) | | 35 | 66 | 76 | (a) |
| Oulu, Finland | Not specified in IPPC[b] | 41 (annual avg) | | 41 | 79 | 91 | (a) |
| Wisaforest, Finland | Not specified in IPPC[b] | 44 (annual avg) | | 44 | 84 | 96.4 | (a) |
| Huelva, Spain | Not specified in IPPC[b] | 45 (annual avg) | | 45 | 85 | 98 | (a) |
| Mönsteras, Sweden | Not specified in IPPC[b] | 48 (annual avg) | | 48 | 91 | 105 | (a) |
| Frövi, Sweden | Not specified in IPPC[b] | 51 (annual avg) | | 51 | 97 | 111 | (a) |
| Joutseno, Finland | Not specified in IPPC[b] | 51 (annual avg) | | 51 | 97 | 111.3 | (a) |
| Obbola, Sweden | Not specified in IPPC[b] | 51 (annual avg) | | 51 | 98 | 112 | (a) |
| Stora Celbi, Portugal | Not specified in IPPC[b] | 51 (annual avg) | | 51 | 98 | 112 | (a) |
| Sunila, Finland | Not specified in IPPC[b] | 51 (annual avg) | | 51 | 98 | 112.9 | (a) |
| Skoghall, Sweden | Not specified in IPPC[b] | 56 (annual avg) | | 56 | 108 | 124 | (a) |
| Enocell, Finland | Not specified in IPPC[b] | 59 (annual avg) | | 59 | 112 | 128.6 | (a) |
| Husum, Sweden | Not specified in IPPC[b] | 60 (annual avg) | | 60 | 114 | 131 | (a) |
| Bäckhammar, | Not specified in IPPC[b] | 60 (annual avg) | | 60 | 115 | 132 | (a) |
| Dynäs, Sweden | Not specified in IPPC[b] | 61 (annual avg) | | 61 | 117 | 134 | (a) |
| Skutskär, Sweden | Not specified in IPPC[b] | 62 (annual avg) | | 62 | 119 | 136 | (a) |
| Aspa, Sweden | Not specified in IPPC[b] | 63 (annual avg) | | 63 | 121 | 139 | (a) |
| Östrand, Sweden | Not specified in IPPC[b] | 67 (annual avg) | | 67 | 127 | 146 | (a) |
| Kaskinen, Finland | Not specified in IPPC[b] | 67 (annual avg) | | 67 | 128 | 146.6 | (a) |
| Vallvik, Sweden | Not specified in IPPC[b] | 70 (annual avg) | | 70 | 134 | 154 | (a) |
| Iggesund, Sweden | Not specified in IPPC[b] | 73 (annual avg) | | 73 | 139 | 160 | (a) |
| Varö, Sweden | Not specified in IPPC[b] | 73 (annual avg) | | 73 | 140 | 161 | (a) |
| Pöls AG, Austria | Not specified in IPPC[b] | 77 (annual avg) | | 77 | 148 | 170 | (a) |
| Ääneskoski, Finland | Not specified in IPPC[b] | 84 (annual avg) | | 84 | 161 | 184.8 | (a) |
| Georgia | GP Cedar Springs (No. 1) | NA | | | | | |
| Georgia | GP Cedar Springs (No. 2) | NA | | | | | |
| Georgia | GP Cedar Springs (No. 3) | NA | | | | | |
| Georgia | International Paper AM (No. 2) | NA | | | | | |
| Georgia | International Paper AM (No. 3) | NA | | | | | |
| Georgia | Weyerhaeuser PWM (No. 3) | NA | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | NA | | | | | |
| Kentucky | Wycliffe Paper (03) | NA | | | | | |
| Oregon | Cascade Pacific (RFEU) | TBD per permit | | | | | |
| Oregon | GP Consumer Products (EU24) | No limit in permit | | | | | |
| Oregon | Boise White St Helens (2&3) | No limit in permit | | | | | |
| Washington | Boise White Wallula (No. 2) | NA | | | | | |
| Washington | Cosmo (No. 1,2 & 3 common stk) | NA | | | | | |
| Washington | GP Camas (No. 3) | NA | | | | | |
| Washington | GP Camas (No. 4) | NA | | | | | |
| Washington | PTPC (RF) | NA | | | | | |
| British Columbia | Catalyst PC Vancouver (#3, w#4 on) | NA | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 on) | NA | | | | | |
| British Columbia | Catalyst PC Vancouver (#4, w#3 out) | NA | | | | | |
| British Columbia | Howe Sound Vancouver (E218529) | NA | | | | | |
| British Columbia | Prince George Vancouver (RB) | 11.3 | | | 30 | | |
| Europe-sulphite | LCPDs[b]: low range | 91 (24-hr avg) | 91 | | 174 | 200 | 1.0 |
| Europe-sulphite | LCPDs[b]: high range | 137 (24-hr avg) | 137 | | 261 | 300 | 2.0 |

Notes:
(a) See European Mills Summary

# Lime Kiln NOx Unit Conversions

| Location | Facility (LK Unit if specified) | Limit A: ppmd (at 10% O2) | Oil fired: 24-hr avg: ppm (at 10% O2) | Nat Gas fired: 24-hr avg: ppm (at 10% O2) | Annual range ppm @10%O 2 | Nat Gas fired: annua l avg: | Oil fired: annual avg: ppm (at 10% O2) | Nat Gas fired: mg/Nm3( at 10%O2) |
|---|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range (oil) | 39 (24-hr avg) | 39 | | | | | |
| Europe | LCPDs[b]: high range (oil) | 77 (24-hr avg) | 77 | | | | | |
| Alabama | Alabama River Cellulose (No. 2) | 100 | | | | | | |
| Oregon | Cascade Pacific (LKEU) | 112 | | | | | | |
| Europe | LCPDs[b]: low range (natural gas) | 146 (24-hr avg) | | 146 | | | | 280 |
| Maine | Red Shield (# 4) | 170 | | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 175 | | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 189 (or 300 | | | | | | 189 |
| Minnesota | Sappi Cloquet LLC | 220 | | | | | | |
| Europe | LCPDs[b]: high range (natural gas) | 231 (24-hr avg) | | 231 | | | | 442 |
| Oregon | Boise White St Helens | 270 | | | | | | |
| Washington | Kapstone (5) | 275 (24-hr avg) | | | | | | |
| Washington | Kapstone (3) | 340 (24-hr avg) | | | | | | |
| Washington | Kapstone (4) | 340 (24-hr avg) | | | | | | |
| Florida | Palatka (No. 4) | 114 (30-day | | | | | | |
| Bäckhammar, | Not specified in IPPC[b] | 15 (annual avg) | | | 15 | 2 | 15 | 3 |
| Huelva, Spain | Not specified in IPPC[b] | 23 (annual avg) | | | 23 | 2 | 23 | 4 |
| Östrand, | Not specified in IPPC[b] | 31 (annual avg) | | | 31 | 11 | 31 | 21 |
| Ääneskoski, | Not specified in IPPC[b] | 39 (annual avg) | | | 39 | 20 | 39 | 38 |
| Husum, | Not specified in IPPC[b] | 42 (annual avg) | | | 42 | 23 | 42 | 45 |
| Iggesund, | Not specified in IPPC[b] | 50 (annual avg) | | | 50 | 32 | 50 | 61 |
| Skoghall, | Not specified in IPPC[b] | 58 (annual avg) | | | 58 | 40 | 58 | 77 |
| Kaskinen, | Not specified in IPPC[b] | 62 (annual avg) | | | 62 | 45 | 62 | 85 |
| Joutseno, | Not specified in IPPC[b] | 65 (annual avg) | | | 65 | 48 | 65 | 92 |
| Stora Celbi, | Not specified in IPPC[b] | 65 (annual avg) | | | 65 | 49 | 65 | 94 |
| Enocell, | Not specified in IPPC[b] | 66 (annual avg) | | | 66 | 49 | 66 | 94 |
| Obbola, | Not specified in IPPC[b] | 69 (annual avg) | | | 69 | 53 | 69 | 102 |
| Skutskär, | Not specified in IPPC[b] | 73 (annual avg) | | | 73 | 57 | 73 | 110 |
| Aspa, Sweden | Not specified in IPPC[b] | 77 (annual avg) | | | 77 | 62 | 77 | 118 |
| Mönsteras, | Not specified in IPPC[b] | 66-81 (annual | | | 66-81 | 66 | 81 | 126 |
| Frövi, Sweden | Not specified in IPPC[b] | 66-81 (annual | | | 66-81 | 66 | 81 | 126 |
| Vallvik, | Not specified in IPPC[b] | 70-85 (annual | | | 70-85 | 70 | 85 | 134 |
| Dynäs, | Not specified in IPPC[b] | 70-85 (annual | | | 70-85 | 70 | 85 | 134 |
| Skärblacka, | Not specified in IPPC[b] | 74-89 (annual | | | 74-89 | 74 | 89 | 142 |
| Varö, Sweden | Not specified in IPPC[b] | 87-100 (annual | | | 87-100 | 87 | 100 | 167 |
| Oulu, Finland | Not specified in IPPC[b] | 91-104 (annual | | | 91-104 | 91 | 104 | 175 |
| Sunila, Finland | Not specified in IPPC[b] | 93-106 (annual | | | 93-106 | 93 | 106 | 179 |
| Wisaforest, | Not specified in IPPC[b] | 115-126 | | | 115-126 | 115 | 126 | 220 |
| Pöls AG, | Not specified in IPPC[b] | 168 (annual avg) | | | 168 | 168 | 173 | 321 |
| Arkansas | Georgia Pacific Crossert (#4) | NA | | | | | | |
| Georgia | GP Cedar Springs (No. 1) | NA | | | | | | |
| Georgia | GP Cedar Springs (No. 2) | NA | | | | | | |
| Georgia | International Paper AM (No. 2) | NA | | | | | | |
| Georgia | International Paper AM (No. 3) | NA | | | | | | |
| Georgia | Weyerhaeuser PWM (No. 2) | NA | | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | NA | | | | | | |
| Idaho | Clearwater Lewiston (No. 5) | NA | | | | | | |
| Kentucky | Wycliffe Paper (03) | NA | | | | | | |
| Louisiana | Port Hudson (No. 1) | NA | | | | | | |
| Louisiana | Port Hudson (No. 2) | NA | | | | | | |
| Louisiana | International Paper CAMTI (No. 3) | NA | | | | | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | NA | | | | | | |
| North Carolina | Kapstone (No. 7) | NA | | | | | | |
| Oregon | GP Consumer Products (EU21) | NA | | | | | | |
| Washington | Boise White Wallula | NA | | | | | | |
| Washington | GP Camas (No. 4) | NA | | | | | | |
| Washington | PTPC (RF) | NA | | | | | | |
| Washington | WestRock (No. 1) | NA | | | | | | |
| Washington | WestRock (No. 2) | NA | | | | | | |
| Washington | Weyerhaeuser (No. 4) | NA | | | | | | |
| British | Catalyst PC Vancouver (#3, w#4 on) | NA | | | | | | |
| British | Catalyst PC Vancouver (#4, w#3 on) | NA | | | | | | |
| British | Catalyst PC Vancouver (#4, w#3 out) | NA | | | | | | |
| British | Howe Sound Vancouver (E218529) | NA | | | | | | |
| British | Prince George Vancouver (RB) | NA | | | | | | |
| Notes:<br>(a) See European Mills Summary | | | | | | | | |

# Lime Kiln NOx Unit Conversions (Continued)

| Location | Facility (LK Unit if specified) | Limit A: ppmd (at 10% O2) | Oil fired : mg/Nm3(at 10%O2) | Nat Gas fired: mg/Nm3 (at5%O2) | Nat Gas fired: kg NOx/ ADt | Oil fired : mg/Nm3 (at5%O2) | Oil fired: kg NOx/ ADt |
|---|---|---|---|---|---|---|---|
| Europe | LCPDs[b]: low range (oil) | 39 (24-hr avg) | 74 | | | 100 | 0.1 |
| Europe | LCPDs[b]: high range (oil) | 77 (24-hr avg) | 147 | | | 200 | 0.2 |
| Alabama | Alabama River Cellulose (No. 2) | 100 | | | | | |
| Oregon | Cascade Pacific (LKEU) | 112 | | | | | |
| Europe | LCPDs[b]: low range (natural gas) | 146 (24-hr avg) | | 380 | 0.4 | | |
| Maine | Red Shield (# 4) | 170 | | | | | |
| Alabama | Alabama River Cellulose (No. 1) | 175 | | | | | |
| Mississippi | Weyerhaeuser NR PW (AA-110) | 189 (or 300 ppm | | | | | |
| Minnesota | Sappi Cloquet LLC | 220 | | | | | |
| Europe | LCPDs[b]: high range (natural gas) | 231 (24-hr avg) | | 600 | 0.6 | | |
| Oregon | Boise White St Helens | 270 | | | | | |
| Washington | Kapstone (5) | 275 (24-hr avg) | | | | | |
| Washington | Kapstone (3) | 340 (24-hr avg) | | | | | |
| Washington | Kapstone (4) | 340 (24-hr avg) | | | | | |
| Florida | Palatka (No. 4) | 114 (30-day avg) | | | | | |
| Bäckhammar, | Not specified in IPPC[b] | 15 (annual avg) | 29 | 4 | (a) | 40 | (a) |
| Huelva, Spain | Not specified in IPPC[b] | 23 (annual avg) | 44 | 6 | (a) | 60 | (a) |
| Östrand, | Not specified in IPPC[b] | 31 (annual avg) | 59 | 28 | (a) | 80 | (a) |
| Ääneskoski, | Not specified in IPPC[b] | 39 (annual avg) | 74 | 51 | (a) | 101 | (a) |
| Husum, | Not specified in IPPC[b] | 42 (annual avg) | 81 | 61 | (a) | 110 | (a) |
| Iggesund, | Not specified in IPPC[b] | 50 (annual avg) | 96 | 83 | (a) | 130 | (a) |
| Skoghall, | Not specified in IPPC[b] | 58 (annual avg) | 111 | 105 | (a) | 150 | (a) |
| Kaskinen, | Not specified in IPPC[b] | 62 (annual avg) | 118 | 116 | (a) | 160 | (a) |
| Joutseno, | Not specified in IPPC[b] | 65 (annual avg) | 124 | 125 | (a) | 168 | (a) |
| Stora Celbi, | Not specified in IPPC[b] | 65 (annual avg) | 125 | 127 | (a) | 170 | (a) |
| Enocell, | Not specified in IPPC[b] | 66 (annual avg) | 126 | 128 | (a) | 171 | (a) |
| Obbola, | Not specified in IPPC[b] | 69 (annual avg) | 133 | 138 | (a) | 180 | (a) |
| Skutskär, | Not specified in IPPC[b] | 73 (annual avg) | 140 | 149 | (a) | 190 | (a) |
| Aspa, Sweden | Not specified in IPPC[b] | 77 (annual avg) | 147 | 160 | (a) | 200 | (a) |
| Mönsteras, | Not specified in IPPC[b] | 66-81 (annual | 155 | 171 | (a) | 210 | (a) |
| Frövi, Sweden | Not specified in IPPC[b] | 66-81 (annual | 155 | 171 | (a) | 210 | (a) |
| Vallvik, | Not specified in IPPC[b] | 70-85 (annual | 162 | 182 | (a) | 220 | (a) |
| Dynäs, | Not specified in IPPC[b] | 70-85 (annual | 162 | 182 | (a) | 220 | (a) |
| Skärblacka, | Not specified in IPPC[b] | 74-89 (annual | 169 | 193 | (a) | 230 | (a) |
| Varö, Sweden | Not specified in IPPC[b] | 87-100 (annual | 192 | 226 | (a) | 260 | (a) |
| Oulu, Finland | Not specified in IPPC[b] | 91-104 (annual | 199 | 237 | (a) | 270 | (a) |
| Sunila, Finland | Not specified in IPPC[b] | 93-106 (annual | 203 | 242.5 | (a) | 275 | (a) |
| Wisaforest, | Not specified in IPPC[b] | 115-126 (annual | 240 | 298.6 | (a) | 326 | (a) |
| Pöls AG, | Not specified in IPPC[b] | 168 (annual avg) | 332 | 435 | (a) | 450 | (a) |
| Arkansas | Georgia Pacific Crossert (#4) | NA | | | | | |
| Georgia | GP Cedar Springs (No. 1) | NA | | | | | |
| Georgia | GP Cedar Springs (No. 2) | NA | | | | | |
| Georgia | International Paper AM (No. 2) | NA | | | | | |
| Georgia | International Paper AM (No. 3) | NA | | | | | |
| Georgia | Weyerhaeuser PWM (No. 2) | NA | | | | | |
| Idaho | Clearwater Lewiston (No. 4) | NA | | | | | |
| Idaho | Clearwater Lewiston (No. 5) | NA | | | | | |
| Kentucky | Wycliffe Paper (03) | NA | | | | | |
| Louisiana | Port Hudson (No. 1) | NA | | | | | |
| Louisiana | Port Hudson (No. 2) | NA | | | | | |
| Louisiana | International Paper CAMTI (No. 3) | NA | | | | | |
| Minnesota | Boise Cascade Int'l Falls (EU320) | NA | | | | | |
| North Carolina | Kapstone (No. 7) | NA | | | | | |
| Oregon | GP Consumer Products (EU21) | NA | | | | | |
| Washington | Boise White Wallula | NA | | | | | |
| Washington | GP Camas (No. 4) | NA | | | | | |
| Washington | PTPC (RF) | NA | | | | | |
| Washington | WestRock (No. 1) | NA | | | | | |
| Washington | WestRock (No. 2) | NA | | | | | |
| Washington | Weyerhaeuser (No. 4) | NA | | | | | |
| British | Catalyst PC Vancouver (#3, w#4 on) | NA | | | | | |
| British | Catalyst PC Vancouver (#4, w#3 on) | NA | | | | | |
| British | Catalyst PC Vancouver (#4, w#3 out) | NA | | | | | |
| British | Howe Sound Vancouver (E218529) | NA | | | | | |
| British | Prince George Vancouver (RB) | NA | | | | | |

Notes:
(a) See European Mills Summary

# European Mills Summary

| Estimated Annual Average Calculations (5),(6) | | | | | |
|---|---|---|---|---|---|
| | | (oil fired) | (gas fired) | | (oil w/o ncg incineration) |
| | Recovery Boiler | Lime Kiln | Lime Kiln | Recovery Boiler | Lime Kiln |
| | NOx | NOx (4) | NOx (4) | SO2 (1),(2) | SO2 (1),(2) |
| Facility | mg/Nm3 | mg/Nm3 | mg/Nm3 | mg/Nm3 | mg/Nm3 |
| Aspa, Sweden | 139 | 200 | 160 | 44.7 | 100.0 |
| Iggesund, Sweden | 160 | 130 | 83 | 50.0 | 110.0 |
| Husum, Sweden | 131 | 110 | 61 | 36.7 | 10.0 |
| Mönsteras, Sweden | 105 | 210 | 171 | 11.3 | 50.0 |
| Östrand, Sweden | 146 | 80 | 28 | 4.7 | 400.0 |
| Skutskär, Sweden | 136 | 190 | 149 | 15.3 | 100.0 |
| Skärblacka, Sweden | 76 | 230 | 193 | 19.3 | 50.0 |
| Skoghall, Sweden | 124 | 150 | 105 | 19.3 | 10.0 |
| Vallvik, Sweden | 154 | 220 | 182 | 6.0 | 290.0 |
| Varö, Sweden | 161 | 260 | 226 | 4.7 | 290.0 |
| Dynäs, Sweden | 134 | 220 | 182 | 2.0 | 10.0 |
| Frövi, Sweden | 111 | 210 | 171 | 0.7 | 10.0 |
| Obbola, Sweden | 112 | 180 | 138 | 11.3 | 10.0 |
| Bäckhammar, Sweden | 132 | 40 | *4* | 15.3 | 10.0 |
| Huelva, Spain | 98 | 60 | 6 | 51.3 | 670.0 |
| Pöls AG, Austria | 170 | 450 | 435 | 2.0 | 10.0 |
| Stora Celbi, Portugal | 112 | 170 | 127 | 4.7 | 20.0 |
| Enocell, Finland | 128.6 | 171 | 128 | *0.2* | 133.0 |
| Oulu, Finland | 91 | 270 | 237 | 2.8 | 6.0 |
| Ääneskoski, Finland | 184.8 | 101 | 51 | 47.3 | 59.0 |
| Kaskinen, Finland | 146.6 | 160 | 116 | 48.9 | 44.0 |
| Sunila, Finland | 112.9 | 275 | 243 | 54.4 | 61.0 |
| Joutseno, Finland | 111.3 | 168 | 125 | 1.5 | 12.0 |
| Wisaforest, Finland | 96.4 | 326 | 299 | 20.4 | 30.0 |

Notes:

ICCP reference O2 content = 5%. For mg/Nm3, the N stands for normal conditions or standard European conditions of 0 degrees Celsius and sea level pressure (101.3 kPa).

(1) Inflated value - includes S from TRS [From IPPC Dec 2001 document: "Gaseous sulphur is mainly SO2-S. Usually only very small amounts of H2S is released (usually below 10 mg H2S/Nm3)"]

(2) SO2 trendline was calculated from information provided even though y-intercept of zero would normally be assumed. Results were positive except for the recovery boiler calculated SO2 value (mg/Nm3) at Enocell, Finland. To avoid a negative calculated result at this facility, the mg/Nm3 value was estimated as a scaled fraction of the kg/ADt ratio of the next lowest SO2 emitting facility (Frovi, Sweden).

(3) Source data values of <0.01, were set to 0.00999 as conservative approximations.

(4) NOx Trendline was calculated from information provided even though y-intercept of zero would normally be assumed. Results were positive except for gas fired lime kiln calculated NOx value (mg/Nm3) at Backhammar, Sweden. To avoid a negative calculated result at this facility, the mg/Nm3 value was estimated as a scaled fraction of the kg/ADt ratio of the next lowest NOx emitting facility (Huelva, Spain).

(5) Source data: Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques in the Pulp and Paper Industry, December 2001, European Commission.

(6) Whether an individual facility's lime kiln(s) is gas fired or oil fired for NOx, and whether it is oil fired with non-condensable gas incineration, or without non-condensable gas incineration for SO2 were not known. Ranges of values were calculated for both NOx options and both SO2 options. For NOx values within or close to the oil-fired range, oil was the assumed fuel. For NOx values within or close to the gas-fired range, gas was the assumed fuel. For values in between, both gas and oil fired ranges were provided.

# European Mills Summary (Continued)

| Estimated Annual Average Calculations (5),(6) | | | | | |
|---|---|---|---|---|---|
| | (oil & ncg incineration) | | | | |
| | Lime Kiln | Recovery Boiler | Lime Kiln | Recovery Boiler | Lime Kiln |
| | SO2 (1),(2) | NOx | NOx | SO2 | SO2 (3) |
| **Facility** | **mg/Nm3** | **kg/Adt** | **kg/Adt** | **kg/Adt** | **kg/Adt** |
| Aspa, Sweden | 150.0 | 1.29 | 0.20 | 0.36 | 0.1 |
| Iggesund, Sweden | 157.5 | 1.5 | 0.13 | 0.4 | 0.11 |
| Husum, Sweden | 82.5 | 1.21 | 0.11 | 0.3 | 0.01 |
| Mönsteras, Sweden | 112.5 | 0.95 | 0.21 | 0.11 | 0.05 |
| Östrand, Sweden | 375.0 | 1.36 | 0.08 | 0.06 | 0.4 |
| Skutskär, Sweden | 150.0 | 1.26 | 0.19 | 0.14 | 0.1 |
| Skärblacka, Sweden | 112.5 | 0.66 | 0.23 | 0.17 | 0.05 |
| Skoghall, Sweden | 82.5 | 1.14 | 0.15 | 0.17 | 0.00999 |
| Vallvik, Sweden | 292.5 | 1.44 | 0.22 | 0.07 | 0.29 |
| Varö, Sweden | 292.5 | 1.51 | 0.26 | 0.06 | 0.29 |
| Dynäs, Sweden | 82.5 | 1.24 | 0.22 | 0.04 | 0.00999 |
| Frövi, Sweden | 82.5 | 1.01 | 0.21 | 0.03 | 0.01 |
| Obbola, Sweden | 82.5 | 1.02 | 0.18 | 0.11 | 0.00999 |
| Bäckhammar, Sweden | 82.5 | 1.22 | 0.04 | 0.14 | 0.01 |
| Huelva, Spain | 577.5 | 0.88 | 0.06 | 0.41 | 0.67 |
| Pöls AG, Austria | 82.5 | 1.6 | 0.45 | 0.04 | 0.00999 |
| Stora Celbi, Portugal | 90.0 | 1.02 | 0.17 | 0.06 | 0.02 |
| Enocell, Finland | 174.8 | 1.186 | 0.171 | 0.011 | 0.133 |
| Oulu, Finland | 79.5 | 0.81 | 0.27 | 0.046 | 0.006 |
| Ääneskoski, Finland | 119.3 | 1.748 | 0.101 | 0.38 | 0.059 |
| Kaskinen, Finland | 108.0 | 1.366 | 0.16 | 0.392 | 0.044 |
| Sunila, Finland | 120.8 | 1.029 | 0.275 | 0.433 | 0.061 |
| Joutseno, Finland | 84.0 | 1.013 | 0.168 | 0.036 | 0.012 |
| Wisaforest, Finland | 97.5 | 0.864 | 0.326 | 0.178 | 0.03 |

Notes:

ICCP reference O2 content = 5%. For mg/Nm3, the N stands for normal conditions or standard European conditions of 0 degrees Celsius and sea level pressure (101.3 kPa).

(1) Inflated value - includes S from TRS [From IPPC Dec 2001 document: "Gaseous sulphur is mainly SO2-S. Usually only very small amounts of H2S is released (usually below 10 mg H2S/Nm3)"]

(2) SO2 Trendline was calculated from information provided even though y-intercept of zero would normally be assumed. Results were positive except for the recovery boiler calculated SO2 value (mg/Nm3) at Enocell, Finland. To avoid a negative calculated result at this facility, the mg/Nm3 value was estimated as a scaled fraction of the kg/ADt ratio of the next lowest SO2 emitting facility (Frovi, Sweden).

(3) Source data values of <0.01, were set to 0.00999 as conservative approximations.

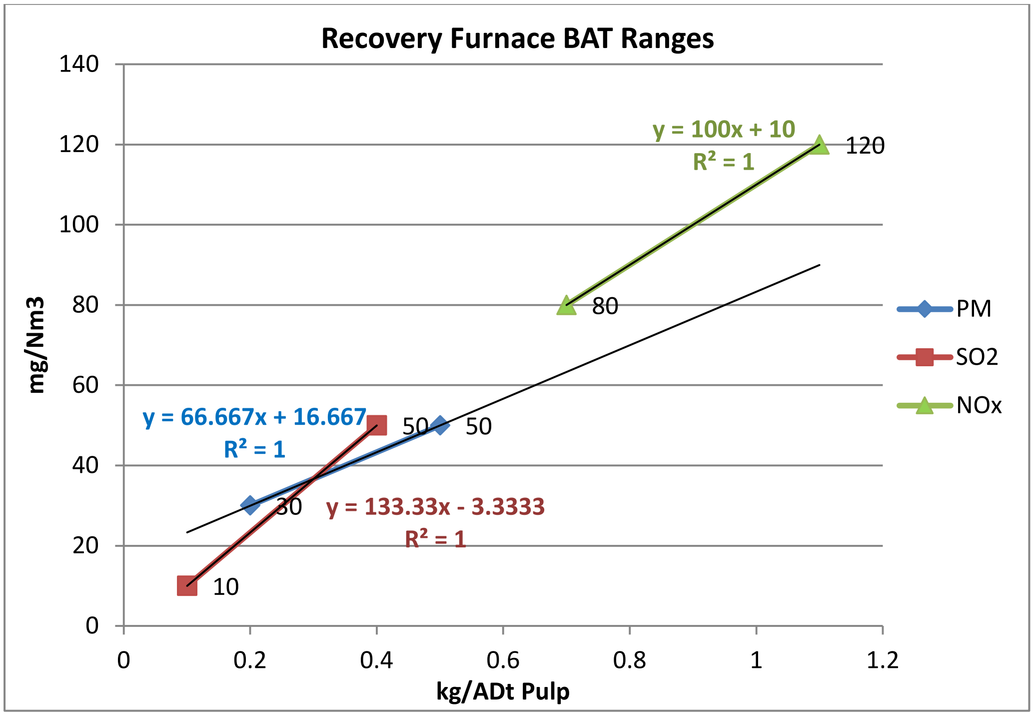
(4) NOx Trendline was calculated from information provided even though y-intercept of zero would normally be assumed. Results were positive except for gas fired lime kiln calculated NOx value (mg/Nm3) at Backhammar, Sweden. To avoid a negative calculated result at this facility, the mg/Nm3 value was estimated as a scaled fraction of the kg/ADt ratio of the next lowest NOx emitting facility (Huelva, Spain).

(5) Source data: Integrated Pollution Prevention Control (ICCP) Reference Document on Best Available Techniques in the Pulp and Paper Industry, December 2001, European Commission.

(6) Whether an individual facility's lime kiln(s) is gas fired or oil fired for NOx, and whether it is oil fired with non-condensable gas incineration (ncg), or without non-condensable gas incineration for SO2 were not known. Ranges of values were calculated for both NOx options and both SO2 options. For NOx values within or close to the oil-fired range, oil was the assumed fuel. For NOx values within or close to the gas-fired range, gas was the assumed fuel. For values in between, both gas and oil fired ranges were provided.

# European Mills Summary (Continued)
## Plot of kg/ADt pulp based on values from IPPC Dec 2001 page 106-108

| Recovery Furnaces BAT Ranges | | | |
|---|---|---|---|
| | PM | SO2 | NOx |
| kg/ADt Pulp | mg/Nm3 | mg/Nm3 | mg/Nm3 |
| 0.1 | | 10 | |
| 0.2 | 30 | | |
| 0.4 | | 50 | |
| 0.5 | 50 | | |
| 0.7 | | | 80 |
| 1.1 | | | 120 |
| m | 66.667 | 133.33 | 100 |
| y(2) | 16.667 | -3.333 | 10 |
| | | | |
| Recovery Furnace Gas flow range | Low | High | |
| m3/Adt | 7,000 | 9,000 | |
| ft3/Adt | 247,203 | 317,832 | |



## European Mills Summary (Continued)
## Plot of kg/ADt pulp based on values from IPPC Dec 2001 page 106-108

| Lime Kiln BAT Ranges | | | | | |
|---|---|---|---|---|---|
| kg/ADt Pulp | PM (mg/Nm3) | SO2 (oil w/o ncg incineration) (mg/Nm3) | SO2 (oil & ncg incineration) (mg/Nm3) | NOx (oil fired) (mg/Nm3) | NOx (gas fired) (mg/Nm3) |
| 0.005 | | 5 | | | |
| 0.01 | | | | | |
| 0.02 | | | | | |
| 0.03 | 30 | 30 | | | |
| 0.05 | 50 | | | | |
| 0.1 | | | 150 | 100 | |
| 0.2 | | | | 200 | |
| 0.3 | | | 300 | | |
| 0.4 | | | | | 380 |
| 0.6 | | | | | 600 |
| 0.7 | | | | | |
| 1.1 | | | | | |
| m | 1000 | 1000 | 750 | 1000 | 1100 |
| y(2) | 0 | 0 | 75 | 0 | -60 |
| | | | | | |
| Lime Kiln Gas flow range | | | | | |
| m3/Adt | 1,000 | | | | |
| ft3/Adt | 35,315 | | | | |

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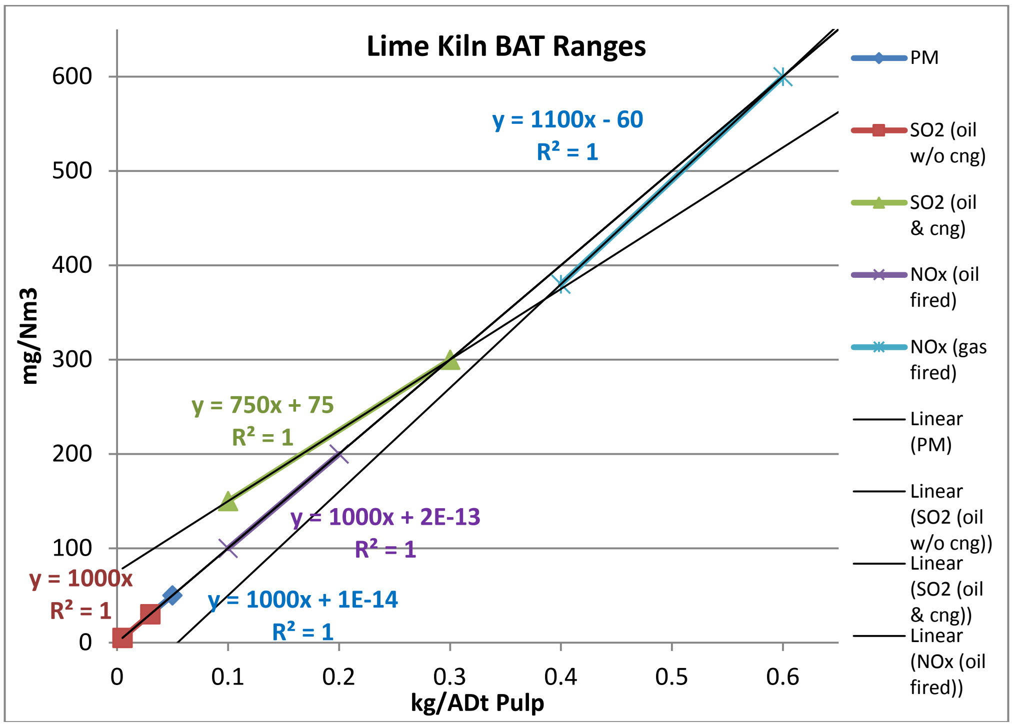

# Section A.2 Permit Limit Information

[This section contains the original format of the pulp mill survey and contains most of the permit limit information found. The full list of pulp mill limits is contained in the main body text of the RACT analysis.]

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **REGIONAL HAZE RACT ANALYSIS - SUPPORTING MATERIAL** | | | | |
| | | | | **Pulp & Paper Mills** | | | |
| | | | **Recovery Furnace and Lime Kiln Emission Limits and Rules** | | | | |
| **State** | **Facility/ Unit** | **Pollutant** | **BACT** | **BACT Demonstrated in Practice? Yes/No (reference & date)** | **RACT** | ***Summary of Other Rules (BART, LAER, NSPS, MACT, State rules, etc.)*** | **Comments/Notes** |
| **Louisiana** | **Port Hudson Operations Georgia-Pacific Consumer Operations, LLC; Zachary, East Baton Rouge Parish** | | | | | | State facility ID #:2617 |
| | Recovery Furnace No 1. (2.81* MM lbs/day BLS) | PM/ PM10: | 0.025 gr/dscf; 42.11 lbs/hr. ESP | Yes (Source test; Sept 19-20, 2012) | NA | *PM<=4.0 lbs/equiv pulp ton :* | *3.32 MM lbs/day max; Limit for combined furnaces = 1.216 MM tpy |
| | | | | | | **PM<=0.044 gr/dscf@8%O2: NSPS 40CFR60.282 subpart BB. NESHAP 40CFR63.862 MM* | *Permit specifies this limit for PM10 (not PM), both CFRs however list the limit for PM (not PM10). |
| | | NOx: | 112 ppmv @8% O2; 156.20 lbs/hr. GED, PCT | | NA | *NA* | |
| | | SO2: | 120 ppmv @8% O2: 5.88 lbs/hr | Stack test results not found | NA | *<=2000 ppmv @ STP: LAC 33:III.1503.C* | |
| | Recovery Furnace No 2. (3.96* MM lbs/day) | PM/ PM10: | 0.025 gr/dscf; 64.57 lbs/hr. ESP | Yes (Source test; Sept 19-20, 2012) | NA | *PM<=4.0 lbs/equiv pulp ton : LAC 33:III.2301.D.1.a* | *4.6 MM lbs/day max; Limit for combined furnaces = 1.216 MM tpy |
| | | | | | | **PM<=0.044 gr/dscf@8%O2: NSPS 40CFR60.282 subpart BB. NESHAP 40CFR63.862 MM* | *Permit specifies this limit for PM10 (not PM), both CFRs however list the limit for PM (not PM10). |
| | | NOx: | 112 ppmv @8% O2; 216.45 lbs/hr. GED, PCT. | | NA | *NA* | |
| | | SO2: | 120 ppmv @8% O2: 7.86 lbs/hr | Stack test results not found | NA | *<=2000 ppmv @ STP: LAC 33:III.1503.C* | |
| | Lime Kiln No. 1 (340 TCaO/day) | PM/ PM10: | 0.05 gr/dscf; 25.76 lbs/hr; wet scrubber | Yes, w/ replacement high dp scrubber (3/4/2010 test); [Not with orig AirPol H-K scrubber using pet coke per 8/12/2005 ltr] | NA | *PM<=1.0 lbs/equiv pulp ton ("subsumed by BACT"): LAC 33:III.2301.D.1.c* | EPA allowed violation to go unfined due to hurricane Rita (post Katrina) natural gas ration. EPA required the extra 8.6 tons PM that were emited due to burning pet coke to be mitigated. Issued deadline for new scrubber. |
| | | | | | | **PM<=0.066 gr/dscf@10%O2: NSPS 40CFR60.282* | *Listed as 0.15 g/dscm in both CFRs cited. Difference in English units (0.066 gr/dscf vs 0.064 gr/dscf) assumed to be rounding error. Also, Permit specifies this limit for PM10 (not PM), both CFRs however apply the limit for PM (not PM10). |
| | | | | | | **PM<=0.064 gr/dscf@10%O2: NESHAP 40CFR63.862 MM* | |
| | | NOx: | 48.78 lbs/hr; GED* & PCT* | NA | NA | *NA* | *GED = Good Equipment Design; *PCT = Proper Combustion Techniques |
| | | SO2: | 3.26 lbs/hr: Using wet scrubber and mud washing | NA | NA | *NA* | |
| | Lime Kiln No. 2 (340 TCaO/day) | PM/ PM10: | 0.033 gr/dscf; 20.45 lbs/hr; ESP + wet scrubber | Yes (GP ltr 8/12/2005) | NA | *PM<=1.0 lbs/equiv pulp ton: LAC 33:III.2301.D.1.c* | |
| | | | | | | **PM<=0.066 gr/dscf@10%O2: NSPS 40CFR60.282* | *Listed as 0.15 g/dscm in both CFRs cited. Difference in English units (0.066 gr/dscf vs 0.064 gr/dscf) assumed to be rounding error. Also, Permit specifies this limit for PM10 (not PM), both CFRs however apply the limit for PM (not PM10). |
| | | | | | | **PM<=0.064 gr/dscf@10%O2: NESHAP 40CFR63.862 MM* | |
| | | NOx: | 38.75 lbs/hr; GED* & PCT* | NA | NA | *NA* | *GED = Good Equipment Design; *PCT = Proper Combustion Techniques |
| | | SO2: | 2.59 lbs/hr: Using wet scrubber and mud washing | NA | NA | *NA* | |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Maine** | **Red Shield Acquisition LLC (formerly GP), Old Town, Maine, Penobscot County** | | | | | : | |
| | #4 Recovery Boiler (2.57 MM lb/day black LS; 375 MMBtu/hr #6, #2, and/or diesel fuel) | PM: | *0.028 gr/dscf; ; **BPT(for PM and PM10): 34.3 lb/hr BLS, 37.4 lb/hr oil. Flakt dry bottom two field ESP (compliance obtained with just 1 field) | Yes. No current BACT (or RACT) non-demonstration issues in state for recovery furnaces and lime kilns per Eric Kennedy of MDEP (11/27/2012 conversation with Gary Huitsing of WA State Dept of Ecology). | NA | *<=4.0 lbs/equiv pulp ton; : CMR 06-096.105.(2)* | *Alternative to 0.044 gr/dscf allowed per MACT rule. **Best Practical Treatment (BPT) means that method which controls or reduces emissions of regulated pollutants to the lowest possible level considering: then existing state of technology, effectiveness of available alternatives for reducing emissions from the source being considered, and economic feasibility for the type establishment involved. |
| | | | | | | *<=*0.044 gr/dscf@8%O2 : NSPS 40CFR60.282 subpart BB (NA due to cost); NESHAP 40CFR63.862 MM* | |
| | | | | | | *0.3 lbs/MMBtu : CMR 06-096.103(2)(A)(4); [incorrect ref: should be CMR 06-096.103(2)(A)(3)(b)]* | |
| | | NOx: | May 8, 1996 RACT appears to have replaced previous BACT determinations. **BPT: 154.4 lb/hr BLS, 182.2 lb/hr oil. | | 120 ppmv wet@8% O2 or 12%CO; *150 ppmv | *RACT: CMR 06-096.138.3.C.1* | *From State rule referenced in Permit. (120 ppm wet converted to dry basis). **(BPT = see definition above) |
| | | SO2: | **BPT: 100 ppm; 143 lb/hr BLS, 196.5 lb/hr oil. | | NA | *NA* | **(BPT = see definition above) |
| | Lime Kiln System (64 MMBtu/hr) | PM: | *0.13 gr/dscf; variable throat wet venturi scrubber. **BPT(for PM and PM10): 32.9 lb/hr. | Yes. No current BACT (or RACT) non-demonstration issues in state for recovery furnaces and lime kilns per Eric Kennedy of MDEP (11/27/2012 conversation with Gary Huitsing of WA State Dept of Ecology). | NA | *<=1.0 lbs/equiv pulp ton: CMR 06-096.105.(2)* | *Alternative to 0.064 gr/dscf allowed per MACT rule. **(BPT = see definition above) |
| | | | | | | *PM<=*0.064 gr/dscf@10%O2 : NSPS 40CFR60.282; NESHAP 40CFR63.862 MM* | |
| | | NOx: | May 8, 1996 RACT appears to have replaced previous BACT determinations. **BPT: 36.0 lb/hr. | | 120 ppmv wet@10 %O2; or *170 | *RACT: CMR 06-096.138.3.E.1* | **(BPT = see definition above) |
| | | SO2: | **BPT: 7.1 lbs/hr (emission concentration not provided); variable throat wet venturi scrubber. | | NA | *NA* | **(BPT = see definition above) |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| **North Caro** | **KapStone Kraft Paper Corporation, Roanaoke Rapids, North Carolina, Halifax County** | | | | : | |
| | No. 7 Recovery Furnace | PM: | 0.021 gr/dscf @8% O2; 144 tpy per consecutive 12-month period; ESP* | Yes, per Air Permit Review accompanying Permit (No. 01649T53) | NA | *<=3.0 lbs/equiv pulp ton; : 15A NCAC 2D.0508* | *Single stage, cold side 140k ft2 plate area. |
| | | | | | | *<=*0.044 gr/dscf@8%O2 : NSPS 40CFR60.282 subpart BB; 15A NCAC 2D.0524* | |
| | | NOx: | 100 ppm @8%O2 (30-day rolling avg); 626 tpy (per 12-month consecutive period) | | NA | : | |
| | | SO2: | 75 ppm @8%O2 (annual rolling avg); 110 ppm @8%O2 (3-hr avg); 571 tpy per consecutive 12-month period | | NA | *2.3 lbs/MMBtu : 15A NCAC 2D.0516* | |
| | Lime Kiln System | PM: | 0.14 gr/dscf @10%O2; Variable throat wet venturi scrubber. | Yes, per Air Permit Review accompanying Permit (No. 01649T53) | NA | *<=0.5 lbs/equiv pulp ton: 15A NCAC 2D.0508* | |
| | | | | | | : | |
| | | NOx: | NA | | | : | |
| | | SO2: | Variable throat wet venturi scrubber. | | NA | *2.3 lbs/MMBtu : 15A NCAC 2D.0516* | |

## Section A.2 Permit Limit Information (Continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| **Alabama** | **ALABAMA RIVER CELLULOSE LLC (PKA: ALABAMA RIVER PULP MILL CO INC); PO BOX 301463 MONTG(** | | | | | |
| | No. 1 Recovery Boiler (2,600 tons dry BLS/day capacity) | PM: | 0.025 gr/dscf @8%O2; 74 lb/hr; two ESPs in parallel | Yes, based on stack tests: 5/24/20012 | NA | *<=4.0 lbs/equiv pulp ton; : 335-3-4-.07.2.a* |
| | | | | | | *<=0.044 gr/dscf@8%O2: NSPS 40CFR60.282 subpart BB. NESHAP 40CFR63.862 MM* |
| | | | | | | *0.1 lbs/MMBtu : Not provided* |
| | | NOx: | 90 ppmv @8% O2; 223 lb/hr | | NA | *0.3 lbs/MMBtu : Not provided* |
| | | SO2: | 100 ppmv @8% O2; 345 lb/hr | | NA | *0.8 lbs/MMBtu : Not provided* |
| | No. 2 Recovery Boiler (3,200 tons dry BLS/day capacity) | PM: | 0.025 gr/dscf @8%O2; 77 lb/hr; ESP | Yes, based on stack tests: 4/12/20012; 2/29/20012 | NA | *<=4.0 lbs/equiv pulp ton; : 335-3-4-.07.2.a* |
| | | | | | | *<=0.044 gr/dscf@8%O2: NSPS 40CFR60.282 subpart BB. NESHAP 40CFR63.862 MM* |
| | | | | | | *0.1 lbs/MMBtu : Not provided* |
| | | NOx: | 75 ppmv @8% O2; 192.7 lb/hr | | NA | *NA* |
| | | SO2: | 100 ppmv @8% O2; 357.3 lb/hr (BLS) 0.3 lb/MMBtu (oil) | | NA | *0.3 lbs/MMBtu : Not provided* |
| | No. 1 Lime Kiln (420 tons/day as CaO capacity) | PM: | 0.035 gr/dscf @10%O2(gas) and 14.7 lb/hr; 0.064 gr/dscf @10%O2 (oil/CTO/pet coke) and 24.6 lb/hr; venturi scrubber | Yes, based on stack tests: 5/24/2007; 5/25/2007 | NA | *<=1.0 lbs/equiv pulp ton: 335-3-4-.07.2.c* |
| | | | | | | *PM<=0.066 gr/dscf@10%O2: NSPS 40CFR60.282* |
| | | | | | | *PM<=0.064 gr/dscf@10%O2: NESHAP 40CFR63.862 MM* |
| | | NOx: | 175 ppmv @10%O2 and 58.9 lb/hr | | NA | *NA* |
| | | SO2: | 50 ppmv @10% O2 and 23.3 lb/hr; venturi scrubber | | NA | *NA* |
| | No. 2 Lime Kiln (540 tons/day as CaO capacity) | PM: | 0.035 gr/dscf @10%O2(gas) and 14.6 lb/hr; 0.064 gr/dscf @10%O2 (oil/CTO/pet coke) and 29.2 lb/hr; ESP | Yes, based on stack tests: 4/3/20012 | NA | *<=1.0 lbs/equiv pulp ton: 335-3-4-.07.2.c* |
| | | | | | | *PM<=0.066 gr/dscf@10%O2: NSPS 40CFR60.282* |
| | | | | | | *PM<=0.064 gr/dscf@10%O2: NESHAP 40CFR63.862 MM* |
| | | NOx: | 100 ppmv @10%O2 and 36.3 lb/hr | | NA | *NA* |
| | | SO2: | 50 ppmv @10% O2 and 25.3 lb/hr | | NA | *NA* |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Florida** | **Palatka Mill; Georgia-Pacific Consumer Operations LLC, Palatka FL, Putnam County** | | | | | *:* | |
| | No.4 Recovery Boiler (210,000 lbs/hr black LS; 1345 MMBtu/hr) | PM: | 0.030 gr/dscf @8% O2; 75.6 lb/hr; ULSD=15ppmw; ESP (12 fields*). | Could not find testing data, but according to website, the facility passed the most recent 5-yr compliance inspection on 9/5/2012. | NA | *<=3 lbs/3000 lbs BLS fed; : 62-296.404(2)a* | * ESP has two chambers of 6 fields each. Tube replacement considerations. |
| | | | | | | *:* | |
| | | | | | | *:* | |
| | | NOx: | 80 ppmvd @8% O2 and 168.5 lb/hr. | | NA | *NA* | |
| | | SO2: | 100 ppmvd @8% O2; 292.8 lbs/hr (cap = 153.9 tpy). | | NA | *NA* | |
| | No. 4 Lime Kiln (41.5 tons/hr lime mud solids; 19.4 tons quicklime per hr) | PM: | 0.55 lb/ton lime mud solids; 22.9 lb/hr; venturi scrubber. | | NA | *NA* | 8/21/2009 FDEP authorization to install dual orifice implingement tray and chevron mist eliminator in scrubber separator tank of No. 4 lime kiln. Purpose: to improve performance and pm removal efficiency of scrubber. Could not find information indicating noncompliance prior to this. |
| | | | | | | *:* | |
| | | NOx: | 140 ppmvd @10% O2 and 52.4 lb/hr | | NA | *NA* | |
| | | SO2: | 16.9 ppmvd @10%O2 and 9.1 lb/hr; venturi scrubber. | | NA | *NA* | |
| **Mississipp** | **Weyerhaeuser NR Company, Columbus Cellulose Fibers, Columbus, MS, Lowndes County** | | | | | *:* | |
| | Recovery Boiler-AA-100; (6.3 MM lbs BLS/day) | PM/ PM10: | 0.023 gr/dscf @8% O2; not to exceed 93 lbs/hr and 407.3 tpy; ESP. | Information not provided on state website | NA | *PM<=4.0 lbs/equiv pulp ton; : APC-S-1 Section 3.5* | |
| | | | | | | *E(PM)=0.08808*I-0.1667: E=emission limit(lbs/MMBTU/hr); I=heat input(MMBTU/hr): APC-S-1 Section 3.4(a)(2);* | |
| | | | | | | *PM<=0.044 gr/dscf@8%O2: NSPS 40CFR60.282 subpart BB. NESHAP 40CFR63.862 MM* | |
| | | NOx: | 80 ppmvd @8% O2 not to exceed 272.6 lbs/hr and 1193.9 tpy. | | NA | *NA* | |
| | | SO2: | 200 ppmvd @4% O2; not to exceed 724.2 lbs/hr and 3172.1 tpy. | | NA | *4.8 lbs/MMBTU [*0.5 lb/MMBTU]: APC-S-1 Section 4.1(a) [*NSPS 40CFR60.42b(d) subpart Db]* | *Applies for oil other than very low sulfur oil |
| | Lime Kiln-AA-110 (420 tons per day) | PM/ PM10: | 0.033 gr/dscf @10% O2; not to exceed 12.67 lbs/hr and 55.5 tpy; ESP. | | NA | *PM<=*0.067 gr/dscf@10%O2; **0.13 gr/dscf@10%O2: NSPS 40CFR60.282* | *Applies when burning gaseous fossil fuel |
| | | | | | | *PM<=**0.064 gr/dscf@10%O2: NESHAP 40CFR63.862 MM* | |
| | | | | | | *E(PM)=4.1*p0.67: APC-S-1 Section 3.6(a)* | E=emission limit(lbs/hr); p=process weight input rate(tph) |
| | | NOx: | 300 ppmvd @3.6% O2 not to exceed 60.9 lbs/hr and 266.7 tpy. | | NA | *NA* | |
| | | SO2: | *50 ppmvd @10% O2; not to exceed 22.42 lbs/hr and 98.2 tpy. | | NA | *500 ppmv : APC-S-1 Section 4.2(a)* | *When controlling NCG in lieu of the NCG incinerator, 450 ppmv@7%O2 not to exceed 110 lbs/hr and 98.2 tpy |

# Section A.2 Permit Limit Information (Continued)

| Georgia | Weyerhaeuser Company - Port Wentworth Mill, Port Wetworth, GA, Chatham County | | | | | : | |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | No. 3 Recovery Boiler with two stacks | PM | East and West ESP. (see comments regarding emissions) | 11/13/2000 peformance test results show emissions with less than 100% of allowable PM and NOx for the Recovery Boiler. Test results for SO2 and Lime kiln not found on state website. | NA | *<=0.044 gr/dscf@8%O2: NSPS 40CFR60.282(a)(1)(i); NESHAP 40CFR63.862 (a)(1)(i)(A)* | |
| | | | | | | *< 47 lbs/hr: 40CFR52.21 (PSD)* | PSD limit: "The facility has accepted the following limits under PSD." |
| | | | | | | *(a) E=4.1*p0.67;<br>(b) E=55*P0.11- 40: Equipment SIP Rule Standards: 391-3-1-.02(2)(e)1(i); E=emission limit(lbs/hr);<br>p=process weight input rate(tph) excluding moisture.<br>(a) for p <= 30 tpy;<br>(b) for p > 30tpy:* | |
| | | NOx: | | | NA | *174.3 lbs/hr: Avoidance of 40CFR52.21 (PSD)* | PSD avoidance:<br>"The facility has accepted the following limits to avoid PSD review." |
| | | SO2: | | | NA | *< *200 lbs/hr @8%O2 : *(see note)* | PSD limit: "The facility has accepted the following limits under PSD."<br>*Previously = 500 lbs/hr until 12/23/2009; The 500 lbs/hr limit was based on 40CFR52.21; the 200 lbs/hr limit was adapted to eliminate need to convert CEMS data to lbs/hr value. |
| | | | | | | . | |
| | No. 2 Lime Kiln | PM | ESP. (see comments regarding emissions) | | NA | *PM<=0.064 gr/dscf@10%O2: NSPS 40CFR60.282;<br>NESHAP 40CFR63.862;<br>40CFR52.21* | PSD limit: "The facility has accepted the following limits under PSD." |
| | | | | | | *(a) E=4.1*p0.67;<br>(b) E=55*P0.11- 40: Equipment SIP Rule Standards: 391-3-1-.02(2)(e)1(i)* | E=emission limit(lbs/hr);<br>p=process weight input rate(tph) excluding moisture.<br>(a) for p <= 30 tpy;<br>(b) for p > 30tpy: |
| | | NOx: | | | NA | *NA* | |
| | | SO2: | | | NA | *49.6 lbs/hr: 40CFR52.21 (PSD)* | PSD limit: "The facility has accepted the following limits under PSD." |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Georgia** | **Georgia-Pacific Cedar Springs LLC, Cedar Springs, GA, Early County** | | | | | *:* | |
| | Recovery Boiler No. 1 | PM: | *0.030 gr/dscf @8%O2<br><br>ESP. | Yes.<br>Performance test results (year 2000):<br>0.0151 gr/drsc @8%O2 | NA | **PM<=0.030 gr/dscf @8% O2: 40CFR52.21; NESHAP 40CFR63.862; NSPS 40CFR Subpart BB subsumed* | MACT MM limit;<br>*PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." "This is the same as the PSD BACT limit." |
| | | | | | | *PM<= 46 lbs/hr:* | PSD limit: "The facility is a major source under PSD. The facility is |
| | | NOx: | | | NA | *154 lbs/hr;<br>0.2 lbs MMBtu heat input:* | PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." |
| | | SO2: | | | NA | *< 300 ppm@8%O2;<br>535 lbs/hr:* | PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." |
| | Recovery Boiler No. 2 | PM | *0.030 gr/dscf @8%O2<br><br>ESP. | Yes.<br>Performance test results (year 2000):<br>0.0114 gr/drsc @8%O2 | NA | **PM<=0.030 gr/dscf @8% O2: 40CFR52.21; NESHAP 40CFR63.862; NSPS 40CFR Subpart BB subsumed* | MACT MM limit;<br>*PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." "This is the same as the PSD BACT limit." |
| | | | | | | *PM<=46 lbs/hr:* | PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." |
| | | NOx: | | | NA | *154 lbs/hr;<br>0.2 lbs MMBtu heat input:* | PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." |
| | | SO2: | | | NA | *< 300 ppm@8%O2;<br>535 lbs/hr:* | PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." |
| | Recovery Boiler No. 3 | PM | See NESHAP limit<br><br>ESP. | Yes.<br>Performance test results (year 2000):<br>0.0066 gr/drsc @8%O2 | NA | *PM<=0.024 gr/dscf @8% O2: NESHAP 40CFR63.862* | Georgia rule subsumed by listed NESHAP. |
| | | | | | | *PM<= 49.7 lbs/hr:* | PSD limit: "The facility is a major source under PSD. The facility is subject to the following PSD limits." |
| | | | | | | *:* | |
| | | NOx: | | | NA | *:* | |
| | | SO2: | | | NA | **350 ppmvd @8%O2<br>(Intall CEMS): 40CFR Part 51 Appendix Y-BART* | *When firing black liquor for complete 24-hr block period. |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Georgia** | **Georgia-Pacific Cedar Springs LLC, Cedar Springs, GA, Early County** | | | | | : | |
| | Lime Kiln No. 1; (250 CaO tpd - unchanged per LK2 modification) | PM/ PM10 | See comments regarding emission limits listed in site Permit;<br><br>Venturi Scrubber | Yes. Performance test results (year 2000): 0.0399 gr/drsc @10%O2 | NA | *PM<=0.064 gr/dscf @10% O2: NESHAP 40CFR63.862* | PSD limit: "The facility has accepted the following limits under PSD." Georgia rule subsumed by listed NESHAP. |
| | | | | | | *PM<=17.62 lbs/hr; PM10<=15.18 lbs/hr: Avoidance of 40CFR52.21, 40CFR52.21 BACT subsumed* | PSD avoidance: "The facility has accepted the following limits to avoid PSD review." "PM emissions were limited to 20 lbs/hr. The limit was subsumed by more stringent PSD avoidance limits for PM/PM10." |
| | | NOx: | | | NA | *14.06 lbs/hr: Avoidance of 40CFR52.21* | PSD avoidance: The facility has accepted the following limits to avoid PSD review. |
| | | SO2: | Venturi Scrubber | | NA | *13.54 lbs/hr: Avoidance of 40CFR52.21, 40CFR52.21 BACT subsumed* | PSD avoidance: "The facility has accepted the following limits to avoid PSD review." "SO2 emissions were limited to 113 lbs/hr. The limit was subsumed by a more stringent PSD avoidance limit. |
| | | | | | | | |
| | Lime Kiln No. 2 (Previous capacity of 250 tpd CaO increased to 300 tpd due to preheating via new lime mud flash dryer per 4/18/2007 Permit) | PM | See comments regarding emission limits listed in site Permit;<br><br>Micro Mist Scrubber [replaced Venturi Scrubber (per 4/18/2007 Permit). Later permit (1/10/2013) refers to venturi scrubber with no explanation (possibly in error using old permit template?)] | Yes for PM Performance test results (year 2000) 0.0354 gr/drsc @10%O2. SO2?, NOx?: No specific reason is provided for replaceing the venturi scrubber by a Micro Mist scrubber in 2007 other than to "control emissions from the No. 2 Lime Kiln". | NA | *PM<=0.056 gr/dscf@10%O2: NESHAP 40CFR63.862* | PSD limit: "The facility has accepted the following limits under PSD." Georgia rule subsumed by listed NESHAP. |
| | | | | | | *PM<=12.28 lbs/hr; PM10<=10.71 lbs/hr: Avoidance of 40CFR52.21, 40CFR52.21 BACT subsumed* | PSD avoidance: "The facility has accepted the following limits to avoid PSD review." "PM emissions were limited to 20 lbs/hr. The limit was subsumed by more stringent PSD avoidance limits for PM/PM10." |
| | | NOx: | | | NA | *16.87 lbs/hr: Avoidance of 40CFR52.21* | PSD avoidance: The facility has accepted the following limits to avoid PSD review. |
| | | SO2: | | | NA | *16.25 lbs/hr: Avoidance of 40CFR52.21, 40CFR52.21 BACT subsumed* | PSD avoidance: "The facility has accepted the following limits to avoid PSD review." "SO2 emissions were limited to 113 lbs/hr. The limit was subsumed by a more stringent PSD avoidance limit. |
| | | | | | | | |
| **Georgia** | **International Paper - Augusta Mill, Augusta, GA, Richmond County** | | | | | : | |
| | | PM | (0.021 gr/dscf @8%O2) | Yes, demonstrated with 0.015 gr/dscf@8%O2 in March 2004 | | : | |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Idaho** | **Clearwater Paper Corporation, Pulp and Paperboard Division (PKA Potlatch), Lewiston Idaho, Nez Perce County** | | | | | | |
| | Recovery Furnace No. 4 | PM | 0.040 gr/dscf @8% O2;<br>ESP | | NA | *PM<=0.044 gr/dscf @8% O2 : NESHAP 40CFR63.862(a)(1)(i)* | PM surrogate for HAPS |
| | | NOx: | NA | NA | NA | *NA* | |
| | | SO2: | NA | NA | NA | *NA* | |
| | Recovery Furnace No. 5 | PM | 0.03 gr/dscf;<br>58 lbs/hr;<br>ESP (97.7% efficient) | | NA | *PM<=0.044 gr/dscf @8% O2 : NSPS 40CFR60.282;<br>NESHAP 40CFR63.862(a)(1)(i)* | PM surrogate for HAPS |
| | | NOx: | 100 ppm;<br>160 lb/hr;<br>700 tpy | | NA | *NA* | |
| | | SO2: | 50 ppm;<br>112 lb/hr;<br>490 tpy | | NA | *NA* | |
| | Lime Kiln No. 3 | PM | 5.2 lb/hr each kiln;<br>(27 tpy combined with Lime Kiln No 4)<br>ESP | | NA | *PM<=0.064 gr/dscf @*10% O2 : NESHAP 40CFR63.862* | PM surrogate for HAPS;<br>*(8% O2 listed in permit - assume 10% per 40CFR862) |
| | | PM10 | 5.2 lb/hr each kiln;<br>(17.3 tpy combined kilns)<br>ESP | | | *:* | |
| | | NOx: | 766 lb/day (each kiln);<br>113 tpy (combined with Lime Kiln No 4) | | NA | *NA* | |
| | | SO2: | 153 lb/3-hr;<br>21 tpy | | NA | *NA* | |
| | Lime Kiln No. 4 | PM | 5.2 lb/hr each kiln;<br>(27 tpy combined with Lime Kiln No 4)<br>ESP | | NA | *PM<=0.064 gr/dscf @*10% O2 : NESHAP 40CFR63.862* | PM surrogate for HAPS;<br>*(8% O2 listed in permit - assume 10% per 40CFR862) |
| | | PM10 | 5.2 lb/hr each kiln;<br>(17.3 tpy combined kilns)<br>ESP | | | | |
| | | NOx: | 766 lb/day (each kiln);<br>113 tpy (combined with Lime Kiln No 4) | | NA | *NA NA* | |
| | | SO2: | 20 ppmv;<br>10.4 lb/3-hr;<br>15 tpy<br>Packed bed scrubber downstream of ESP | | NA | *NA NA* | |

## Section A.2 Permit Limit Information (Continued)

| **Oregon** | **Cascade Pacific Pulp, LLC, Halsey OR, Linn County** | | | | | | |
|---|---|---|---|---|---|---|---|
| | Recovery Furnace RFEU | PM | 2.77 lb/air dired ton (1.38 kg/mt) daily avg;<br><br>1.91 lb/air dired ton (0.95 kg/mt) monthly avg.<br><br>ESP | | NA | *PM<=0.044 gr/dscf @8% O2 NESHAP 40CFR63.862(a)(1)(i)* | PM surrogate for HAPS |
| | | NOx: | NA | NA | NA | *NA NA* | |
| | | SO2: | 180 ppm@8%O2 | NA | NA | *300 ppm @8%O2 OAR 340-234-0240(4)* | |
| | Lime Kiln LKEU | PM | 0.50 lb/air dired ton (0..25 kg/mt) daily avg [NG];<br><br>1.00 lb/air dired ton (0.50 kg/mt) daily avg [oil or pet coke.<br><br>ESP | | NA | *PM<=0.064 gr/dscf @10% O2 NESHAP 40CFR63.862* | |
| | | NOx: | 112 ppm @10%O2 [NG or oil with existing burner];<br><br>185 ppm @10%O2 [with pet coke burner];<br><br>1000 ppm @10%O2 [if different burner installed] | | NA | *NA NA* | |
| | | SO2: | NA | | NA | *NA NA* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Washingto** | **LONGVIEW FIBRE PAPER AND PACKAGING, INC,(dba KapStone) Longview, WA, Cowlitz County.** | | | | | : | |
| | Recovery Furnace 18 | PM/ PM10: | 0.044 gr/dscf @8% O2 1-hr avg; 219 tpy 12-month total; ESP (no scrubber) | | NA | *PM<=0.10 gr/dscf @8% O2 1-hr avg: WAC 173-405-040(1)(a)* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 : NESHAP 40CFR63.862(a)i; 40CFR63.864(d)&(k); 40CFR63.6(h)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 95 ppmdv @8%O2, 24-hr avg; 452 TPY 12 month total | | NA | *:* | |
| | | SO2: | 94 lbs/hr, 3-hr avg; 202 tpy 12 month total | | NA | *500 ppm@8%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |
| | Recovery Furnace 19 | PM/ PM10: | 0.040 gr/dscf @8% O2 1-hr avg; 292 tpy 12-month total; ESP | | NA | *PM<=0.10 gr/dscf @8% O2 1-hr avg: WAC 173-405-040(1)(a)* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 : NESHAP 40CFR63.862(a)i; 40CFR63.864(d)&(k); 40CFR63.6(h)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 95 ppmdv @8%O2, 24-hr avg; 753 TPY 12 month total | | NA | *:* | |
| | | SO2: | 149 lbs/hr, 3-hr avg; 301 tpy 12 month total | | NA | *500 ppm@8%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |
| | Recovery Furnace 22 | PM/ PM10: | 0.027 gr/dscf @8% O2 1-hr avg; 256 tpy 12-month total; ESP | | NA | *PM<=0.10 gr/dscf @8% O2 1-hr avg: WAC 173-405-040(1)(a)* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 : NESHAP 40CFR63.862(a)i; 40CFR63.864(d)&(k); 40CFR63.6(h)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 95 ppmdv @8%O2, 24-hr avg; 735 TPY 12 month total | | NA | *:* | |
| | | SO2: | 295 lbs/hr, 3-hr avg; 301 tpy 12 month total | | NA | *500 ppm@8%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |

## Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Washingto** | **LONGVIEW FIBRE PAPER AND PACKAGING, INC,(dba KapStone) Longview, WA, Cowlitz County.** | | | | | : | |
| | ~~Recovery Furnace 15~~ **(out of service)** | ~~PM/ PM10:~~ | ~~0.033 gr/dscf @8% O2 1-hr avg; 182.5 tpy 12-month total~~; ~~ESP & Scrubber~~ | | ~~NA~~ | *PM<=0.10 gr/dscf @8% O2 1-hr avg: WAC 173-405-040(1)(a)* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 : 40CFR63.862(a)i; 40CFR63.864(d)&(k); 40CFR63.6(h)(SSM exclusion)* | ~~PM surrogate for HAPS~~ |
| | | ~~NOx:~~ | ~~95 ppmdv @8%O2, 24-hr avg;~~ ~~434 TPY 12 month total~~ | | ~~NA~~ | : | |
| | | ~~SO2:~~ | ~~60 ppmdv @8% O2, 3-hr avg; 365 tpy 12 month total~~ | | ~~NA~~ | *500 ppm@8%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |
| | Lime Kiln 3 | PM/ PM10: | 0.030 gr/dscf @10% O2 1-hr avg; 34 tpy 12-month total; *venturi scrubber | | NA | *PM<=0.13 gr/dscf @10% O2, 1-hr avg: WAC 173-405-040(3)(a)* | |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 : NESHAP 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 340 ppmdv @10%O2, 24-hr avg; 238 TPY 12 month total | | NA | : | |
| | | SO2: | *20 ppmdv @10% O2, 3-hr avg; 27 tpy 12 month total; *venturi scrubber | | NA | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | *SO2 is typically controlled using operational practices, but caustic addition to the scrubber water is used when operational conditions vary from establised standards. |
| | Lime Kiln 4 | PM/ PM10: | 0.030 gr/dscf @10% O2 1-hr avg; 35.6 tpy 12-month total; *venturi scrubber | | NA | *PM<=0.13 gr/dscf @10% O2, 1-hr avg: WAC 173-405-040(3)(a)* | |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 : NESHAP 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 340 ppmdv @10%O2, 24-hr avg; 248 TPY 12 month total | | NA | : | |
| | | SO2: | *20 ppmdv @10% O2, 3-hr avg; 28 tpy 12 month total; *venturi scrubber | | NA | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | *SO2 is typically controlled using operational practices, but caustic addition to the scrubber water is used when operational conditions vary from establised standards. |

## Section A.2 Permit Limit Information (Continued)

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|---|---|---|---|---|---|---|---|
| **Washingto** | **LONGVIEW FIBRE PAPER AND PACKAGING, INC,(dba KapStone) Longview, WA, Cowlitz County.** | | | | | : | |
| | Lime Kiln 5 | PM/ PM10: | *0.035 gr/dscf @10% O2 1-hr avg; **0.060 gr/dscf @10% O2 1-hr avg; 69 tpy 12-month total; ESP | | NA | *PM<=*0.067 gr/dscf @10% O2 : NESHAP 40CFR63.862(a)3* | *When firing natural gas. ** When firing oil. |
| | | | | | | *PM<=**0.13 gr/dscf @10% O2, 1-hr avg: NSPS 40 CFR 60.282(a)3* | |
| | | | | | | *PM<=0.13 gr/dscf @10% O2, 1-hr avg: WAC 173-405-040(3)(a)* | For both natural gas and oil |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 : NESHAP 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 275 ppmdv @10%O2, 24-hr avg; 262 TPY 12 month total | | NA | : | |
| | | SO2: | 20 ppmdv @10% O2, 3-hr avg; 28 tpy 12 month total | | NA | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |
| | ~~Lime Kiln 1~~ **(out of service)** | ~~PM/ PM10~~ | ~~0.030 gr/dscf @10% O2 1-hr avg; 20 tpy 12-month total; *venturi scrubber~~ | | ~~NA~~ | *PM<=0.13 gr/dscf @10% O2, 1-hr avg: WAC 173-405-040(3)(a)* | |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 : 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | ~~PM surrogate for HAPS~~ |
| | | ~~NOx:~~ | ~~340 ppmdv @10%O2, 24-hr avg; 139 TPY 12 month total~~ | | ~~NA~~ | : | |
| | | ~~SO2:~~ | ~~*20 ppmdv @10% O2, 3-hr avg; 16 tpy 12 month total~~ | | ~~NA~~ | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | ~~*SO2 is typically controlled using operational practices, but caustic addition to the scrubber water is used when operational conditions vary from establised standards.~~ |
| | ~~Lime Kiln 2~~ **(out of service)** | ~~PM/ PM10:~~ | ~~0.030 gr/dscf @10% O2 1-hr avg; 20 tpy 12-month total; *venturi scrubber~~ | | ~~NA~~ | *PM<=0.13 gr/dscf @10% O2, 1-hr avg: WAC 173-405-040(3)(a)* | |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 : 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | ~~PM surrogate for HAPS~~ |
| | | ~~NOx:~~ | ~~340 ppmdv @10%O2, 24-hr avg; 139 TPY 12 month total~~ | | ~~NA~~ | : | |
| | | ~~SO2:~~ | ~~*20 ppmdv @10% O2, 3-hr avg; 16 tpy 12 month total~~ | | ~~NA~~ | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | ~~*SO2 is typically controlled using operational practices, but caustic addition to the scrubber water is used when operational conditions vary from establised standards.~~ |

# Section A.2 Permit Limit Information (Continued)

| Washingto | Georgia-Pacific Consumers Products (GP Camas) LLC, [PKA: JAMES RIVER CORP] Camas, WA, Clark ( | | | | | : | |
|---|---|---|---|---|---|---|---|
| | No. 3 Kraft Recovery Furnace<br><br>(tpy bubble emission limit for No. 3 and No 4 furnaces combined: PM10<=328; NOx <=609; SO2<=46.2) | PM10: | 0.033 gr/dscf (0.075 g/dscm) @8% O2 avg of 3 one-hr runs;<br><br>ESP-><br>caustic scrubber*-><br>wet heat recovery system | Yes, per support document (SUP DOC 031506FIN.doc) available on Ecology Industrial section website. | NA | *PM<=0.044 gr/dscf (0.10 g/dscm) @8% O2 hourly avg.: NESHAP 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | PM surrogate for HAPS |
| | | | | | | *PM10<=0.10 gr/dscf @8% O2; avg three 1-hr runs: WAC 173-405-040(1)(a)* | *(packed bed, cross-flow AirPol) |
| | | NOx: | 1.3 lb/ton<br>(0.65 kg/Mg) bls fired | | NA | *:* | |
| | | SO2: | 10 ppm @8% O2,<br>24-hr avg; scrubber* | | NA | *:* | |
| | No. 4 Kraft Recovery Furnace<br><br>(tpy bubble emission limit for No. 3 and No 4 furnaces combined: PM10<=328; NOx <=609; SO2<=46.2) | PM10: | 0.033 gr/dscf (0.075 g/dscm) @8% O2 1-hr avg;<br><br>ESP -><br>caustic scrubber -><br>wet heat recovery system | Yes, per support document (SUP DOC 031506FIN.doc) available on Ecology Industrial section website. | NA | *PM<=0.044 gr/dscf (0.10 g/dscm) @8% O2 hourly avg.: NESHAP 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | PM surrogate for HAPS |
| | | | | | | *:* | |
| | | NOx: | 1.5 lb/ton<br>(0.75 kg/Mg) bls fired | | NA | *:* | |
| | | SO2: | 10 ppm @8% O2, 24-hr avg;<br><br>caustic scrubber | | NA | *:* | |
| | Lime Kiln 4 | PM10: | 0.13 gr/dscf (0.295 g/dscm) @10% O2 1-hr avg;<br><br>wet scrubber | Yes, per support document (SUP DOC 031506FIN.doc) available on Ecology Industrial section website. | NA | *PM<=*0.067 gr/dscf<br>(0.152 d/dscm) @10% O2;<br>3 one-hr runs: NESHAP 40CFR63.862(a)3* | *When firing natural gas (88 tpy limit). |
| | | | | | | *PM<=**0.13 gr/dscf<br>(0.295 g/dscm) @10% O2,<br>1-hr avg: NSPS 40 CFR 60.282(a)3* | ** When firing fuel oil (44 tpy limit). |
| | | | | | NA | *PM<=0.064 gr/dscf (0.15 g/dscm) @10% O2 hourly avg: NESHAP 40CFR63.862(a)i; 40CFR63.864(e)&(k); 40CFR63.6(f)(SSM exclusion)* | PM surrogate for HAPS |
| | | NOx: | 234 tpy annual average | | NA | *:* | |
| | | SO2: | 36.1 tpy annual average;<br><br>wet scrubber | | NA | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Washingto** | **Cosmo Specialty Fibers, Inc. (Cosmo) [Previously owned by Weyerhaeuser], Cosmopolis, WA, Grays** | | | | | *:* | |
| | Recovery Boilers No. 1, 2, and 3 (common stack) | PM: | (See Summary of Other Rules)<br><br>multi-cyclones* | Yes, per permit support document (No. 000080-9) available on Ecology Industrial section website. | NA | *0.10 gr/dscf @8% O2;: WAC 173-410-040(2)(a); and<br>Order DE 95AQ-1034 (Attachment B)* | |
| | | | | | | **<=10.0 lbs/hr (4.535 kg/hr) : 40CFR63.862(d) (MACT rule dated February 18, 2003; effective May 19, 2003)* | *Special site specific MACT rule for PM (as a surrogate for HAPS). PM is controlled through hog fuel boiler instead of recovery furnace |
| | | NOx: | NA | | NA | *:* | |
| | | SO2: | (See Summary of Other Rules)<br><br>Absorption tower/<br>venturi absorbers* | | NA | *800 ppm hrly avg.: WAC 173-410-040(d); 40CFR64;<br>and WAC 173-401-615(4)* | *Recovery Boilers No. 1 and 2, flow from multicyclone to an absorption tower;<br>*Recovery Boiler No. 3 flows from multicyclone to dual-purpose cooler/cyclone evaporator, and three venturi SO2 absorbers in |
| | | | | | NA | *360 ppm hrly avg.: Order DE 95AQ-1034 (Attachment B)* | |
| **Washingto** | **Port Townsend Paper Corporation (PTPC), Port Townsend, WA, Jefferson County** | | | | | *:* | |
| | Recovery Furnace | PM: | (See Summary of Other Rules)<br><br>ESP | Yes. Multiple source tests per support document (PTSUPA20.DOC) | NA | *0.08 gr/dscf @8% O2; 1-hr avg: Order 2892-05AQ;<br>and 40 CFR 64.6 (c) for CAM* | |
| | | | | | | *0.10 gr/dscf @8% O2;: WAC 173-405-040* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 hourly avg.: NESHAP 40CFR63.862* | PM surrogate for HAPS |
| | | NOx: | NA | | NA | *:* | |
| | | SO2: | 200 ppm @8%O2 1-hr avg. | Yes. Multiple source tests per support document (PTSUPA20.DOC) | NA | *500 ppm hrly avg.: WAC 173-410-040* | |
| | Lime Kiln | PM: | (See Summary of Other Rules)<br><br>Venturi Scrubber | Yes. Multiple source tests per support document (PTSUPA20.DOC) | NA | *0.13 gr/dscf @10% 02; 1-hr avg.: WAC 173-405-040;<br>and 40 CFR 64.6 (c) for CAM* | |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 hourly avg.: 40CFR63.862* | PM surrogate for HAPS |
| | | NOx: | NA | | NA | *:* | |
| | | SO2: | (See Summary of Other Rules)<br><br>Venturi Scrubber | Yes. Multiple source tests per support document (PTSUPA20.DOC) | NA | *500 ppm hrly avg.: WAC 173-410-040* | |

## Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Washingtor | WestRock, Tacoma, WA, Pierce County | | | | | : | |
| | | | | | | | |
| | Recovery Furnace # 4. | PM: | (See Summary of Other Rules) | | NA | *0.10 gr/dscf @8% O2;: WAC 173-405-040* | |
| | (669 tpy as 12-month rolling avg) | | ESP | | | *PM<=0.044 gr/dscf @8% O2 hourly avg.: NESHAP 40CFR63.862* | PM surrogate for HAPS |
| | | NOx: | 85 ppm @8% O2, 30-day rolling avg; 515 tpy as 12-month rolling avg. | | NA | : | |
| | | SO2: | 150 ppm @8%O2, 30-day rolling avg; 669 tons /yr as 12-month rolling avg. | | NA | *500 ppm hrly avg.: WAC 173-410-040* | |
| | | | | | | | |
| | Lime Kilns #s 1 & 2. | PM: | (See Summary of Other Rules) | Yes, avg of three tests on 7/27/04 and 8/9/04 | NA | *0.13 gr/dscf @10% 02; 1-hr avg.: WAC 173-405-040* | |
| | | | Scrubber | | | *PM<=0.064 gr/dscf @10% O2 hourly avg.: NESHAP 40CFR63.862* | PM surrogate for HAPS |
| | | NOx: | NA | | NA | : | |
| | | SO2: | (See Summary of Other Rules); Scrubber | | NA | *500 ppm hrly avg.: WAC 173-410-040* | |

# Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Washington** | **Weyerhaeuser Longview, WA, Cowlitz County** | | | | | : | |
| | | | | | | | |
| | Recovery Furnace # 10. | PM/ PM10: | 0.027 gr/dscf @8% O2 avg of three 1-hr runs; 0.020 gr/dscf @8% annually; 252 tpy;<br><br>ESP | | NA | *Same as BACT limits: BART = "Current BACT limits in PSD 92-03, Ammendment 4"* | |
| | | | | | | *PM<=0.10 gr/dscf @8% O2;<br>avg of three 1-hr runs: WAC 173-405-040* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 hourly avg.: NESHAP 40CFR63.862* | PM surrogate for HAPS |
| | | NOx: | 140 ppm @ 8% O2, 24 hr avg; 1179 tpy annual avg | | NA | *Same as BACT limit: BART = "Current BACT limit in PSD 92-03, Ammendment 4"* | |
| | | SO2: | 75 ppm @8%O2, 3 hr avg (when not using suppl oil or when using suppl oil and BLS firing rate >150,000 lbs/hr); 500 ppm 3-hr avg (when BLS firing rate <120,000 lbs/hr and firing suppl oil); 586 tpy* | | | *: WAC 173-410-040* | |
| | | | | | | *Same as BACT limit: BART = "Current BACT limit in PSD 92-03, Ammendment 4"* | Quote from *WA State Regional Haze SIP, Dec 2010* (p.L-374) |
| | | | | | NA | *1000 ppm hrly avg.<br>(when firing oil): WAC 173-410-040(11)(b)* | *586 tpy + 0.036 tpy for each hr of NCG incinerator operation. The combined total not to exceed 884 tpy. |
| | | | | | | | |
| | Lime Kiln | PM | *0.035 gr/dscf @10% O2 (gas fired); 0.07 gr/dscf @10% O2 (oil fired);<br><br>ESP | | NA | *PM<=*0.067 gr/dscf @10% O2 : NESHAP 40CFR63.862(a)3; WAC173-405-040* | *When firing natural gas. |
| | | | | | | *PM<=**0.13 gr/dscf @10% O2, 1-hr avg: NSPS 40 CFR 60.282(a)3* | **For liquid fossil fuel |
| | | | | | | *PM<=0.064 gr/dscf @10% O2 : NESHAP 40CFR63.862* | PM surrogate for HAPS |
| | | NOx: | NA | | NA | *NA* | |
| | | SO2: | NA | | NA | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |

# Section A.2 Permit Limit Information (Continued)

| Washingto | Boise White Wallula, WA, Walla Walla County | | | | | : | |
|---|---|---|---|---|---|---|---|
| | No. 2 Recovery Furnace | PM | 0.044 gr/dscf @8% O2<br>1-hr avg;<br>476 lbs/day rolling annual avg;<br><br>ESP | Yes for Particulate (multiple years of data per support document file name: "1/7/2005 Boise Cascade AOP Fact Sheet.doc") | NA | *PM<=0.1 gr/dscf @8% O2 avg three 1-hr tests: WAC 173-400-091* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 : NESHAP 40CFR63.862(a)(1)(i)* | PM surrogate for HAPS |
| | | | | | | *PM<=75 tpy;<br>PM10<=63 tpy PM10<br>(12-month rolling avg);: Order No. DE 02AQ91S-5019;* | |
| | | NOx: | NA | | NA | *NA* | |
| | | SO2: | 5424 lbs/day rolling annual avg | | | *500 ppm@8%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | |
| | | | | | NA | *585 tpy 12-month rolling avg.: Order No. DE 02AQ91S-5019;<br>WAC 173-400-091* | |
| | | | | | | | |
| | No. 3 Recovery Furnace | PM/ PM10: | See Summary of Other Rules (**LAER**)<br><br>ESP | Yes for Particulate (multiple years of data per support document file name: "1/7/2005 Boise Cascade AOP Fact Sheet.doc") | NA | *0.027 gr/dscf @8% O2 avg of three 1-hr runs; 0.021 gr/dscf @8% annually; 186 tpy; : LAER for state non-attainment area NSR (per WAC 173-400-112)* | |
| | | | | | | *PM<=0.1 gr/dscf @8% O2 avg three 1-hr tests: WAC 173-405-040* | |
| | | | | | | *PM<=0.044 gr/dscf @8% O2 : NESHAP 40CFR63.862(a)(1)(i)* | PM surrogate for HAPS |
| | | NOx: | 112 ppmvd @ 8% O2, daily avg; 825 tpy | | NA | *NA* | |
| | | SO2: | *1301 12 month rolling annual avg | | | *500 ppm@8%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | *PSD condition as BACT avoidance limit. |

## Section A.2 Permit Limit Information (Continued)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Washingt(** | **Boise White Wallula, WA, Walla Walla County** | | | | | *:* | |
| | Lime Kiln | PM | 0.12 gr/dscf @10%O2 when firing fuel oil;<br>906 lbs/day for fuel oil;<br>466 lbs/day for natural gas (rolling annual avg)<br><br>Scrubber | Yes for Particulate (multiple years of data per support document file name: "1/7/2005 Boise Cascade AOP Fact Sheet.doc") | NA | *PM<=0.064 gr/dscf @10% O2 : NESHAP 40CFR63.862* | PM surrogate for HAPS |
| | | | | | | *PM<=*0.066 gr/dscf @10% O2 : NESHAP 40CFR60.282* | *When firing natural gas. |
| | | | | | | *PM<=**0.13 gr/dscf @10% O2: NSPS 40 CFR 60.282* | **For liquid fossil fuel |
| | | | | | | *PM<=0.13 gr/dscf @10% O2: WAC 173-405-040(3)* | |
| | | NOx: | NA | | NA | *NA* | |
| | | SO2: | **5 ppmvd @10% O2;*<br>***19 lbs/day*<br>*(rolling annual avg);* | | NA | *500 ppm @10%O2; 1-hr avg.: WAC 173-405-040(11)(a)* | *Order DE 96-AQI078;<br>**PSD-X-77-04 as consolidated in Order DE 96-AQI078 |
| | | | ****1.55% sulfur content in fuel oil;*<br>****15.8 ppmvd at 10%O2 and 147.7 lbs/day (rolling annual avg) for oil above 1 gpm* | | | *:* | ***PSD X-77-04 Amendment 2 |

# Appendix B. Facility Operating and Emissions Data

# Facility Specific Operating and Emissions Data

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Facility: | Port Hudson | Port Hudson | Boise White | Int'l Paper |
| | | | Zachary, LA | Zachary, LA | Int'l Falls MN. | Camti, LA |
| | | Run ID or Unit ID: | 1 | 2 | | 1 |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **30.057** | **30.069** | | **29.926** |
| Pressure (barometric) | Pbar | in HG | 30.09 | 30.10 | | 29.97 |
| Pressure (stack) | Pa | in H20 | -0.45 | -0.42 | | -0.6 |
| Conversion Factor | F1 | inH20/inHg | 13.6 | 13.6 | | 13.6 |
| | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | |
| | f | scf H20/gm | 0.04715 | | | |
| **Total water condensed** | **Vw** | **std ft3** | **11.91010** | **12.46219** | | **13.03316** |
| total impinger wt | | | | | | 276.2 |
| Impinger 1 | Vi | g | 187.6 | 206.2 | | |
| Impinger 2 | Vii | g | 45.2 | 36.3 | | |
| Impinger 3 | Viii | g | 6 | 5.7 | | |
| Impinger 4 | Viv | g | 13.6 | 15.9 | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | 21.85 | 21.85 | | 21.85 |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | | 460 |
| Temp std | Tstd | R (527.67) | 528 | 528 | | 528 |
| Conversion Factor | F2 | g/lb (should be | 453.59 | 453.59 | | 453.59 |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | | 29.92 |
| MW of water | MH20 | lb/lbmole | 18.015 | 18.015 | | 18.015 |
| | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | **45.256** | **46.31779** | | **44.31501** |
| Sample Volume from meter | Vm | dcf | 46.714 | 48.236 | | 45.74 |
| Dry gas mtr cal factor | Y | no units | 0.991 | 0.991 | | 0.996 |
| Meter orifice pressure | dH | in H20 | 1.9021 | 2.0938 | | 1.9075 |
| Dry gas meter temp | Tm | F | 85.7 | 91.0 | | 86.3 |
| | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.20834** | **0.21201** | | **0.22726** |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | **0.20834** | **0.21201** | | **0.22726** |
| same as BWS (because Bws>SBws) | | | | | | |
| | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.560** | **30.506** | | **30.412** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.0559** | **0.0599** | | **0.06** |
| CO2 conc in stack | conc CO2 | %/100 | 0.1451 | 0.1409 | | 0.135 |
| N2 conc in stack | con N2 | %/100 | 0.7991 | 0.7992 | | 0.805 |
| | | | 1.0001 | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | **27.946** | **27.858** | | **27.594** |
| | | | | | | |
| | | | | | | |
| **Stack Area** | **A** | **ft2** | **80.5156** | **80.5156** | **75.9436** | **122.7185** |
| Diameter of stack | D | inches | 121.5 | 121.5 | 118 | 150 |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 |
| | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **53.5051** | **56.2279** | 61.44908 | **70.7728** |
| Pitot tube constant | Kp | test Vs: | 85.49 | 85.49 | | 85.49 |
| Pitot tube calibration coef | Cp | | 0.84 | 0.84 | | 0.84 |
| Stack Gas Velocity Head | dP | in H20 | 0.549 | 0.603 | | 0.963 |
| Stack Gas Velocity Head | dP^.5 | | 0.741 | | | 0.9815 |
| Stack gas temp | Ts | F | 390 | 391.3 | 391 | 372.6667 |
| flow check | | | | | | |
| | | | | | | |
| Stack Ht | Ht | Ft | | | | |
| | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | **258480** | **271633** | 280000 | **521,108** |
| | | **acfs** | | | | |
| Conversion Factor | F5 | sec/min | 60 | 60 | 60 | 60 |
| | | | | | | |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **127691** | **133417** | **145000** | **255,392** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 7661487 | 8005033 | | 15,323,511 |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | | 3600 |
| | Qstd | dscf/min | | | | |
| **Isokinetic percent** | I | % | 103.69 | 101.57 | | 100.07 |
| sample nozzle cross section | An | ft2 | 0.00045869 | 0.00045869 | | 0.00035466 |
| length of sample test | theta | minutes | 60 | | | |
| | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | **8.4** | **9.8** | | **0.6** |
| Mass of part: probe wash | Mp | mg | 3.8 | 4.9 | | 0.4 |
| Mass of part: filter | Mf | mg | 4.6 | 4.9 | | 0.2 |
| | | | | | | |
| Unit Totals (tons per year) | **PM10** | | | | | |
| Unit Totals (tons per year) | **SO2** | | | | | |
| Unit Totals (tons per year) | **NOx** | | | | | |
| Facility Totals (tons per year) | **PM10** | | | | | |
| Facility Totals (tons per year) | **TSP** | | | | | |
| Facility Totals (tons per year) | **SO2** | | | | | |
| Facility Totals (tons per year) | **NOx** | | | | | |

# Facility Specific Operating and Emissions Data (PTPC)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | PTPC | PTPC | PTPC | PTPC | PTPC | PTPC | PTPC |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2003- |
| | | Run ID or Unit ID: | | RF | RF | RF | RF | RF | RF Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** |
| Pressure (barometric) | Pbar | in HG | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | |
| | | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | | |
| | f | scf H20/gm | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | |
| total impinger wt | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R- | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | |
| | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.17** | **0.19** | **0.18** | **0.17** | **0.18** | **0.18** | **0.1783** |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | | |
| | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **29.867** | **29.675** | **30.035** | **29.879** | **29.651** | **29.771** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.112** | **0.128** | **0.098** | **0.111** | **0.13** | **0.12** | **0.1165** |
| CO2 conc in stack | conc CO2 | %/100 | 0.088 | 0.072 | 0.102 | 0.089 | 0.07 | 0.08 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | **27.852** | **27.460** | **27.872** | **27.862** | **27.556** | **27.655** | |
| | | | | | | | | | |
| | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | |
| Diameter of stack | D | inches | 108 | 108 | 108 | 108 | 108 | 108 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **78.1706** | **85.3982** | **96.2632** | **90.7615** | **89.5197** | **70.9399** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 317 | 334 | 371 | 309 | 313 | 302 | 324 |
| flow check | | | **298,380** | **325,968** | **367,440** | | | | |
| | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | |
| | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 298380 | 325968 | 367440 | 346440 | 341700 | 270780 | 325118 |
| | | **acfs** | 4973 | 5432.8 | 6124 | 5774 | 5695 | 4513 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **168,291** | **175,579** | **191,440** | **197,430** | | | 179664 |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 10,097,456 | 10,534,760 | 11,486,413 | | 11,483,24 | 9,231,253 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | |
| length of sample test | theta | minutes | | | | | | | |
| | | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | |
| | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 100 | 75 | 150 | 144 | 139 | 85 | **116** |
| Unit Totals (tons per year) | **SO2** | | 106 | 102 | 196 | 195 | 26 | 4 | **105** |
| Unit Totals (tons per year) | **NOx** | | 178 | 176 | 193 | 185 | 264 | 242 | **206** |
| Facility Totals (tons per year) | **PM10** | | 331 | 301 | 333 | 346 | 340 | 292 | **324** |
| Facility Totals (tons per year) | **TSP** | | 515 | 478 | 514 | 589 | 580 | 512 | **531** |
| Facility Totals (tons per year) | **SO2** | | 351 | 349 | 410 | 287 | 123 | 50 | **262** |
| Facility Totals (tons per year) | **NOx** | | 516 | 544 | 581 | 551 | 565 | 519 | **546** |

# Facility Specific Operating and Emissions Data (PTPC - Continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | PTPC | PTPC | PTPC | PTPC | PTPC | PTPC | PTPC |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2003- |
| | | Run ID or Unit ID: | LK | LK | LK | LK | LK | LK | LK Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | |
| | | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | | |
| | f | scf H20/gm | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | |
| total impinger wt | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | |
| | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.26** | **0.26** | **0.29** | **0.27** | **0.28** | **0.29** | 0.275 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | | |
| | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.131** | **30.119** | **30.179** | **30.264** | **30.348** | **30.492** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.09** | **0.091** | **0.086** | **0.079** | **0.072** | **0.06** | **0.07967** |
| CO2 conc in stack | conc CO2 | %/100 | 0.11 | 0.109 | 0.114 | 0.121 | 0.128 | 0.14 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | **26.981** | **26.972** | **26.652** | **26.956** | **26.894** | **26.873** | |
| | | | | | | | | | |
| | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | |
| Diameter of stack | D | inches | 72 | 72 | 72 | 72 | 72 | 72 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **17.6131** | **15.8448** | **15.8801** | **15.3850** | **16.8704** | **15.5618** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 156 | 155 | 155 | 153 | 155 | 155 | **155** |
| flow check | | | **29,880** | **26,880** | **26,940** | **26,100** | **28,620** | **6,400** | |
| | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | |
| | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 29880 | 26880 | 26940 | 26100 | 28620 | 26400 | |
| | | **acfs** | 498 | 448 | 449 | 435 | 477 | 440 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **18,952** | **17,077** | **16,422** | **16,411** | **17,691** | | |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 1,137,147 | 1,024,639 | 985,294 | 84,664 | 1,061,481 | | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | |
| length of sample test | theta | minutes | | | | | | | |
| | | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | |
| | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 27 | 27 | 20 | 26 | 15 | 23 | **23** |
| Unit Totals (tons per year) | **SO2** | | 1 | 2 | 2 | 1 | 1 | 1 | **1** |
| Unit Totals (tons per year) | **NOx** | | 59 | 59 | 64 | 62 | 34 | 30 | **51** |
| Facility Totals (tons per year) | **PM10** | | 331 | 301 | 333 | 346 | 340 | 292 | **324** |
| Facility Totals (tons per year) | **TSP** | | 515 | 478 | 514 | 589 | 580 | 512 | **531** |
| Facility Totals (tons per year) | **SO2** | | 351 | 349 | 410 | 287 | 123 | 50 | **262** |
| Facility Totals (tons per year) | **NOx** | | 516 | 544 | 581 | 551 | 565 | 519 | **546** |

# Facility Specific Operating and Emissions Data (WestRock)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Facility: | WestRock | WestRock | WestRock | WestRock | WestRock | WestRock |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2005-2009 |
| | | Run ID or Unit ID: | rf | rf | rf | rf | rf | RF AVG |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.247** | **0.228** | **0.25** | **0.229** | **0.231** | 0.237 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.480** | **30.396** | **30.516** | **30.516** | **30.300** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.061** | **0.068** | **0.058** | **0.058** | **0.076** | **0.0642** |
| CO2 conc in stack | conc CO2 | %/100 | 0.139 | 0.132 | 0.142 | 0.142 | 0.124 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | **27.401** | **27.573** | **27.391** | **27.653** | **27.462** | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **153.9380** | **153.9380** | **153.9380** | **153.9380** | **153.9380** | |
| Diameter of stack | D | inches | 168 | 168 | 168 | 168 | 168 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **37.3592** | **37.2358** | **38.5740** | **35.2739** | **37.9179** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 377 | 378 | 383 | 388 | 372 | **380** |
| flow check | | | **345,060** | **343,920** | **356,280** | **325,800** | **350,220** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 345060 | 343920 | 356280 | 325800 | 350220 | **344,256** |
| | | **acfs** | 5751 | 5732 | 5938 | 5430 | 5837 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **163,907** | **167,288** | **167,363** | **156,402** | **170,914** | **165,175** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 9,834,433 | 10,037,276 | 10,041,77 | 9,384,146 | 10,254,84 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 13 | 23 | 46 | 29 | 19 | **26** |
| Unit Totals (tons per year) | **SO2** | | 293 | 238 | 400 | 390 | 110 | **286** |
| Unit Totals (tons per year) | **NOx** | | 291 | 294 | 281 | 303 | 257 | **285** |
| Facility Totals (tons per year) | **PM10** | | 103 | 75 | 117 | 87 | 76 | **92** |
| Facility Totals (tons per year) | **TSP** | | 121 | 94 | 147 | 105 | 87 | **111** |
| Facility Totals (tons per year) | **SO2** | | 378 | 503 | 693 | 635 | 319 | **506** |
| Facility Totals (tons per year) | **NOx** | | 610 | 743 | 708 | 684 | 808 | **711** |

# Facility Specific Operating and Emissions Data (WestRock - Continued)

| | | Facility: | WestRock | WestRock | WestRock | WestRock | WestRock | WestRock |
|---|---|---|---|---|---|---|---|---|
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2005-2009 |
| | | Run ID or Unit ID: | lk 1 | lk1 | lk 1 | lk 1 | lk 1 | LK 1 Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.291** | **0.346** | **0.284** | **0.345** | **0.346** | 0.322 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.900** | **30.696** | **30.612** | **30.636** | **30.384** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.026** | **0.043** | **0.05** | **0.048** | **0.069** | **0.0472** |
| CO2 conc in stack | conc CO2 | %/100 | 0.174 | 0.157 | 0.15 | 0.152 | 0.131 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | **27.151** | **26.308** | **27.034** | **26.282** | **26.104** | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **12.5664** | **12.5664** | **12.5664** | **12.5664** | **12.5664** | |
| Diameter of stack | D | inches | 48 | 48 | 48 | 48 | 48 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **48.3035** | **55.4655** | **47.1894** | **48.5423** | **56.3408** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 157 | 162 | 158 | 156 | 162 | 159 |
| flow check | | | **36,420** | **41,820** | **35,580** | **36,600** | **42,480** | **AVG** |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 36420 | 41820 | 35580 | 36600 | 42480 | 38580 |
| | | **acfs** | 607 | 697 | 593 | 610 | 708 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **22,097** | **23,217** | **21,765** | **20,548** | **23,583** | 22,242 |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 1,325,825 | 1,393,017 | 1,305,917 | 1,232,897 | 1,415,002 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 30 | 19 | 28 | 22 | 19 | 23.6 |
| Unit Totals (tons per year) | **SO2** | | 1 | 3 | 1 | 5 | 8 | 3.6 |
| Unit Totals (tons per year) | **NOx** | | 42 | 42 | 39 | 37 | 54 | 42.8 |
| Facility Totals (tons per year) | **PM10** | | 103 | 75 | 117 | 87 | 76 | **92** |
| Facility Totals (tons per year) | **TSP** | | 121 | 94 | 147 | 105 | 87 | **111** |
| Facility Totals (tons per year) | **SO2** | | 378 | 503 | 693 | 635 | 319 | **506** |
| Facility Totals (tons per year) | **NOx** | | 610 | 743 | 708 | 684 | 808 | **711** |

# Facility Specific Operating and Emissions Data (WestRock - Continued)

| | | Facility: | WestRock | WestRock | WestRock | WestRock | WestRock | WestRock |
|---|---|---|---|---|---|---|---|---|
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2005-2009 |
| | | Run ID or Unit ID: | lk2 | lk2 | lk2 | lk2 | lk2 | LK 2 Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.233** | **0.17** | **0.117** | **0.136** | **0.149** | 0.161 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.504** | **30.672** | **30.720** | **30.432** | **30.492** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.059** | **0.045** | **0.041** | **0.065** | **0.06** | **0.054** |
| CO2 conc in stack | conc CO2 | %/100 | 0.141 | 0.155 | 0.159 | 0.135 | 0.14 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | **27.594** | **28.520** | **29.233** | **28.743** | **28.633** | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **12.5664** | **12.5664** | **12.5664** | **12.5664** | **12.5664** | |
| Diameter of stack | D | inches | 48 | 48 | 48 | 48 | 48 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **26.4993** | **15.9951** | **12.0162** | **11.9366** | **12.7324** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 144 | 133 | 126 | 121 | 129 | 130.6 |
| flow check | | | **19,980** | **12,060** | **9,060** | **9,000** | **9,600** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 19980 | 12060 | 9060 | 9000 | 9600 | 11940 |
| | | **acfs** | 333 | 201 | 151 | 150 | 160 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **13,396** | **8,913** | **7,208** | **7,067** | **7,324** | **8,781** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 803,783 | 534,756 | 432,490 | 423,999 | 439,411 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 6 | 4 | 5 | 4 | 5 | **4.8** |
| Unit Totals (tons per year) | **SO2** | | 1 | 1 | 2 | 2 | 0 | **1.2** |
| Unit Totals (tons per year) | **NOx** | | 1 | 1 | 2 | 2 | 6 | **2.4** |
| Facility Totals (tons per year) | **PM10** | | 103 | 75 | 117 | 87 | 76 | **92** |
| Facility Totals (tons per year) | **TSP** | | 121 | 94 | 147 | 105 | 87 | **111** |
| Facility Totals (tons per year) | **SO2** | | 378 | 503 | 693 | 635 | 319 | **506** |
| Facility Totals (tons per year) | **NOx** | | 610 | 743 | 708 | 684 | 808 | **711** |

# Facility Specific Operating and Emissions Data (Weyerhaeuser)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Facility: | Weyerhaeus | Weyerhaeus | Weyerhaeus | Weyerh | Weyerhae | Weyerhaeus |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2003-2007 |
| | | Run ID or Unit ID: | rf | rf | rf | rf | rf | RF Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.29** | **0.28** | **0.26** | **0.28** | **0.2775** | 0.2775 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.372** | **30.492** | **30.312** | **30.504** | **30.420** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.07** | **0.06** | **0.075** | **0.059** | **0.066** | **0.0660** |
| CO2 conc in stack | conc CO2 | %/100 | 0.13 | 0.14 | 0.125 | 0.141 | 0.134 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **153.9380** | **153.9380** | **153.9380** | **153.938** | **153.9380** | |
| Diameter of stack | D | inches | 168 | 168 | 168 | 168 | 168 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **58.6859** | **55.4314** | **55.5613** | **63.3956** | **63.5300** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 362 | 357 | 373 | 387 | 388 | **373** |
| flow check | | | **542,040** | **511,980** | **513,180** | **585,540** | **586,781** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 542040 | 511980 | 513180 | 585540 | 586800 | **547,908** |
| | | **acfs** | 9034 | 8533 | 8553 | 9759 | 9780 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **247,202** | **238,230** | **240,708** | **262,809** | **263,968** | **250,583** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 14,832,114 | 14,293,830 | 14,442,475 | 15,768, | 15,838,10 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 50 | 45 | 32 | 50 | 40 | **43** |
| Unit Totals (tons per year) | **SO2** | | 26 | 20 | 50 | 42 | 38 | **35** |
| Unit Totals (tons per year) | **NOx** | | 627 | 541 | 483 | 601 | 666 | **584** |
| Facility Totals (tons per year) | **PM10** | | 279 | 196 | 173 | 191 | 89 | **186** |
| Facility Totals (tons per year) | **TSP** | | 375 | 278 | 244 | 211 | na | **277** |
| Facility Totals (tons per year) | **SO2** | | 967 | 1047 | 854 | 719 | 775 | **872** |
| Facility Totals (tons per year) | **NOx** | | 2487 | 2069 | 1959 | 2057 | 2630 | **2,240** |

# Facility Specific Operating and Emissions Data (Weyerhaeuser - Continued)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Facility: | Weyerhaeus | Weyerhaeus | Weyerhaeus | Weyerh | Weyerhae | Weyerhaeus |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2003-2007 |
| | | Run ID or Unit ID: | lk | lk | lk | lk | lk | LK Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | **0.29** | **0.3** | **0.3** | **0.31** | **0.3** | 0.3 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.252** | **30.252** | **30.011** | **30.252** | **30.191** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.08** | **0.08** | **0.1** | **0.08** | **0.085** | **0.0850** |
| CO2 conc in stack | conc CO2 | %/100 | 0.12 | 0.12 | 0.1 | 0.12 | 0.115 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **12.5664** | **12.5664** | **12.5664** | **12.5664** | **12.5664** | |
| Diameter of stack | D | inches | 48 | 48 | 48 | 48 | 48 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **41.1416** | **94.2993** | **67.8000** | **74.3254** | **75.6000** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 388 | 396 | 380 | 390 | 391 | **389** |
| flow check | | | **31,020** | **71,100** | **51,120** | **56,040** | **57,001** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 31020 | 71100 | 51120 | 56040 | 57000 | **53,256** |
| | | **acfs** | 517 | 1185 | 852 | 934 | 950 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **13,713** | **30,699** | **22,493** | **24,019** | **24,756** | **23,136** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 822,791 | 1,841,955 | 1,349,568 | 1,441,1 | 1,485,377 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 88 | 2 | 1 | 9 | 1 | **20** |
| Unit Totals (tons per year) | **SO2** | | 3 | 4 | 12 | 7 | 4 | **6** |
| Unit Totals (tons per year) | **NOx** | | 104 | 100 | 158 | 147 | 135 | **129** |
| Facility Totals (tons per year) | **PM10** | | 279 | 196 | 173 | 191 | 89 | **186** |
| Facility Totals (tons per year) | **TSP** | | 375 | 278 | 244 | 211 | na | **277** |
| Facility Totals (tons per year) | **SO2** | | 967 | 1047 | 854 | 719 | 775 | **872** |
| Facility Totals (tons per year) | **NOx** | | 2487 | 2069 | 1959 | 2057 | 2630 | **2,240** |

# Facility Specific Operating and Emissions Data (GP Camas)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Facility: | GP Camas | GPCamas | GPCamas | GPCam | GPCamas | avg |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2003-2007 |
| | | Run ID or Unit ID: | rf4 | rf4 | rf4 | rf4 | rf4 | RF4 Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.84** | **29.84** | **29.84** | **29.84** | **29.84** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.2 | 0.2 | 0.23 | 0.21 | 0.28 | 0.224 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.372** | **30.372** | **30.372** | **30.372** | **30.312** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.07** | **0.07** | **0.07** | **0.07** | **0.075** | **0.0710** |
| CO2 conc in stack | conc CO2 | %/100 | 0.13 | 0.13 | 0.13 | 0.13 | 0.125 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | |
| Diameter of stack | D | inches | 108 | 108 | 108 | 108 | 108 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **31.9096** | **34.2046** | **30.8407** | **31.3437** | **36.1694** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 139 | 140 | 145 | 143 | 154 | **144** |
| flow check | | | **121,800** | **130,560** | **117,720** | **119,640** | **138,060** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 121800 | 130560 | 117720 | 119640 | 138060 | **125,556** |
| | | **acfs** | 2030 | 2176 | 1962 | 1994 | 2301 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **85,661** | **91,668** | **78,896** | **82,539** | **85,252** | **84,803** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 5,139,642 | 5,500,109 | 4,733,779 | 4,952,3 | 5,115,103 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 74 | 74 | 52 | 50 | 75 | **65** |
| Unit Totals (tons per year) | **SO2** | | 2 | 4 | 3 | 3 | 3 | **3** |
| Unit Totals (tons per year) | **NOx** | | 173 | 166 | 224 | 223 | 251 | **207** |
| Facility Totals (tons per year) | **PM10** | | 174 | 191 | 254 | 233 | 236 | **218** |
| Facility Totals (tons per year) | **TSP** | | 188 | 195 | 259 | 240 | 239 | **224** |
| Facility Totals (tons per year) | **SO2** | | 66 | 151 | 18 | 13 | 21 | **54** |
| Facility Totals (tons per year) | **NOx** | | 772 | 709 | 783 | 765 | 660 | **738** |

# Facility Specific Operating and Emissions Data (GP Camas - Continued)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Facility: | GP Camas | GP Camas | GP Camas | GPCam | GPCamas | avg |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2003-2007 |
| | | Run ID or Unit ID: | rf3 | rf3 | rf3 | rf3 | rf3 | RF3 Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.84** | **29.84** | **29.84** | **29.84** | **29.84** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.22 | 0.18 | 0.21 | 0.2 | 0.19 | 0.2 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | avg of | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.504** | **30.492** | **30.492** | **30.492** | **30.540** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **na** | **0.06** | **0.06** | **0.06** | **0.056** | **0.0590** |
| CO2 conc in stack | conc CO2 | %/100 | na | 0.14 | 0.14 | 0.14 | 0.144 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | **63.6173** | |
| Diameter of stack | D | inches | 108 | 108 | 108 | 108 | 108 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **22.1638** | **25.3076** | **19.8531** | **19.5702** | **19.1300** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 143 | 136 | 144 | 141 | 137 | **140** |
| flow check | | | **84,600** | **96,600** | **75,780** | **74,700** | **73,020** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 84600 | 96600 | 75780 | 74700 | 73020 | **80,940** |
| | | **acfs** | 1410 | 1610 | 1263 | 1245 | 1217 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **57,626** | **69,987** | **52,193** | **52,361** | **52,170** | **56,867** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 3,457,563 | 4,199,205 | 3,131,606 | 3,141,6 | 3,130,220 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 8 | 8 | 9 | 5 | 3 | **7** |
| Unit Totals (tons per year) | **SO2** | | 2 | 2 | 3 | 2 | 2 | **2** |
| Unit Totals (tons per year) | **NOx** | | 138 | 140 | 157 | 102 | 58 | **119** |
| Facility Totals (tons per year) | **PM10** | | 174 | 191 | 254 | 233 | 236 | **218** |
| Facility Totals (tons per year) | **TSP** | | 188 | 195 | 259 | 240 | 239 | **224** |
| Facility Totals (tons per year) | **SO2** | | 66 | 151 | 18 | 13 | 21 | **54** |
| Facility Totals (tons per year) | **NOx** | | 772 | 709 | 783 | 765 | 660 | **738** |

# Facility Specific Operating and Emissions Data (GP Camas - Continued)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Facility: | GP Camas | GP Camas | GP Camas | GPCam | GPCamas | avg |
| | | | 2003 | 2004 | 2005 | 2006 | 2007 | 2003-2007 |
| | | Run ID or Unit ID: | lk | lk | lk | lk | lk | LK Avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.84** | **29.84** | **29.84** | **29.84** | **29.84** | |
| Pressure (barometric) | Pbar | in HG | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | |
| | | | | | | | | |
| **Total water condensed** | **Vwstd** | scf H2) | | | | | | |
| | f | scf H20/gm | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | |
| total impinger wt | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | |
| Impinger 2 | Vii | g | | | | | | |
| Impinger 3 | Viii | g | | | | | | |
| Impinger 4 | Viv | g | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | |
| **Sample Volume** | **Vmstd** | **dscf** | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | |
| | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.35 | 0.32 | 0.39 | 0.4 | 0.41 | 0.374 |
| **Saturation Moisture Fraction@STP** | **SBws** | **(sat vap press)/Ps** | | | | | | |
| same as BWS (because Bws>SBws) | | | | | | | | |
| | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.732** | **30.852** | **30.852** | **30.852** | **30.996** | **AVG** |
| **Oxygen conc in stack** | **conc O2** | **%/100** | **0.04** | **0.03** | **0.03** | **0.03** | **0.018** | **0.0296** |
| CO2 conc in stack | conc CO2 | %/100 | 0.16 | 0.17 | 0.17 | 0.17 | 0.182 | |
| N2 conc in stack | con N2 | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **19.6350** | **19.6350** | **19.6350** | **19.6350** | **19.6350** | |
| Diameter of stack | D | inches | 60 | 60 | 60 | 60 | 60 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **9.7276** | **11.0517** | **9.4729** | **7.7413** | **5.8569** | |
| Pitot tube constant | Kp | test Vs: | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 149 | 150 | 160 | 159 | 158 | **155** |
| flow check | | | **11,460** | **13,020** | **11,160** | **9,120** | **6,900** | |
| | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | |
| | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 11460 | 13020 | 11160 | 9120 | 6900 | **10,332** |
| | | **acfs** | 191 | 217 | 186 | 152 | 115 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **6,441** | **7,643** | **5,782** | **4,655** | **3,469** | **5,598** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 386,459 | 458,577 | 346,916 | 279,304 | 208,130 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | |
| **Isokinetic percent** | I | % | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | |
| length of sample test | theta | minutes | | | | | | |
| | | | | | | | | |
| **Mass of part: combined samples** | **Mn** | **mg** | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | |
| | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 17 | 15 | 18 | 8 | 8 | **13** |
| Unit Totals (tons per year) | **SO2** | | 0 | 1 | 1 | 1 | 1 | **1** |
| Unit Totals (tons per year) | **NOx** | | 83 | 77 | 150 | 132 | 79 | **104** |
| Facility Totals (tons per year) | **PM10** | | 174 | 191 | 254 | 233 | 236 | **218** |
| Facility Totals (tons per year) | **TSP** | | 188 | 195 | 259 | 240 | 239 | **224** |
| Facility Totals (tons per year) | **SO2** | | 66 | 151 | 18 | 13 | 21 | **54** |
| Facility Totals (tons per year) | **NOx** | | 772 | 709 | 783 | 765 | 660 | **738** |

# Facility Specific Operating and Emissions Data (KapStone)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | KaptS | KaptSto | KaptSto | KaptStone | KaptStone | KaptStone | KaptSton | KaptSton |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | rf 18 | rf 18 | rf 18 | rf 18 | rf 18 | rf 18 | rf 18 | RF 18 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.254 | 0.283 | 0.312 | 0.271 | na | 0.244 | 0.255 | 0.26983 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.19** | **30.215** | **30.155** | **30.095** | | **30.011** | **30.071** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.085** | **0.083** | **0.088** | **0.093** | **na** | **0.1** | **0.095** | **0.0907** |
| CO2 conc in stack | conc | %/100 | 0.115 | 0.117 | 0.112 | 0.107 | | 0.1 | 0.105 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **103.8** | **103.868** | **103.868** | **103.8689** | | **103.8689** | **103.8689** | |
| Diameter of stack | D | inches | 138 | 138 | 138 | 138 | 138 | 138 | 138 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **44.08** | **44.4118** | **41.1576** | **49.6395** | | **48.8789** | **44.9028** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 243 | 256 | 244 | 247 | na | 206 | 237 | **239** |
| flow check | | | **274,7** | **276,780** | **256,500** | **309,360** | | **304,620** | **279,840** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | **214** | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 27474 | 276780 | 256500 | 309360 | na | 304620 | 279840 | **283,640** |
| | | **acfs** | 4579 | 4613 | 4275 | 5156 | na | 5077 | 4664 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **153,9** | **146,344** | **132,354** | **168,425** | **na** | **182,574** | **157,931** | **156,927** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 9,236, | 8,780,6 | 7,941,2 | 10,105,492 | na | 10,954,465 | 9,475,856 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 3 | 2 | 3 | 6 | na | 4 | 6 | **4** |
| Unit Totals (tons per year) | **SO2** | | 17 | 12 | 10 | 9 | na | 12 | 13 | **12** |
| Unit Totals (tons per year) | **NOx** | | 125 | 132 | 159 | 141 | na | 72 | 132 | **127** |
| Facility Totals (tons per year) | **PM10** | | 163 | 121 | 114 | 76 | 81 | 87 | 81 | **103** |
| Facility Totals (tons per year) | **TSP** | | 176 | 132 | 119 | 81 | 86 | 91 | 85 | **110** |
| Facility Totals (tons per year) | **SO2** | | 239 | 274 | 275 | 281 | 201 | 239 | 202 | **244** |
| Facility Totals (tons per year) | **NOx** | | 1493 | 1541 | 1488 | 1440 | 1164 | 1301 | 1372 | **1,400** |

# Facility Specific Operating and Emissions Data (KapStone - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | KaptS | KaptSto | KaptSto | KaptStone | KaptStone | KaptStone | KaptSton | KaptSton |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | rf19 | rf19 | rf19 | rf19 | rf19 | rf19 | rf19 | RF 19 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.287 | 0.287 | 0.281 | 0.297 | 0.265 | 0.249 | 0.265 | 0.27586 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.31** | **30.312** | **30.240** | **30.215** | **30.131** | **30.095** | **30.095** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.075** | **0.075** | **0.081** | **0.083** | **0.09** | **0.093** | **0.093** | **0.0843** |
| CO2 conc in stack | conc | %/100 | 0.125 | 0.125 | 0.119 | 0.117 | 0.11 | 0.107 | 0.107 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **143.1** | **143.138** | **143.138** | **143.1388** | **143.1388** | **143.1388** | **143.1388** | |
| Diameter of stack | D | inches | 162 | 162 | 162 | 162 | 162 | 162 | 162 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **36.85** | **37.2436** | **39.8424** | **45.4664** | **40.6598** | **42.6858** | **41.4982** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 246 | 247 | 251 | 253 | 242 | 255 | 229 | **246** |
| flow check | | | **316,5** | **319,860** | **342,180** | **390,480** | **349,200** | **366,600** | **356,400** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | **198** | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 31650 | 319860 | 342180 | 390480 | 349200 | 366600 | 356400 | **348,746** |
| | | **acfs** | 5275 | 5331 | 5703 | 6508 | 5820 | 6110 | 5940 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **168,7** | **170,319** | **182,704** | **203,282** | **193,045** | **203,311** | **200,743** | **188,882** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 10,12 | 10,219, | 10,962, | 12,196,908 | 11,582,695 | 12,198,643 | 12,044,56 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 10 | 33 | 13 | 6 | 16 | 11 | 6 | **14** |
| Unit Totals (tons per year) | **SO2** | | 9 | 15 | 6 | 20 | 41 | 20 | 14 | **18** |
| Unit Totals (tons per year) | **NOx** | | 302 | 182 | 137 | 61 | 172 | 182 | 173 | **173** |
| Facility Totals (tons per year) | **PM10** | | 163 | 121 | 114 | 76 | 81 | 87 | 81 | **103** |
| Facility Totals (tons per year) | **TSP** | | 176 | 132 | 119 | 81 | 86 | 91 | 85 | **110** |
| Facility Totals (tons per year) | **SO2** | | 239 | 274 | 275 | 281 | 201 | 239 | 202 | **244** |
| Facility Totals (tons per year) | **NOx** | | 1493 | 1541 | 1488 | 1440 | 1164 | 1301 | 1372 | **1,400** |

# Facility Specific Operating and Emissions Data (KapStone - Continued)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | KaptS | KaptSto | KaptSto | KaptStone | KaptStone | KaptStone | KaptSton | KaptSton |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | rf22 | rf22 | rf22 | rf22 | rf22 | rf22 | rf22 | RF 22 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.242 | 0.218 | 0.223 | 0.211 | 0.21 | 0.226 | 0.203 | 0.219 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.45** | **30.360** | **30.276** | **30.372** | **30.468** | **30.480** | **30.348** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.063** | **0.071** | **0.078** | **0.07** | **0.062** | **0.061** | **0.072** | **0.0681** |
| CO2 conc in stack | conc | %/100 | 0.137 | 0.129 | 0.122 | 0.13 | 0.138 | 0.139 | 0.128 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **103.8** | **103.868** | **103.868** | **103.8689** | **103.8689** | **103.8689** | **103.8689** | |
| Diameter of stack | D | inches | 138 | 138 | 138 | 138 | 138 | 138 | 138 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **47.82** | **43.3335** | **47.6273** | **46.1736** | **50.7563** | **44.1518** | **47.3674** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 271 | 267 | 264 | 281 | 291 | 572 | 341 | **327** |
| flow check | | | **298,0** | **270,060** | **296,820** | **287,760** | **316,320** | **275,160** | **295,200** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | **246** | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 29808 | 270060 | 296820 | 287760 | 316320 | 275160 | 295200 | **291,343** |
| | | **acfs** | 4968 | 4501 | 4947 | 4796 | 5272 | 4586 | 4920 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **163,1** | **153,379** | **168,194** | **161,779** | **175,690** | **108,963** | **155,087** | **155,185** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 9,791, | 9,202,7 | 10,091, | 9,706,762 | 10,541,417 | 6,537,802 | 9,305,235 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 11 | 4 | 5 | 8 | 13 | 8 | 5 | **8** |
| Unit Totals (tons per year) | **SO2** | | 58 | 53 | 47 | 60 | 48 | 87 | 66 | **60** |
| Unit Totals (tons per year) | **NOx** | | 245 | 242 | 251 | 274 | 280 | 297 | 288 | **268** |
| Facility Totals (tons per year) | **PM10** | | 163 | 121 | 114 | 76 | 81 | 87 | 81 | **103** |
| Facility Totals (tons per year) | **TSP** | | 176 | 132 | 119 | 81 | 86 | 91 | 85 | **110** |
| Facility Totals (tons per year) | **SO2** | | 239 | 274 | 275 | 281 | 201 | 239 | 202 | **244** |
| Facility Totals (tons per year) | **NOx** | | 1493 | 1541 | 1488 | 1440 | 1164 | 1301 | 1372 | **1,400** |

# Facility Specific Operating and Emissions Data (KapStone - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | KaptS | KaptSto | KaptSto | KaptStone | KaptStone | KaptStone | KaptSton | KaptSton |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | lk3 | lk3 | lk3 | lk3 | lk3 | lk3 | lk3 | LK 3 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.252 | 0.265 | 0.296 | 0.273 | 0.256 | 0.165 | 0.221 | 0.2469 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.11** | **30.360** | **30.360** | **30.179** | **29.867** | **29.963** | **30.107** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.091** | **0.071** | **0.071** | **0.086** | **0.112** | **0.104** | **0.092** | **0.0896** |
| CO2 conc in stack | conc | %/100 | 0.109 | 0.129 | 0.129 | 0.114 | 0.088 | 0.096 | 0.108 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **28.27** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | |
| Diameter of stack | D | inches | 72 | 72 | 72 | 72 | 72 | 72 | 72 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **14.96** | **10.9640** | **12.3080** | **12.5202** | **14.1117** | **13.0507** | **11.3884** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 149 | 148 | 155 | 153 | 151 | 135 | 148 | **148** |
| flow check | | | **25,38** | **18,600** | **20,880** | **21,240** | **23,940** | **22,140** | **19,320** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 25380 | 18600 | 20880 | 21240 | 23940 | 22140 | 19320 | **21,643** |
| | | **acfs** | 423 | 310 | 348 | 354 | 399 | 369 | 322 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **16,45** | **11,872** | **12,620** | **13,300** | **15,392** | **16,405** | **13,070** | **14,160** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 987,5 | 712,331 | 757,205 | 798,020 | 923,509 | 984,311 | 784,199 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 13 | 2 | 2 | 3 | 2 | 2 | 0 | **3** |
| Unit Totals (tons per year) | **SO2** | | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **0** |
| Unit Totals (tons per year) | **NOx** | | 54 | 56 | 12 | 21 | 12 | 8 | 3 | **24** |
| Facility Totals (tons per year) | **PM10** | | 163 | 121 | 114 | 76 | 81 | 87 | 81 | **103** |
| Facility Totals (tons per year) | **TSP** | | 176 | 132 | 119 | 81 | 86 | 91 | 85 | **110** |
| Facility Totals (tons per year) | **SO2** | | 239 | 274 | 275 | 281 | 201 | 239 | 202 | **244** |
| Facility Totals (tons per year) | **NOx** | | 1493 | 1541 | 1488 | 1440 | 1164 | 1301 | 1372 | **1,400** |

# Facility Specific Operating and Emissions Data (KapStone - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | KaptS | KaptSto | KaptSto | KaptStone | KaptStone | KaptStone | KaptSton | KaptSton |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | lk4 | lk4 | lk4 | lk4 | lk4 | lk4 | lk4 | LK 4 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.243 | 0.226 | 0.225 | 0.224 | 0.148 | 0.209 | 0.186 | 0.2087 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.67** | **30.552** | **30.504** | **30.576** | **30.360** | **30.540** | **30.660** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.045** | **0.055** | **0.059** | **0.053** | **0.071** | **0.056** | **0.046** | **0.0550** |
| CO2 conc in stack | conc | %/100 | 0.155 | 0.145 | 0.141 | 0.147 | 0.129 | 0.144 | 0.154 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **38.48** | **38.4845** | **38.4845** | **38.4845** | **38.4845** | **38.4845** | **38.4845** | |
| Diameter of stack | D | inches | 84 | 84 | 84 | 84 | 84 | 84 | 84 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **8.938** | **8.0292** | **9.0166** | **9.3804** | **8.7048** | **8.8347** | **8.2111** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 140 | 141 | 140 | 140 | 124 | 139 | 136 | **137** |
| flow check | | | **20,64** | **18,540** | **20,820** | **21,660** | **20,100** | **20,400** | **18,960** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 20640 | 18540 | 20820 | 21660 | 20100 | 20400 | 18960 | **20,160** |
| | | **acfs** | 344 | 309 | 347 | 361 | 335 | 340 | 316 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **13,75** | **12,607** | **14,199** | **14,791** | **15,483** | **14,224** | **13,673** | **14,104** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 824,9 | 756,417 | 851,954 | 887,471 | 928,983 | 853,424 | 820,355 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 8 | 6 | 13 | 7 | 4 | 8 | 12 | **8** |
| Unit Totals (tons per year) | **SO2** | | 3 | 4 | 1 | 1 | 1 | 1 | 1 | **2** |
| Unit Totals (tons per year) | **NOx** | | 30 | 82 | 74 | 34 | 37 | 51 | 70 | **54** |
| Facility Totals (tons per year) | **PM10** | | 163 | 121 | 114 | 76 | 81 | 87 | 81 | **103** |
| Facility Totals (tons per year) | **TSP** | | 176 | 132 | 119 | 81 | 86 | 91 | 85 | **110** |
| Facility Totals (tons per year) | **SO2** | | 239 | 274 | 275 | 281 | 201 | 239 | 202 | **244** |
| Facility Totals (tons per year) | **NOx** | | 1493 | 1541 | 1488 | 1440 | 1164 | 1301 | 1372 | **1,400** |

# Facility Specific Operating and Emissions Data (KapStone - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | KaptS | KaptSto | KaptSto | KaptStone | KaptStone | KaptStone | KaptSton | KaptSton |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | lk5 | lk5 | lk5 | lk5 | lk5 | lk5 | lk5 | LK 5 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.286 | 0.314 | 0.303 | 0.281 | 0.302 | 0.297 | 0.298 | 0.2973 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.42** | **30.312** | **30.588** | **30.576** | **30.504** | **30.564** | **30.612** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.066** | **0.075** | **0.052** | **0.053** | **0.059** | **0.054** | **0.05** | **0.0584** |
| CO2 conc in stack | conc | %/100 | 0.134 | 0.125 | 0.148 | 0.147 | 0.141 | 0.146 | 0.15 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **15.90** | **15.9043** | **15.9043** | **15.9043** | **15.9043** | **15.9043** | **15.9043** | |
| Diameter of stack | D | inches | 54 | 54 | 54 | 54 | 54 | 54 | 54 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **23.51** | **27.0996** | **25.1504** | **15.7819** | **17.4795** | **18.6742** | **17.1023** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 281 | 284 | 275 | 333 | 326 | 338 | 341 | **311** |
| flow check | | | **22,44** | **25,860** | **24,000** | **15,060** | **16,680** | **17,820** | **16,320** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 22440 | 25860 | 24000 | 15060 | 16680 | 17820 | 16320 | **19,740** |
| | | **acfs** | 374 | 431 | 400 | 251 | 278 | 297 | 272 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **11,41** | **12,590** | **12,017** | **7,210** | **7,821** | **8,289** | **7,552** | **9,556** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 684,9 | 755,379 | 721,011 | 432,579 | 469,261 | 497,331 | 453,117 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 2 | 0 | 0 | 2 | 3 | 1 | 2 | **1** |
| Unit Totals (tons per year) | **SO2** | | 1 | 1 | 1 | 2 | 1 | 2 | 2 | **1** |
| Unit Totals (tons per year) | **NOx** | | 26 | 20 | 47 | 61 | 35 | 37 | 58 | **41** |
| Facility Totals (tons per year) | **PM10** | | 163 | 121 | 114 | 76 | 81 | 87 | 81 | **103** |
| Facility Totals (tons per year) | **TSP** | | 176 | 132 | 119 | 81 | 86 | 91 | 85 | **110** |
| Facility Totals (tons per year) | **SO2** | | 239 | 274 | 275 | 281 | 201 | 239 | 202 | **244** |
| Facility Totals (tons per year) | **NOx** | | 1493 | 1541 | 1488 | 1440 | 1164 | 1301 | 1372 | **1,400** |

# Facility Specific Operating and Emissions Data (Boise While Wallula)

| | | Facility: | Boise | Boise | Boise | Boise | Boise | Boise | Boise | Boise |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | rf2 | rf2 | rf2 | rf2 | rf2 | rf2 | rf2 | Rf2 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.222 | 0.251 | 0.267 | 0.246 | 0.237 | 0.23 | 0.253 | 0.2437 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **29.98** | **30.119** | **30.011** | **30.059** | **29.867** | **29.975** | **30.191** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.102** | **0.091** | **0.1** | **0.096** | **0.112** | **0.103** | **0.085** | **0.0984** |
| CO2 conc in stack | conc | %/100 | 0.098 | 0.109 | 0.1 | 0.104 | 0.088 | 0.097 | 0.115 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **62.21** | **62.2114** | **62.2114** | **62.2114** | **62.2114** | **62.2114** | **62.2114** | |
| Diameter of stack | D | inches | 106.8 | 106.8 | 106.8 | 106.8 | 106.8 | 106.8 | 106.8 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **23.25** | **21.2501** | **22.4396** | **22.4235** | **22.4557** | **24.3846** | **25.1883** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 327 | 333 | 283 | 305 | 335 | 342 | 344 | **324** |
| flow check | | | **86,82** | **79,320** | **83,760** | **83,700** | **83,820** | **91,020** | **94,020** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 86820 | 79320 | 83760 | 83700 | 83820 | 91020 | 94020 | **86,066** |
| | | **acfs** | 1447 | 1322 | 1396 | 1395 | 1397 | 1517 | 1567 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **45,31** | **39,557** | **43,630** | **43,558** | **42,476** | **46,141** | **46,123** | **43,829** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 2,719, | 2,373,4 | 2,617,8 | 2,613,488 | 2,548,533 | 2,768,461 | 2,767,387 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 20 | 8 | 6 | 7 | 10 | 10 | 5 | **9** |
| Unit Totals (tons per year) | **SO2** | | 255 | 239 | 268 | 358 | 255 | 332 | 352 | **294** |
| Unit Totals (tons per year) | **NOx** | | 65 | 64 | 63 | 73 | 59 | 74 | 71 | **67** |
| Facility Totals (tons per year) | **PM10** | | 213 | 218 | 184 | 157 | 131 | 131 | 127 | **166** |
| Facility Totals (tons per year) | **TSP** | | 295 | 300 | 270 | 227 | 156 | 156 | 149 | **222** |
| Facility Totals (tons per year) | **SO2** | | 793 | 1247 | 684 | 780 | 713 | 802 | 793 | **830** |
| Facility Totals (tons per year) | **NOx** | | 764 | 778 | 771 | 1073 | 841 | 859 | 861 | **850** |

# Facility Specific Operating and Emissions Data (Boise While Wallula - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | Boise | Boise | Boise | Boise | Boise | Boise | Boise | Boise |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | rf3 | rf3 | rf3 | rf3 | rf3 | rf3 | rf3 | Rf3 avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.223 | 0.246 | 0.239 | 0.24 | 0.247 | 0.245 | 0.238 | 0.239714 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.44** | **30.444** | **30.324** | **30.456** | **30.456** | **30.540** | **30.624** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.064** | **0.064** | **0.074** | **0.063** | **0.063** | **0.056** | **0.049** | **0.0619** |
| CO2 conc in stack | conc | %/100 | 0.136 | 0.136 | 0.126 | 0.137 | 0.137 | 0.144 | 0.151 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **132.7** | **132.732** | **132.732** | **132.7323** | **132.7323** | **132.7323** | **132.7323** | |
| Diameter of stack | D | inches | 156 | 156 | 156 | 156 | 156 | 156 | 156 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **40.41** | **39.6512** | **40.7964** | **42.0696** | **43.9531** | **24.3874** | **42.3032** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 357 | 365 | 358 | 382 | 409 | 394 | 401 | **381** |
| flow check | | | **321,8** | **315,780** | **324,900** | **335,040** | **350,040** | **194,220** | **336,900** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 32184 | 315780 | 324900 | 335040 | 350040 | 194220 | 336900 | **311,246** |
| | | **acfs** | 5364 | 5263 | 5415 | 5584 | 5834 | 3237 | 5615 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **161,6** | **152,383** | **159,593** | **159,673** | **160,150** | **90,660** | **157,430** | **148,786** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 9,696, | 9,142,9 | 9,575,6 | 9,580,393 | 9,608,997 | 5,439,616 | 9,445,784 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 29 | 13 | 12 | 12 | 12 | 14 | 12 | **15** |
| Unit Totals (tons per year) | **SO2** | | 506 | 968 | 333 | 374 | 428 | 441 | 420 | **496** |
| Unit Totals (tons per year) | **NOx** | | 286 | 274 | 244 | 294 | 297 | 306 | 292 | **285** |
| Facility Totals (tons per year) | **PM10** | | 213 | 218 | 184 | 157 | 131 | 131 | 127 | **166** |
| Facility Totals (tons per year) | **TSP** | | 295 | 300 | 270 | 227 | 156 | 156 | 149 | **222** |
| Facility Totals (tons per year) | **SO2** | | 793 | 1247 | 684 | 780 | 713 | 802 | 793 | **830** |
| Facility Totals (tons per year) | **NOx** | | 764 | 778 | 771 | 1073 | 841 | 859 | 861 | **850** |

# Facility Specific Operating and Emissions Data (Boise While Wallula - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | Boise | Boise | Boise | Boise | Boise | Boise | Boise | Boise |
| | | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2005- |
| | | Run ID or Unit ID: | LK | LK | LK | LK-oil | LK | LK | LK | LK avg |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | **18.015** | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.327 | 0.359 | 0.341 | 0.351 | 0.339 | 0.359 | 0.326 | 0.3431 |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.60** | **30.576** | **30.332** | **30.576** | **30.552** | **30.720** | **30.648** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.051** | **0.053** | **0.0733** | **0.053** | **0.055** | **0.041** | **0.047** | **0.1** |
| CO2 conc in stack | conc | %/100 | 0.149 | 0.147 | 0.1267 | 0.147 | 0.145 | 0.159 | 0.153 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | **0.8** | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | **28.27** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | **28.2743** | |
| Diameter of stack | D | inches | 72 | 72 | 72 | 72 | 72 | 72 | 72 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | 12 | 12 | 12 | 12 | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **23.55** | **27.4808** | **20.1596** | **19.9121** | **18.7803** | **18.7803** | **16.6228** | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | **AVG** |
| Stack gas temp | Ts | F | 164 | 162 | 152 | 161 | 159 | 160 | 161 | **160** |
| flow check | | | **39,96** | **46,620** | **34,200** | **33,780** | **31,860** | **31,860** | **28,200** | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 39960 | 46620 | 34200 | 33780 | 31860 | 31860 | 28200 | **35,211** |
| | | **acfs** | 666 | 777 | 570 | 563 | 531 | 531 | 470 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | 60 | 60 | 60 | 60 | |
| | | | | | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **22,75** | **25,367** | **19,444** | **18,640** | **17,963** | **17,392** | **16,160** | **19,675** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 1,365, | 1,522,0 | 1,166,6 | 1,118,402 | 1,077,809 | 1,043,512 | 969,622 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | used oil for part of 2007-2008 | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 50 | 74 | 45 | 49 | 41 | 42 | 37 | **48** |
| Unit Totals (tons per year) | **SO2** | | 2 | 10 | 0 | 1 | 2 | 3 | 0 | **3** |
| Unit Totals (tons per year) | **NOx** | | 86 | 82 | 42 | 52 | 48 | 51 | 54 | **59** |
| Facility Totals (tons per year) | **PM10** | | 213 | 218 | 184 | 157 | 131 | 131 | 127 | **166** |
| Facility Totals (tons per year) | **TSP** | | 295 | 300 | 270 | 227 | 156 | 156 | 149 | **222** |
| Facility Totals (tons per year) | **SO2** | | 793 | 1247 | 684 | 780 | 713 | 802 | 793 | **830** |
| Facility Totals (tons per year) | **NOx** | | 764 | 778 | 771 | 1073 | 841 | 859 | 861 | **850** |

# Facility Specific Operating and Emissions Data (Cosmo)

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Facility: | Cosmo | Cosmo | Cosmo | avg |
| | | | 2005 | 2006 | 2011 | (not used) |
| | | Run ID or Unit ID: | RB(1-3) | RB(1-3) | RB(1-3) | 2011 data used |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | |
| Pressure (barometric) | Pbar | in HG | | | | |
| Pressure (stack) | Pa | in H20 | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | |
| | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | |
| | f | scf H20/gm | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | |
| total impinger wt | | | | | | |
| Impinger 1 | Vi | g | | | | |
| Impinger 2 | Vii | g | | | | |
| Impinger 3 | Viii | g | | | | |
| Impinger 4 | Viv | g | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | |
| Conversion Factor | F2 | g/lb (should be | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | |
| MW of water | MH20 | lb/lbmole | **18.015** | **18.015** | **18.015** | |
| | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | |
| Sample Volume from meter | Vm | dcf | | | | |
| Dry gas mtr cal factor | Y | no units | | | | |
| Meter orifice pressure | dH | in H20 | | | | |
| Dry gas meter temp | Tm | F | | | | |
| | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | 0.204 | 0.19 | 0.2 | |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | |
| same as BWS (because | | | | | | |
| | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | **30.576** | **30.372** | **30.312** | **AVG** |
| **Oxygen conc in stack** | **conc** | **%/100** | **0.053** | **0.07** | **0.075** | **0.0660** |
| CO2 conc in stack | conc | %/100 | 0.147 | 0.13 | 0.125 | |
| N2 conc in stack | con | %/100 | **0.8** | **0.8** | **0.8** | |
| | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | |
| | | | | | | |
| | | | | | | |
| **Stack Area** | **A** | **ft2** | **50.2655** | **50.2655** | **50.2655** | |
| Diameter of stack | D | inches | 96 | 96 | 96 | |
| Conversion Factor | F3 | in/ft | 12 | 12 | 12 | |
| | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | **48.4826** | **51.7453** | **58.5889** | |
| Pitot tube constant | Kp | test Vs: | | | | |
| Pitot tube calibration coef | Cp | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | **AVG** |
| Stack gas temp | Ts | F | 140 | 141 | 140 | **140** |
| flow check | | | **146,220** | **156,060** | **176,700** | |
| | | | | | | |
| Stack Ht | Ht | Ft | 140 | 140 | 140 | **140** |
| | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | 146220 | 156060 | 176700 | **159,660** |
| | | **acfs** | 2437 | 2601 | 2945 | |
| Converstion Factor | F5 | sec/min | 60 | 60 | 60 | |
| | | | | | | **AVG** |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | **102,424** | **111,054** | **124,397** | **112,625** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | 6,145,451 | 6,663,269 | 7,463,808 | |
| Conversion Factor | F4 | sec/hr | 3600 | 3600 | 3600 | |
| | Qstd | dscf/min | | | | |
| **Isokinetic percent** | I | % | | | | |
| sample nozzle cross section | An | ft2 | | | | |
| length of sample test | theta | minutes | | | | |
| | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | |
| Mass of part: probe wash | Mp | mg | | | | |
| Mass of part: filter | Mf | mg | | | | |
| | | | | | | **AVG** |
| Unit Totals (tons per year) | **PM10** | | 220 | 109 | 195 | **175** |
| Unit Totals (tons per year) | **SO2** | | 211 | 187 | 169 | **189** |
| Unit Totals (tons per year) | **NOx** | | 308 | 128 | 348 | **261** |
| Facility Totals (tons per year) | **PM10** | | 313 | 145 | 272 | **243** |
| Facility Totals (tons per year) | **TSP** | | 314 | 146 | 273 | **244** |
| Facility Totals (tons per year) | **SO2** | | 286 | 274 | 214 | **258** |
| Facility Totals (tons per year) | **NOx** | | 341 | 149 | 367 | **286** |

# Facility Specific Operating and Emissions Data (Graymont)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | Gray | Graymo | Graymo | Graymont- | Graymont- | Graymont | Graymont | Graymont |
| | | | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
| | | Run ID or Unit ID: | clk | clk | clk | clk | clk | clk | clk | clk |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** | **29.92** |
| Pressure (barometric) | Pbar | in HG | | | | | | | | |
| Pressure (stack) | Pa | in H20 | | | | | | | | |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | | | |
| | f | scf H20/gm | | | | | | | | |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | | | |
| total impinger wt | | | | | | | | | | |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R-lbmol) | | | | | | | | |
| Temperature abs | Tabs | R (459.67) | 460 | 460 | 460 | 460 | 460 | | | |
| Temp std | Tstd | R (527.67) | 528 | 528 | 528 | 528 | 528 | | | |
| Conversion Factor | F2 | g/lb (should be | | | | | | | | |
| Pressure (std) | Pstd | in HG | 29.92 | 29.92 | 29.92 | 29.92 | 29.92 | | | |
| MW of water | MH20 | lb/lbmole | **18.01** | **18.015** | **18.015** | **18.015** | **18.015** | | | |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | | | | |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | | | | | | | | |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | | | | | | | | |
| **Oxygen conc in stack** | **conc** | **%/100** | | | | | | | | |
| CO2 conc in stack | conc | %/100 | | | | | | | | |
| N2 conc in stack | con | %/100 | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | | | | | | | | |
| Diameter of stack | D | inches | | | | | | | | |
| Conversion Factor | F3 | in/ft | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | | | | | | | | |
| Pitot tube constant | Kp | test Vs: | | | | | | | | |
| Pitot tube calibration coef | Cp | | | | | | | | | |
| Stack Gas Velocity Head | dP | in H20 | | | | | | | | |
| Stack Gas Velocity Head | dP^.5 | | | | | | | | | |
| Stack gas temp | Ts | F | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | | | | | | | | |
| | | **acfs** | | | | | | | | |
| Converstion Factor | F5 | sec/min | | | | | | | | |
| | | | | | | | | | | |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | | | | | | | | |
| Dry std Stack gas flow rate | Qstd | dscf/hr | | | | | | | | |
| Conversion Factor | F4 | sec/hr | | | | | | | | |
| | Qstd | dscf/min | | | | | | | | |
| **Isokinetic percent** | I | % | | | | | | | | |
| sample nozzle cross section | An | ft2 | | | | | | | | |
| length of sample test | theta | minutes | | | | | | | | |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | | | |
| | | | | | | | | | | |
| Unit Totals (tons per year) | **PM10** | | 146 | | | | | 83 | 81 | 82 |
| Unit Totals (tons per year) | **SO2** | | 103 | | | | | 10 | 9 | 10 |
| Unit Totals (tons per year) | **NOx** | | 195 | | | | | 58 | 57 | 57 |
| Facility Totals (tons per year) | **PM10** | | | | | | | 150 | 148 | 148 |
| Facility Totals (tons per year) | **TSP** | | | 151 | 154 | 148 | 139 | na | na | na |
| Facility Totals (tons per year) | **SO2** | | | 109 | 109 | 101 | 37 | 10 | 9 | 10 |
| Facility Totals (tons per year) | **NOx** | | | 263 | 284 | 283 | 268 | 58 | 57 | 57 |

# Facility Specific Operating and Emissions Data (Graymont - Continued)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Facility: | Graymont | Graymont | Graymont | Graymont | gm avg | **compliance** | **compliance** | |
| | | | 2009 | 2010 | 2011 | 2012 | | **Nov/2009** | **Aug/2011** | Nov/20 |
| | | Run ID or Unit ID: | clk | clk | clk | clk | | **avg** | **avg** | run 1 |
| **Pressure (stack absolute)** | **Ps** | **in HG** | **29.92** | **29.92** | **29.92** | **29.92** | **avg of** | **29.80** | **30.2** | **29.60** |
| Pressure (barometric) | Pbar | in HG | | | | | | | | 29.6 |
| Pressure (stack) | Pa | in H20 | | | | | | | | 0 |
| Conversion Factor | F1 | inH20/inHg | | | | | | | | 13.6 |
| | | | | | | | | | | |
| **Total water condensed** | **Vwst** | scf H2) | | | | | | **1.87** | | **1.6** |
| | f | scf H20/gm | | | | | | | | 0.04715 |
| **Total water condensed** | **Vw** | **std ft3** | | | | | | **1.884** | | **1.633** |
| total impinger wt | | | | | | | | **34.6** | | 34.6 |
| Impinger 1 | Vi | g | | | | | | | | |
| Impinger 2 | Vii | g | | | | | | | | |
| Impinger 3 | Viii | g | | | | | | | | |
| Impinger 4 | Viv | g | | | | | | | | |
| Ideal gas constant | R | (inHG)(ft3)/(R- | | | | | | **21.85** | | 21.85 |
| Temperature abs | Tabs | R (459.67) | | | | | | **460** | | 460 |
| Temp std | Tstd | R (527.67) | | | | | | **528** | | 528 |
| Conversion Factor | F2 | g/lb (should be | | | | | | **453.59** | | 453.59 |
| Pressure (std) | Pstd | in HG | | | | | | **29.92** | | 29.92 |
| MW of water | MH20 | lb/lbmole | | | | | | **18.015** | | **18.015** |
| | | | | | | | | | | |
| **Sample Volume** | **Vmst** | **dscf** | | | | | 62 | **67.038** | **57.121** | **62.891** |
| Sample Volume from meter | Vm | dcf | | | | | | | | |
| Dry gas mtr cal factor | Y | no units | | | | | | | | |
| Meter orifice pressure | dH | in H20 | | | | | | | | |
| Dry gas meter temp | Tm | F | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Moisture Fraction** | **Bws** | **vol%/100** | | | | | 0.0271 | **0.0273** | **0.0268** | **0.0253** |
| **Saturation Moisture** | **SBws** | **(sat vap press)/Ps** | | | | | | | | |
| same as BWS (because | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Gas Mole weight dry** | **Md** | **lb/lbmole** | | | | | | **29.33** | **29.55** | **29.15** |
| **Oxygen conc in stack** | **conc** | **%/100** | | | | | **0.181** | **0.187** | **0.174** | **0.196** |
| CO2 conc in stack | conc | %/100 | | | | | | | | 0.022 |
| N2 conc in stack | con | %/100 | | | | | | | | 0.782 |
| | | | | | | | | | | |
| **Stack Gas Mole weight wet** | **Ms** | **lb/lbmole** | | | | | | **29.02** | **29.24** | **28.86** |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Stack Area** | **A** | **ft2** | | | | | | | | |
| Diameter of stack | D | inches | | | | | | | | |
| Conversion Factor | F3 | in/ft | | | | | | **12** | **12** | 12 |
| | | | | | | | | | | |
| **Stack Gas Velocity** | **Vs** | **ft/sec** | | | | | | **1.45** | | **1.39** |
| Pitot tube constant | Kp | test Vs: | | | | | | **85.49** | | 85.49 |
| Pitot tube calibration coef | Cp | | | | | | | **0.84** | | 0.84 |
| Stack Gas Velocity Head | dP | in H20 | | | | | | **0.0005** | | 0.0005 |
| Stack Gas Velocity Head | dP^.5 | | | | | | | **0.022** | | 0.022 |
| Stack gas temp | Ts | F | | | | | 217 | **183.9** | **250.5** | 187.1 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Stack Ht | Ht | Ft | | | | | | | | |
| | | | | | | | | | | |
| **Actual Stack Gas Flow Rate** | **Acf** | **acfm** | | | | | 82690 | **88331** | **77049** | **0** |
| | | **acfs** | | | | | | | | |
| Converstion Factor | F5 | sec/min | | | | | | **60** | | 60 |
| | | | | | | | | | | |
| **Dry std Stack gas flow rate** | **Qstd** | **dscfm** | | | | | **63224** | **70191** | **56257** | **0** |
| Dry std Stack gas flow rate | Qstd | dscf/hr | | | | | | **0** | | 0 |
| Conversion Factor | F4 | sec/hr | | | | | | **3600** | | 3600 |
| | Qstd | dscf/min | | | | | | **0** | | 0 |
| **Isokinetic percent** | I | % | | | | | | **96.23** | | 95.08 |
| sample nozzle cross section | An | ft2 | | | | | | **0.0084** | | 0.0084 |
| length of sample test | theta | minutes | | | | | | **120** | | 120 |
| | | | | | | | | | | |
| **Mass of part: combined** | **Mn** | **mg** | | | | | | | | |
| Mass of part: probe wash | Mp | mg | | | | | | | | |
| Mass of part: filter | Mf | mg | | | | | | **23.68** | | 23.68 |
| | | | | | | | **AVG** | | | |
| Unit Totals (tons per year) | **PM10** | | 77 | 78 | 21 | 21 | 63 | | | |
| Unit Totals (tons per year) | **SO2** | | 9 | 9 | 9 | 5 | 9 | | | |
| Unit Totals (tons per year) | **NOx** | | 54 | 54 | 54 | 58 | 56 | | | |
| Facility Totals (tons per year) | **PM10** | | 141 | 142 | 85 | 101 | 131 | | | |
| Facility Totals (tons per year) | **TSP** | | na | na | na | na | na | | | |
| Facility Totals (tons per year) | **SO2** | | 9 | 9 | 9 | 5 | 9 | | | |
| Facility Totals (tons per year) | **NOx** | | 54 | 54 | 54 | 58 | 56 | | | |

# Washington State Pulp Mills and Graymont Facility Information

| Facility/Equip Type | Unit ID | Avg flow rate (acfm): | Date Constructed | Control Details | Date modified or rebuilt | Modification or Rebuild details | Additional Modified/ Rebuild Dates | Additional Modification/ Rebuild Details |
|---|---|---|---|---|---|---|---|---|
| GP Camas (Recovery Furnace) | No. 3 | 80,940 | 1957 | 2 chamber, 3 field ESP + venturi & Teller scrubbers | 1990-1992 | new 2-chamber, 3-fld ESP + AirPol cross flow packed bed SCRUBBER + wet heat rcvy | 2005/2006 | Secondary air incineration of HVLC |
| GP Camas (Recovery Furnace) | No. 4 | 125,556 | 1975 | ESP | 1981-1984, (ESP rebuilt in 1998) | 2 chamber, 4 field ESP + Teller SCRUBBER + wet heat rcvy | 2005/2006 | Secondary air incineration of HVLC |
| KapStone (Recovery Furnace) | RF18 | 283,640 | 1965 | ESP | (a) | To be permtly shut down (a) | na | na |
| KapStone (Recovery Furnace) | RF19 | 348,746 | 1975 | ESP | (a) | Steam modifications. More efficient dry bottom ESP (a) | na | na |
| KapStone (Recovery Furnace) | RF22 | 291,343 | 1992 | ESP | na | na | na | na |
| PTPC (Recovery Furnace) | RF | 325,118 | 1968 | ESP | 1968-1976 | na | na | na |
| WestRock (Recovery Furnace) | No. 4 | 344,256 | 1973 | ESP | na | na | na | na |
| WestRock (Recovery Furnace) | No. 3 | 301,000 | 1961 | 1st ESP | 1965, '73 1981-85 | 2nd ESP inst ('65), scrbr ('73), rblt ('81); 1st ESP rblt ('85) | 1998 | permtly shut down |
| Weyerhauser (Recovery Furnace) | No. 10 | 547,908 | 1975 | RF No. 10 w/ESP replaced DCE 3,4,5 inst 1948, '52-'56) | 1995 | Kraft modernization project: Upgrade to hi-conc BL firing and added 3rd ESP chamber | 1978 | Sulphite mill installed 1931 discontinued. Kraft RF10 continues |
| Boise White Wallula (Recovery Furnace) | No. 2 | 86,066 | 1962 | ESP | 1995 | tri-level air equip (PSD-95-04) is now stand alone rqmt | na | na |
| Boise White Wallula (Recovery Furnace) | No. 3 | 311,246 | 1978-80 | ESP | 1995 | tri-level air equip (PSD-95-04) is now stand alone rqmt | 1996 | 3rd ESP cell added to allow maintenance on primary cells during operation |
| Cosmo (Recovery Furnace) | (1,2 & 3) | 159,660 | 1957 (1&2); '66 (#3) | (1&2 mltclones + 3 abs twrs; 3: mltclones +cyclone+3 vent scrubbers) 1,2,3: combined thru vent scbr | 2003 | MACT II site specific: Control PM in hogged fuel dryer instead of RFs as surragte for HAPS | na | na |
| GP Camas (Lime Kiln) | No.4 | 10,332 | 1977-79 | Ducon x-section variable throat vent scbr. New "state of the art" lime kiln (No.4) replaced 3 old lime kilns from 1955-57. | na | na | na | na |
| KapStone (Lime Kiln) | LK3 | 21,643 | 1970 | Ducon vent scr, lime mud oxidation | na | na | na | na |
| KapStone (Lime Kiln) | LK4 | 20,160 | 1955 | AirPol HydroKenetic vent scr, lime mud oxidation | ???? | Scrubber modified | na | na |
| KapStone (Lime Kiln) | LK5 | 19,740 | 1982 | ESP: H2O2 added to shower water on mud filters | na | na | na | na |
| PTPC (Lime Kiln) | LK | 27,470 | 1975 | Venturi scrubber | na | na | na | na |
| WestRock (Lime Kiln) | No.1 | 38,580 | 1960 | Venturi scrubber | na | na | na | na |
| WestRock (Lime Kiln) | No.2 | 11,940 | 1973 | Venturi scrubber | na | na | na | na |
| Weyerhauser (Lime Kiln) | #4 | 53,256 | 1986 | ESP (LK#4 replaced Lime | na | na | na | na |
| Boise White Wallula (Lime Kiln) | LK | 35,211 | 1978-79 | Scrubber | 1998 | baghouse added to hot end of LK to reduce dust. | 2012 | Modified scrubber |
| Graymont (Lime Kiln) | Calcining (Lime) Kiln #1 | 82,690 | <1969 (6/20/69 = earliest NOC found) | Baghouse | Various: See 5/4/07 Statement of Basis table: p.25 of 33. | | | |

Notes:
(a) "Within 7 days after the modified RF19 is placed in operation, a letter informing Ecology of the date the modified unit was placed in operation and the date by which RF18 ... must be permanently retired." Source: June 2, 2011 Ecology letter and NOC 8429. Based on condition of modifying RF19 Date: TBD.

# Appendix C.  WSU Report

# APPENDIX C Regional Haze RACT Analysis: Modeling Protocol and Results



## Section C.0 Summary

This report discusses impacts on regional visibility associated with the implementation of Reasonably Available Control Technology (RACT) for emissions of $SO_2$ and $PM_{2.5}$ from pulp and paper facilities in Washington State. Facilities considered include: Boise White Paper, LLC, (Boise White Wallula), WestRock CP, LLC (WestRock), Cosmo Specialty Fibers Inc., (Cosmo), Port Townsend Paper Corporation (PTPC), Weyerhaeuser Longview Liquid Packaging (Weyerhauser), Georgia Pacific Consumer Products (Camas) LLC (GP Camas), and Longview Fibre Paper and Packaging, Inc. dba KapStone Kraft Paper Corporation (KapStone). Washington State University's AIRPACT4 modeling framework which is based on WRF-SMOKE-CMAQ is employed for modeling visibility improvements attributable to RACT. Based on visibility data from the Interagency Monitoring of Protected Visual Environments (IMPROVE) sites in the Pacific Northwest (PNW), May 2009 – April 2010 was identified as a suitable period for which baseline and RACT emissions were modeled. While model performance criteria for particulate sulfate were met at all 20 IMPROVE sites in the PNW, they were satisfied at 16 and 7 of these sites for $PM_{2.5}$ and organic carbon, respectively. The mean fractional bias calculated over all IMPROVE sites was -31% for $PM_{2.5}$ and was largest for organic carbon (-70%). Results from this modeling study show that RACT implementation in the pulp and paper industry does little to improve visibility in Class I areas. Only Alpine Lakes Wilderness and Glacier Peak Wilderness have modeled $8^{th}$ highest delta deciviews greater than 0.1 dv. The $8^{th}$ highest deciview change was less than 0.05 dv at all of the IMPROVE sites. The largest deciview change at a non- IMPROVE site in Washington was 0.6 dv at Mesa.

## Section C.1 Introduction

Visibility impairment due to fine particles which scatter and absorb light is termed as regional haze. Regional haze is formed due to multitude of sources both anthropogenic and natural- such as motor vehicles, industrial activities, power plants, wildfires, windblown dust etc. and are located across a large geographical area. Under the Clean Air Act, EPA is required to protect the visibility in mandatory class I areas from impairment due to anthropogenic air pollution. States are required to submit progress towards regional haze rule as a part of the State Implementation Plan (SIP). Washington Department of Ecology contracted with Washington State University (WSU) for the modeling portion of this RACT analysis. In the sections below we describe the rational for selecting the modeling period; a brief description of the model and its various components, and a description of Baseline emission (BASE) and Reasonably Available Control Technology limited emission (RACT) cases. An analysis of model evaluation for $PM_{2.5}$ and visibility and potential changes in visibility due to the emission changes are then presented.

## Section C.2 Technical Note: Choosing an Efficient Period to Model for Regional Haze

By Clint Bowman

The analysis described in this note seeks to find a data set suitable for the air quality modeling necessary to support the next phase of the Regional Haze SIP. It seeks to find a period that is both representative of the prevailing visibility in the Class I areas and is efficient in resource requirements. Because the metrics that determine an acceptable SIP consider only the best and worst quintiles of the distribution of visibility, this analysis seeks to find 365 day periods that have greater than average numbers of observations in those quintiles. It uses IMPROVE monitoring data from 20 western sites for the years 2007 through 2012.

Figure C.1 shows the location of 23 IMPROVE sites in the Northwest. They are color coded to show sites that have a strong seasonal variability (15 yellow markers)--specifically they have a higher proportion of poor visibility days in the winter and a lower proportion of poor visibility days in the summer compared with the incidence of good visibility days. The other set (5 red markers) seem to have a long six year period that peaks during the winter of 2009-2010 and a weak to non-existent seasonal component. The three sites with grey symbols were not used in this analysis.

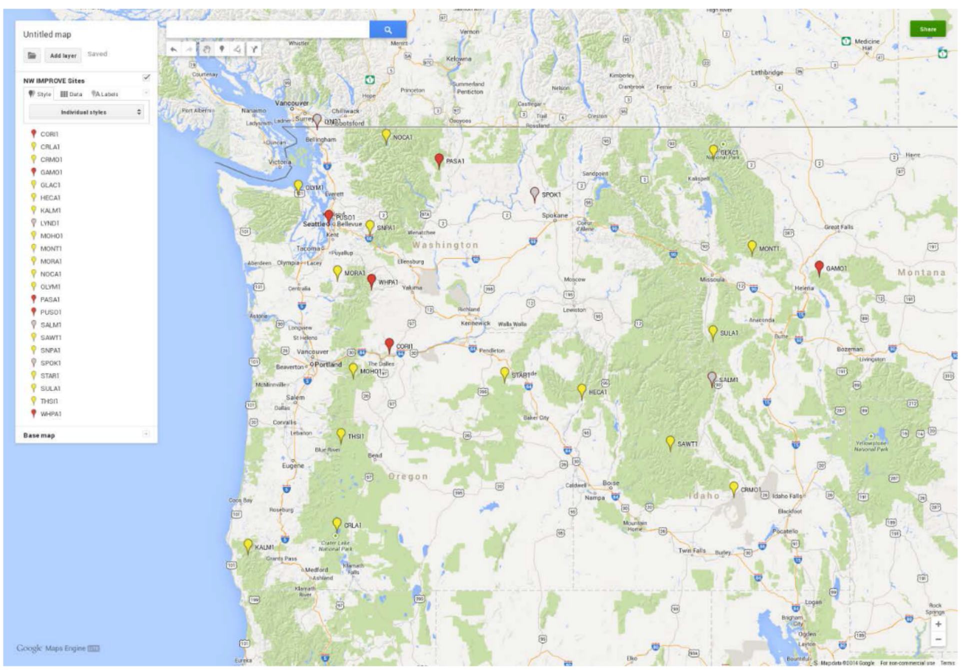


Figure C.1: IMPROVE Sites in the Pacific Northwest

Observations are classified in the extreme quintiles by computing the 20th and 80th percentile extinction using the entire six years of observations at each site. Figure C.2, C.3, and C.4 are time series of aerosol extinction coded so that observations falling in the middle three quintiles are plotted as zero, the worst visibilities are plotted as ones, and the best are plotted as minus one. The red line running through each timeseries is a running sum beginning with January 1, 2007. Time periods when there was a preponderance of poor visibility days show clearly as a positive slope. Conversely, periods of better visibility are shown by a negative slope.

Figure C.2 groups together sites that have a six month period of poor visibility beginning in 2009 followed by six months of good visibility. These sites also show a strong seasonal component. Figure C.3 is a similar time series for the sites that have a lesser seasonal component. The red lines show the boundaries of the period defined by the first group. Figure C.4 shows the three sites that can be best characterized as having a three year long period of worsening visibility followed by three years of improving visibility. Puget Sound (PUSO1) and White Pass (WHPA1) could be reasonably correlated but the site in Glacier National Park doesn't seem to fit.

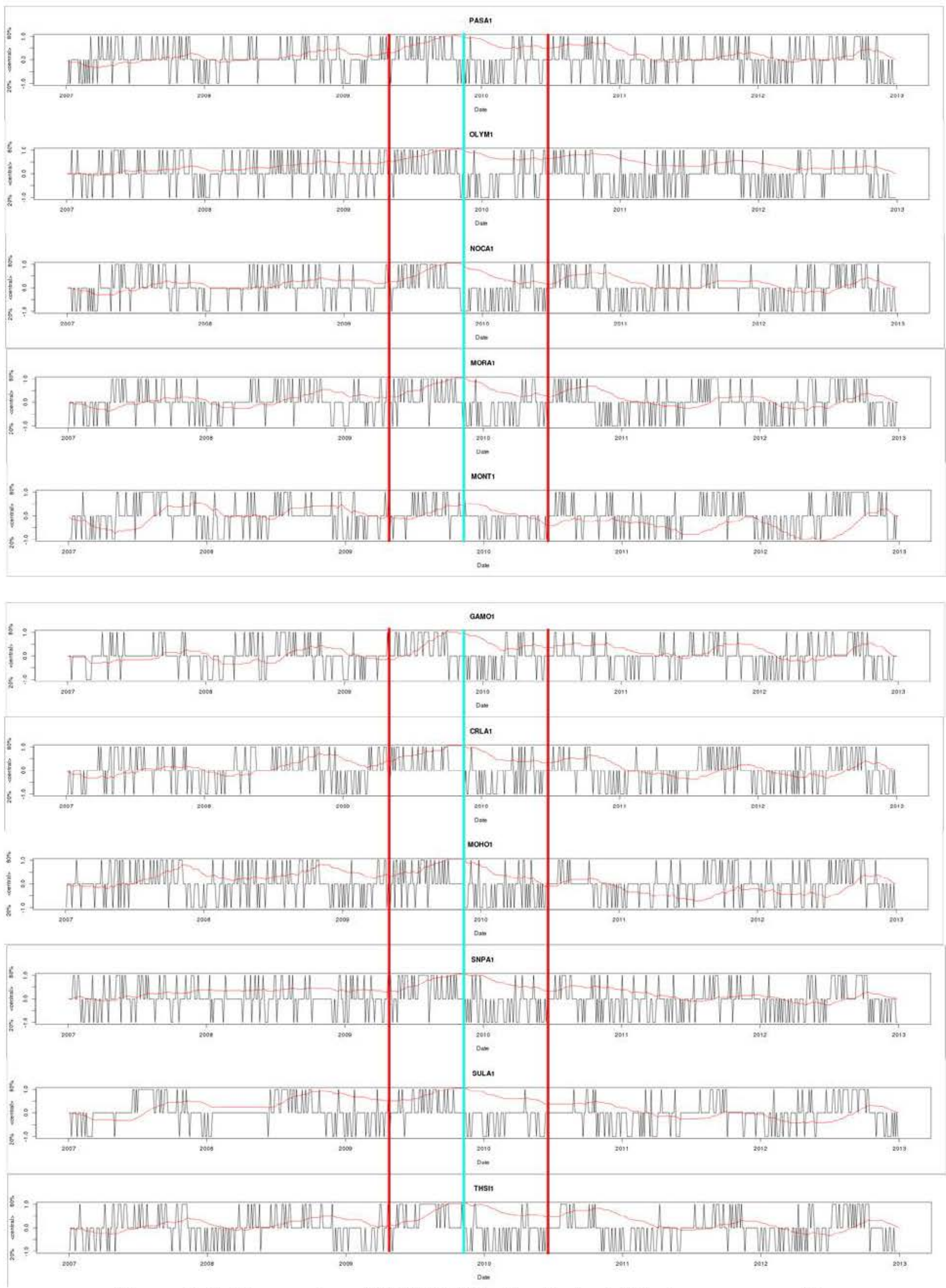


Figure C.2: Time series of IMPROVE sites that exhibit strong seasonality.

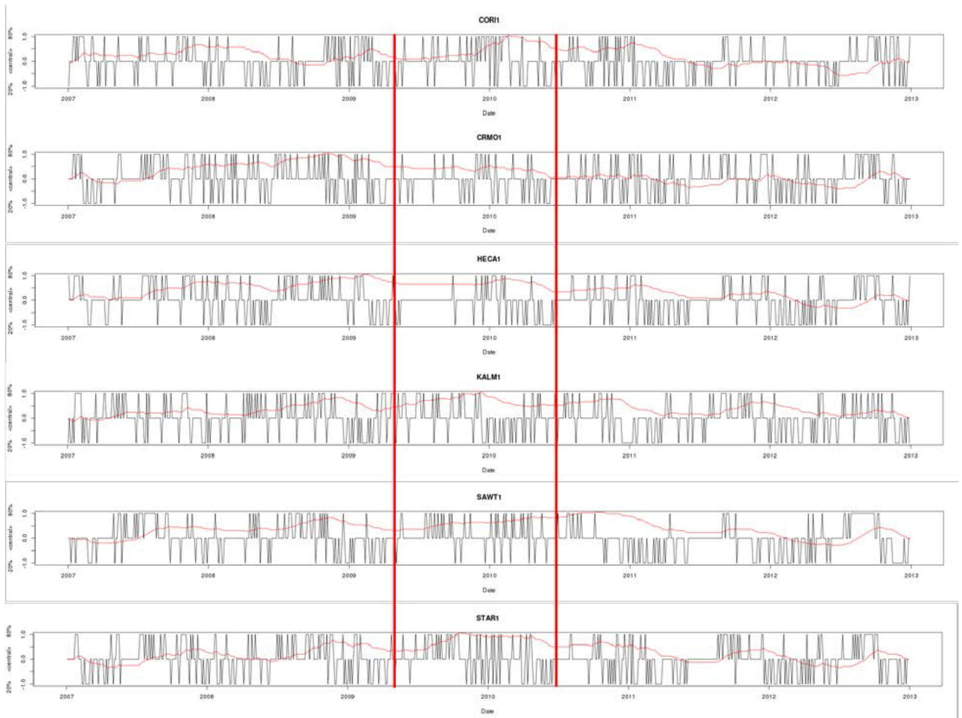

Figure C.3: Time series of IMPROVE sites with weak seasonality.

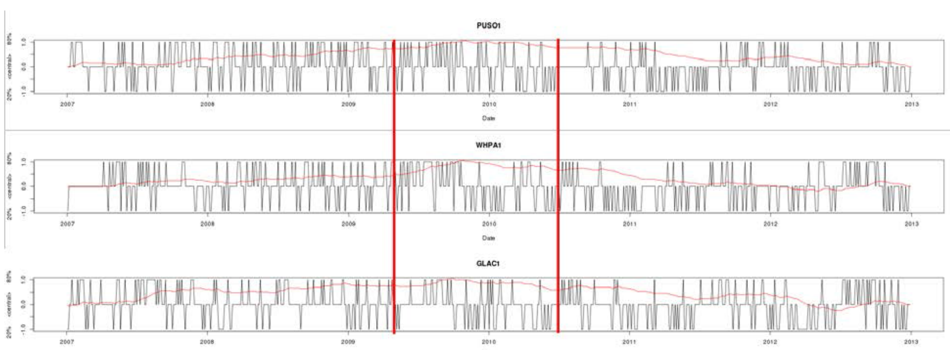

Figure C.4: Time series of IMPROVE sites with multi-year trends.

One additional goal is to find a one year period that will be computationally efficient. The ideal would be to find a twelve month period that minimizes the number of average observations by having only observations in the two extreme quintiles. To find periods that maximize the population of observations in the extreme quintiles, a running 365 day (122 of every third day observations) count of observations falling in the central three quintiles (between the 20th and 80th percentiles) was computed for each site and plotted in Figure C.5, C.6 and C.7 for the three groups of sites. The points are plotted at the 365th day. Most of the sites seem to reach a minimum in April 2010 which implies that the period from May 1, 2009 through April 30, 2010 may be the most efficient consecutive 12 month period.

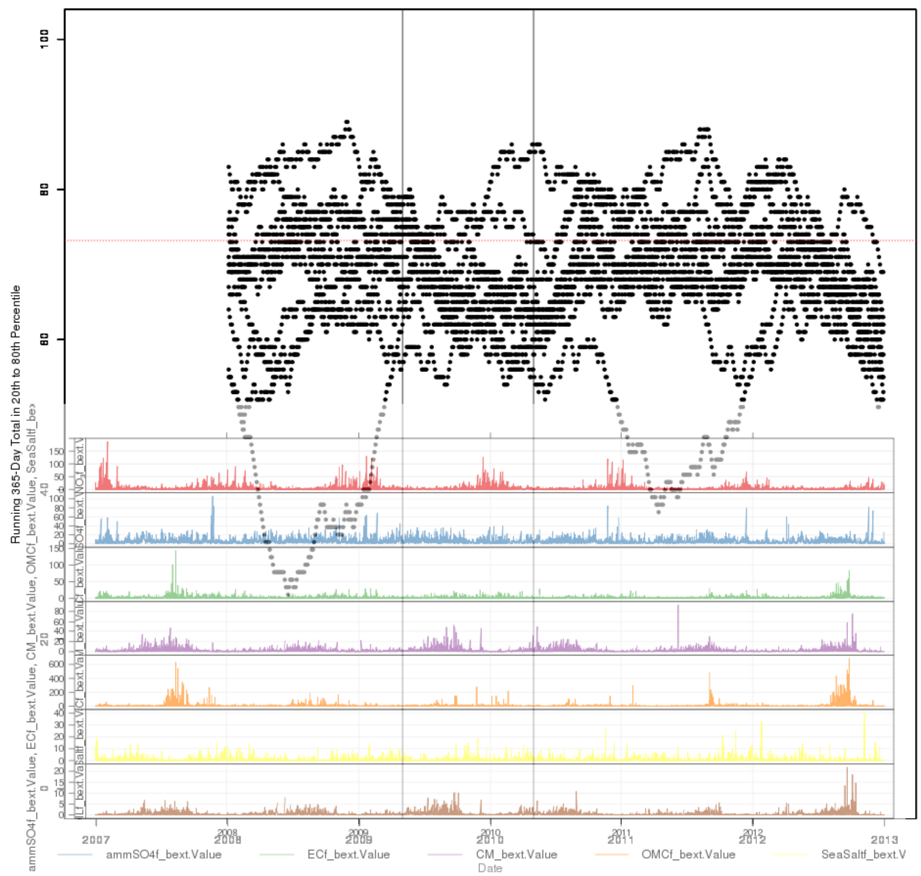


Figure C.5: Time series of running sum of middle quintile occurrences and observed species contributing to visibility degradation.

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The lower portion of each of these figures shows the time series of extinction using the daily maximum observation of all 20 sites produced by the six species known to contribute to visibility degradation: ammonium sulfate, ammonium nitrate, elemental carbon, coarse mass, organic matter (OMC), and sea salt. The wintertime increase in ammonium nitrate (the red series) is prominent in nearly every panel. The wildfires of 2007 and 2012 show prominently in the OMC time series. The two vertical black lines, drawn at May 1, 2009 and April 30, 2010, delineate the proposed twelve month period that can be used for air quality modeling to support the Regional Haze SIP analysis.

Table C.1: Number of occurrences of the best and worst quintile visibilities. Sites with fewer than 74 in the Neutral column are better than the long-term average when analyzing for the extreme quintiles

| Site | Best | Neutral | Worst |
|---|---|---|---|
| PASA1 | 22 | 70 | 28 |
| OLYM1 | 25 | 66 | 29 |
| NOCA1 | 29 | 64 | 27 |
| MORA1 | 27 | 65 | 28 |
| MONT1 | 15 | 90 | 15 |
| GAMO1 | 18 | 72 | 30 |
| CRLA1 | 22 | 76 | 22 |
| MOHO1 | 28 | 66 | 26 |
| SNPA1 | 27 | 61 | 32 |
| SULA1 | 16 | 85 | 19 |
| THSI1 | 21 | 63 | 36 |
| CORI1 | 17 | 72 | 31 |
| CRMO1 | 18 | 88 | 14 |
| HECA1 | 13 | 94 | 13 |
| KALM1 | 23 | 73 | 24 |
| SAWT1 | 8 | 86 | 26 |
| STAR1 | 18 | 71 | 31 |
| PUSO1 | 23 | 68 | 29 |
| WHPA1 | 23 | 59 | 38 |
| GLAC1 | 20 | 80 | 20 |

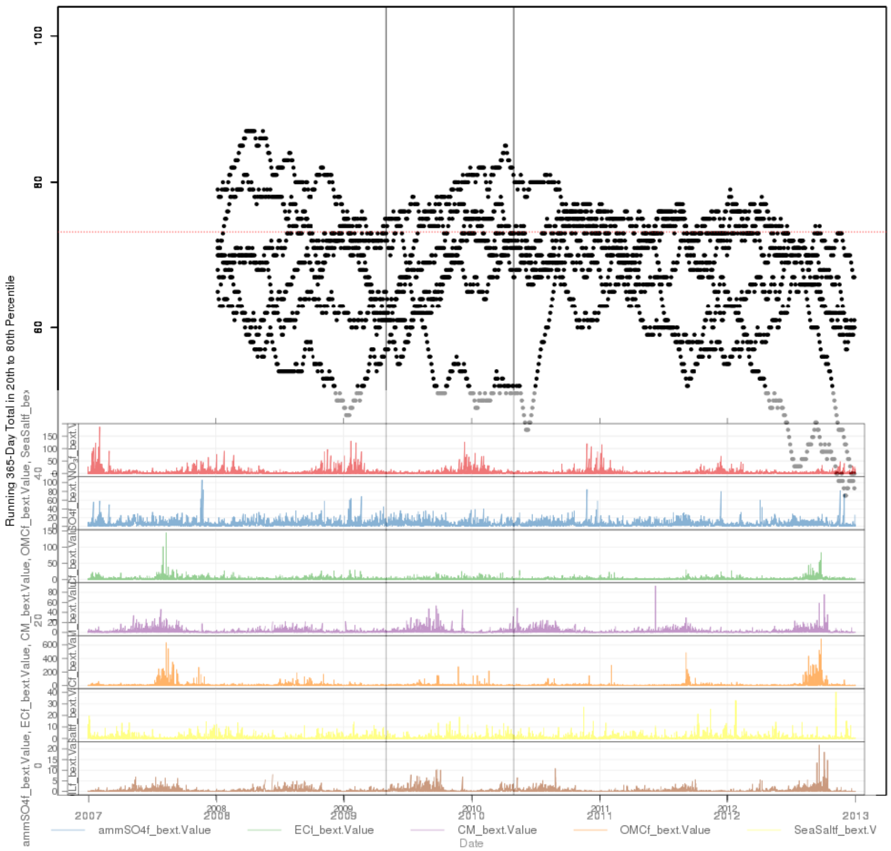

Figure C.6: Time series of cumulative days with visibilities in the middle quintiles

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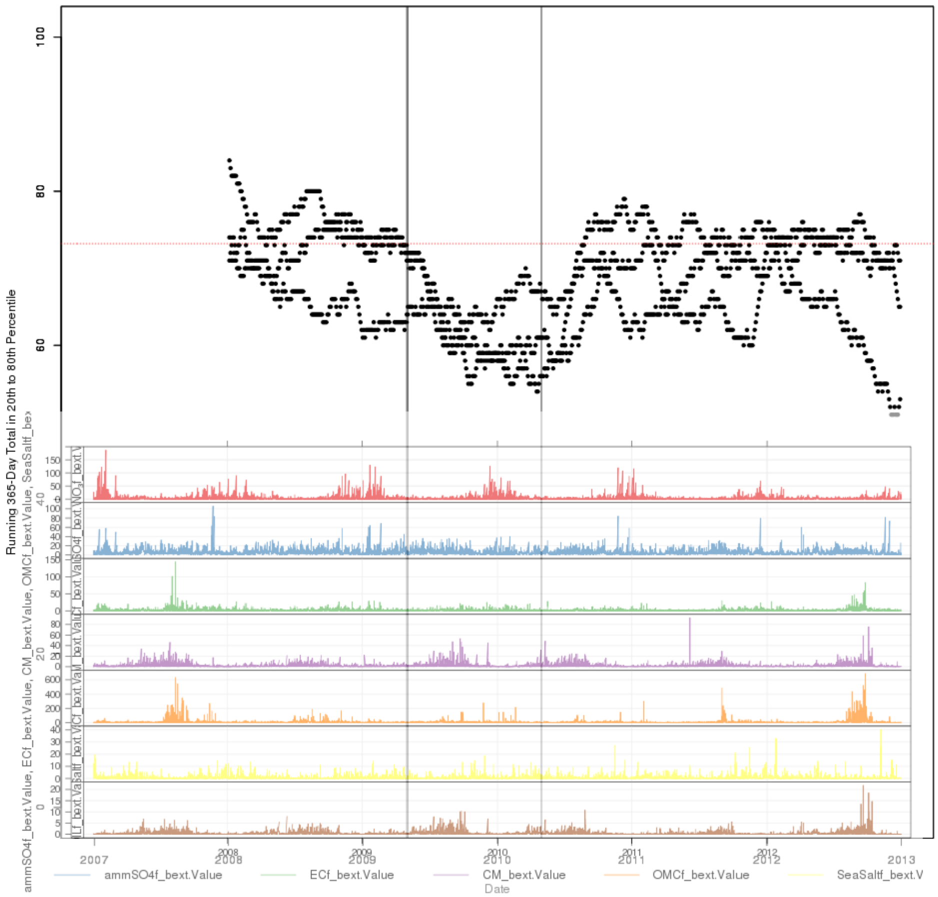


Figure C.7: Time series of cumulative days with visibilities in the middle quintiles.

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## Section C.3 Models and Methods

For this study, WSU's air quality forecasting system AIRPACT-4 (http://lar.wsu.edu/airpact) was used in a retrospective mode. Different components of the model and data used for each are briefly described in the sections below.

### C.3.1 Brief Model Description

**Spatial Domain:** The modeling study uses the 4-km AIRPACT-4 domain of 258 cells east-west by 285 cells north-south, composed of cells of 4 km by 4 km, as shown in Figure C.8.

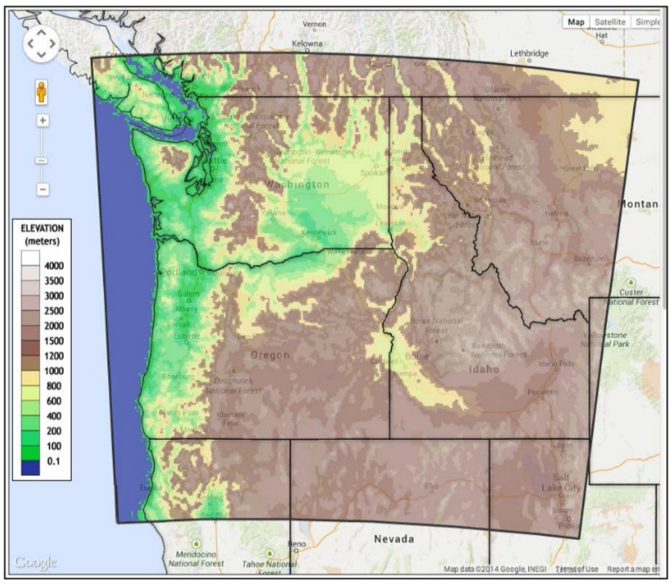


Figure C.8: The 4-km domain used in AIRPACT-4 is 258 cells east-west and 285 cells north-south, with the grid-cells being 4 km by 4 km. (from Vaughan et al., manuscript under review)

**Time Duration:** The period for this study was May 2009 – April 2010. The rationale for selecting this time period is given in Section C.2. AIRPACT-4 model reruns were performed for both the base case and RACT case.

**Meteorology:** The meteorological data for the study were acquired from the UW Pacific Northwest Environmental Forecasts and Observations mesoscale forecasting system, which runs nested domains of 36, 12, 4 and 1.33-km grid spacing. For the current work, archived 4-km WRF forecasts were reprocessed using MCIP v 3.6. It is important to recognize that the meteorological model output represents forecast conditions and is not based on any re-analysis incorporating weather observations. Performance of meteorological model is continuously evaluated and evaluation results are available at the website:
http://www.atmos.washington.edu/mm5rt/

**Chemical Transport Modeling:** The Community Multi-scale Air Quality Model, (CMAQ v4.7.1) was used on a 4-km grid with SAPRC99 chemistry and AE5 aerosol treatment.

**Boundary conditions:** The chemical boundary conditions were monthly mean chemical concentrations at the boundaries obtained by downscaling hourly output from MOZART-4 simulations (Emmons *et al.*, 2010).

**Initial conditions:** For the first day of the modeling period (May 1, 2009), initial conditions were based on idealized initial conditions. Subsequent daily runs in both the base case and RACT case used prior day results as initial conditions.

**Emissions:** Emissions for the model were taken from 2007 inventories provided by state agencies via NW-AIRQUEST. Emissions were processed using the SMOKE modeling system for point, area, mobile and biogenic sources. Emissions from forest fires were not included during any of the model runs. Two different emission scenarios were used which are described in Section C.4

### C.3.2 Calculation of Deciview in CMAQ

CMAQ uses two different approaches for calculation of extinction coefficients: the Mie theory method and the reconstructed extinction method. The reconstructed extinction coefficient calculation method is similar to the IMPROVE method (Byun & Ching, 1999), and uses the following formula:

$$\beta_{ext} = 3 * f(RH) * \{ [(NH_4)_2SO_4] + [(NH_4NO_3]\} + 4 * [OM] + 10 * [EC] + 1 * [Soil] + 0.6 * [Coarse\ Mass] + \beta_{Ray} \quad (C1)$$

Where [$SO_4^{2-}$], [$NO_3^-$], [$NH_4^+$], [OM], [EC] and [Soil] are the concentrations (μg/$m^{-3}$) of sulfate, nitrate, ammonia, organic mass, elemental carbon and, soil respectively in $PM_{2.5}$. $f$(RH) is a dimensionless relative humidity adjustment factor. [CM] is the concentration of coarse particulate matter, which is not used because of the large uncertainties in the coarse particulate matter emission inventory. $\beta_{Ray}$ is the Rayleigh extinction coefficient.

$\beta_{ext}$ is converted to deciviews using the following relationship:

$$DCV = 10 * \ln(\beta_{ext}/10) \quad \text{(C2)}$$

Under many conditions, a change of 1 deciview is perceptible by humans. However, a similar decrease in particle loading during a hazy condition will have less impact on visibility compared to a clean day. Natural visibility in Western US is estimated to be 178 - 186 km which corresponds to approximate deciview value of 8 dv (Malm, 1999) (Figure C.9)

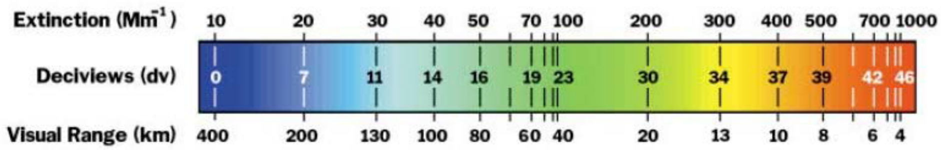


Figure C.9: Comparison of extinction, deciviews and visual range (Source: Malm, 1999)

## Section C.4 Description of Modeling Scenarios

The pre-RACT baseline and the post-RACT model runs are summarized in Sections C.4.1 and C.4.2:

### C.4.1 Baseline Emissions (1st Modeling Scenario)

The 2007 emission inventory was used for this scenario except for an adjustment to the Cosmo facility. Because Cosmo did not operate from 2007 -2010, emission inventories indicate that there were no emissions from this facility for those years. After an evaluation of emission inventories for the years 2005, 2006, and 2011, the 2011 data were used to represent Cosmo's emissions in the base case. However, an error in processing the emission files resulted in no base case emissions for the Cosmo facility. This was addressed, without re-running the base case, as described below.

For Cosmo the RACT case involves both $SO_2$ and $PM_{2.5}$ reductions. The net reduction in emissions is calculated between base case and RACT case as shown in Table C.2. Weighing of PM emissions by particulate species fraction for the SCC codes associated with Cosmo and their respective extinction coefficients don't result in significant changes to this percentage.

Table C.2: Cosmo emissions for the Base and RACT cases.

| **Case** | **$PM_{10}$** | **NOx** | **$PM_{2.5}$** | **$SO_2$** |
|---|---|---|---|---|
| BASE emissions | 272 | 367.13 | 272 | 214 |
| RACT emissions | 272 | 367.13 | 174.5 | 50.07 |
| Net reduction of emissions | $=1- (PM_{10} + NOx + PM_{2.5} + SO_2)_{RACT} / (PM_{10} + NOx + PM_{2.5} + SO_2)_{BASE}$<br>=1- (864.33/1125.13)*100 = 23.2% | | | |

The BASE case with Cosmo emissions included (i.e. true baseline) is then approximated by linearly upscaling the RACT case deciviews attributable to Cosmo, by the net emissions change:

BASE with Cosmo impacts = (RACT- BASE without Cosmo) / (1-0.232).

This increase in deciviews is applied to an array of grid cells around the Cosmo facility (all cells lying between row 165-225 and column 15-60) (Figure C.10). The deciview results after adjustment for these grid cells are then incorporated into the overall BASE case results and this adjusted BASE case is used for calculating the 8th highest delta deciviews.

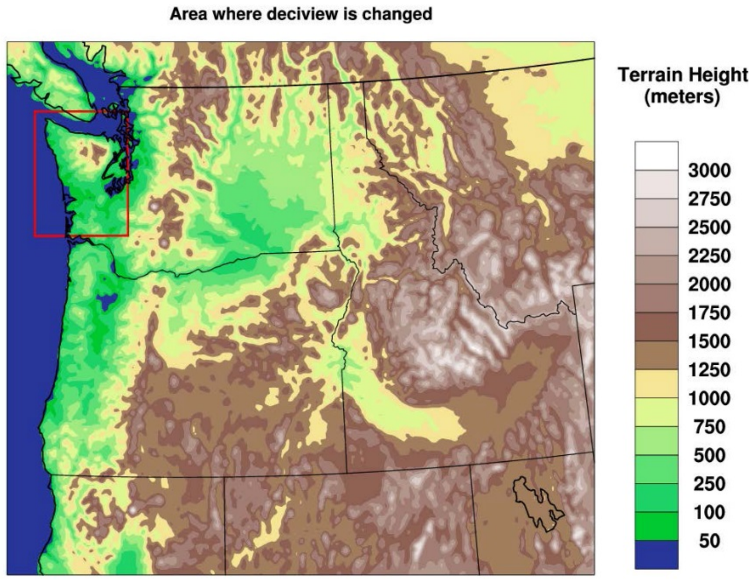


Figure C.10: Area in the domain where base case deciview is increased is shown in the red box

### C.4.2 RACT Limited Emissions (2nd Modeling Scenario)

For this scenario, Ecology applied RACT limit adjustments to the baseline scenario described in Section C.4.1. As detailed in Chapter 4, measured or calculated emissions are averages of compliance tests or are calculated from averages of multi-year emission inventory emissions and other stack parameter information. Estimated emission reductions are the difference between average annual emissions and the average annual emissions multiplied by the ratio of emission at the proposed RACT limit to measured or calculated emission. Ecology's approach is based on a survey of average emission reductions using average emission inventory emissions from multiple years, so that the average individual unit percent reduction is assumed to be applicable to approximately any given year that the facility operated around this timeframe.

Based on Table 4.2.1, Figures 4.2.1, 4.2.2, and Section 4.4.1, the following maximum potential emission reductions using the lowest demonstrated limits in Washington State were used in this scenario:

- For recovery furnaces, the lowest $SO_2$ emission limit demonstrated in Washington State is 10 parts per million (ppm),
- For recovery furnaces, the lowest PM emission limit demonstrated in Washington State is 0.027 gr/dscf @ 8% O2.

Recovery furnace NOx emission reductions and lime kiln emission reductions for $SO_2$, PM, and NOx were less than these two emission reductions, and therefore, were set aside for potential future modeling scenarios depending on the results of the second scenario. Based on the results of the second scenario presented in the next section (Section C.5), Ecology determined that additional modeling scenarios were not needed.

The following percentage reductions from the baseline emissions were used:

Table C.3: Facility Emissions and Post-RACT Adjustments

| Facility | Total Facility Emissions (tpy) for $SO_2$ and $PM_{2.5}$ | | Percent Emission Reductions below Individual Recovery Furnace Unit SO2 Baseline using Potential RACT limit(a)(b) | Percent Emission Reductions below Individual Recovery Furnace Unit PM Baseline using Potential RACT limit (a)(b) |
|---|---|---|---|---|
| | $SO_2$ BASE (RACT) | $PM_{2.5}$ BASE (RACT) | | |
| Boise White Wallula | 684 (157) | 179 (179) | (94% / 80%) | 0% |
| WestRock | 693 (313) | 105 (105) | (95%) | 0% |
| Cosmo | 214 (50) | 272 (174.5) | (97%) | (50%) |
| PTPC | 123 (106) | 261 (261) | (64%) | 0% |
| Weyerhaeuser | - | - | 0% | 0% |
| GP Camas | - | - | 0% | 0% |
| KapStone | 275 (223) | 109 (109) | (67%/64%/88%) | 0% |

(a) Total facility emission reductions below baseline emissions are based on each facility's recovery furnace emission reductions from each unit specific baseline emissions. For facilities with multiple recovery furnaces, the respective recovery furnace identifiers are as follows: Boise White Wallula (Recovery Furnace No. 2/Recovery Furnace No. 3); Kapstone (Recovery Furnace 18/ Recovery Furnace 19/ Recovery Furnace 22)

(b) These emission reductions are based on using a potential 10 parts per million (ppm) SO2 RACT limited emission and a potential 0.027 gr/dscf @ 8% O2 PM RACT limited emission.

These emissions, including the Cosmo facility, were included in the RACT simulation case.

## Section C.5 Regional Haze Modeling Results and Discussion

In the sections below, we describe the results from model performance evaluation for different $PM_{2.5}$ species. This is followed by presentation of the effects of the RACT implementation on visibility in wilderness areas in Washington, Oregon, Idaho and Montana.

### C.5.1 $PM_{2.5}$ Model Performance Evaluation Results

The mean contribution of different species to total $PM_{2.5}$ mass at all the sites for different seasons for years 2009-10 is shown in Figure C.11. OC and $(NH_4)_2SO_4$ are the dominate species contributing to total $PM_{2.5}$ mass for summer and fall months. The contribution of $NH_4NO_3$ becomes significant during winter months.  While there are obvious differences in total PM2.5 mass concentration between the observations and the model results, the relative contributions of different species is approximately the same.

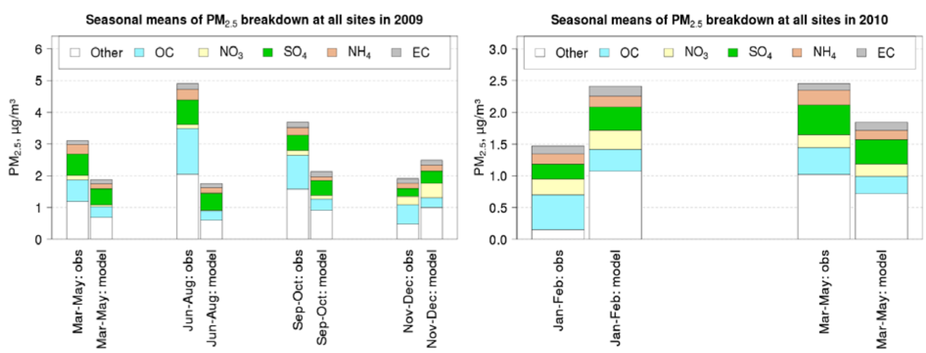


Figure C.11: Observed and modeled seasonal mean of $PM_{2.5}$ for the 2009-10 modeling period.

The Mean Fractional Bias (MFB) and Mean Fractional Error (MFE) (Table C.4) were used for model performance evaluation; these measures have been suggested to be the preferred model performance measures for $PM_{2.5}$ evaluation purposes (Boylan and Russell, (2009).

Table C.4: Metric used for model performance evaluation

| **Metric** | **Equation** |
|---|---|
| Mean Fractional Bias (%)<br>(-200% to +200%) | $FB = \frac{1}{N}\sum_{i=1}^{N}\frac{(C_m - C_o)}{(C_m + C_o)/2}$ |

| | |
|---|---|
| Mean Fractional Error (%)<br>(0% to +200%) | $$FE = \frac{1}{N}\sum_{i=1}^{N}\frac{\lvert C_m - C_o\rvert}{(C_m + C_o)/2}$$ |

MFB and MFE were calculated over all IMPROVE sites for each of the model species shown in the Table C.5. Elemental carbon and sulfate have low bias compared to other species and MFB is close to the median MFB from various model studies reported in Simon et. al. (2012) (Figure C.12). Organic carbon and ammonium aerosols each have a large negative bias and a much lower than the median MFB reported in Simon et al. (2012). However, Simon et. al. report larger negative bias for nitrate and ammonium in the western US compared to the eastern US. In general, the model performance summarized here is similar to results from other air quality model evaluation studies.

Table C.5: MFB and MFE for all $PM_{2.5}$ species (calculated over all IMPROVE sites)

| **PM Species** | **MFB (%)** | **MFE** |
|---|---|---|
| Total $PM_{2.5}$ | -31 | 72 |
| Organic Carbon (OC) | -70 | 103 |
| Elemental Carbon (EC) | -12 | 75 |
| Sulfate ($SO_4^{2-}$) | 9 | 52 |
| Nitrate ($NO_3^-$) | -42 | 115 |
| Ammonium ($NH_4^+$) | -37 | 67 |

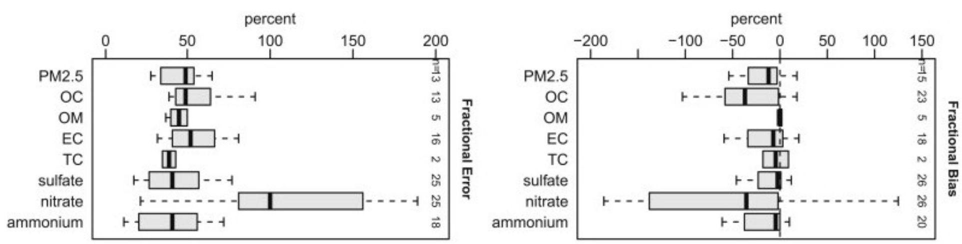


Figure C.12: PM MFB/MFE from various modeling studies reported in Simon et. al. (2012)

The MFB and MFE at each individual IMPROVE site in the modeling domain is shown in the Table C.6.

Table C.6: $PM_{2.5}$ Mean Fractional Bias (MFB) and Mean Fractional Error (MFE) at each IMPROVE site in the model domain

| Site No. | Site Name | Site ID | $PM_{2.5}$ | | PM OC | | PM $SO_4$ | | # Obs |
|---|---|---|---|---|---|---|---|---|---|
| | | | MFB (%) | MFE (%) | MFB (%) | MFE (%) | MFB (%) | MFE (%) | N |
| 1. | Craters of the Moon | 160230101 | -48 | 83 | -86 | 104 | 0 | 43 | 115 |
| 2. | Sawtooth | 160370002 | -83 | 88 | -164 | 164 | 3 | 45 | 102 |
| 3. | Glacier | 300299001 | -13 | 54 | -90 | 93 | -11 | 48 | 115 |
| 4. | Gates of the Mountains | 300499000 | -24 | 85 | -69 | 106 | 11 | 54 | 104 |
| 5. | Monture | 300779000 | -75 | 88 | -125 | 126 | -8 | 51 | 113 |
| 6. | Sula Peak | 300819000 | 41 | 71 | -48 | 95 | 1 | 42 | 108 |
| 7. | Mt Hood | 410050010 | 29 | 65 | 38 | 101 | 34 | 59 | 115 |
| 8. | Kalmiopsis | 410330010 | -67 | 72 | -118 | 119 | 20 | 58 | 119 |
| 9. | Crater Lake | 410358001 | -54 | 72 | -84 | 103 | 11 | 50 | 117 |
| 10. | Three Sisters | 410390070 | -17 | 73 | -54 | 92 | 26 | 57 | 115 |
| 11. | Starkey | 410610010 | -66 | 82 | -107 | 120 | -8 | 44 | 122 |
| 12. | Hells Canyon | 410630002 | -60 | 78 | -109 | 111 | -5 | 38 | 115 |
| 13. | Olympic | 530090020 | -15 | 55 | -20 | 83 | 13 | 46 | 120 |
| 14. | Snoqualmie Pass | 530370004 | -31 | 75 | -71 | 99 | 5 | 57 | 121 |
| 15. | Wishram CORI | 530390011 | -43 | 60 | -76 | 81 | -14 | 47 | 122 |
| 16. | White Pass | 530410007 | -18 | 75 | -36 | 106 | 34 | 65 | 118 |
| 17. | Pasayten | 530470012 | -38 | 84 | -73 | 115 | 20 | 59 | 113 |
| 18. | Mt Rainier | 530530014 | -35 | 55 | -38 | 78 | 13 | 56 | 117 |
| 19. | North Cascades | 530730022 | -53 | 76 | -73 | 115 | 3 | 56 | 120 |
| 20. | Seattle Beacon Hill | 530330080 | 38 | 53 | 11 | 48 | 39 | 58 | 119 |

The MFB and MFE for total $PM_{2.5}$, organics carbon and sulfate are shown in Figure C.13, where the MFB and MFE are compared to performance goals and criteria. These graphs show that the model has reasonably good performance with 16 out of 20 IMPROVE sites within the performance criteria[1] for $PM_{2.5}$, 7 out of 20 sites within the performance criteria for OC and all sites within the criteria for sulfate.

The MFB and MFE show strong seasonal behavior for all $PM_{2.5}$ species (Figure C.14). In general, the MFB (calculated for all sites) shows an underprediction during summer and slight overprediction during winter. Also the interquartile range is largest during the winter months,

[1] Sites outside MFB are:Sawtooth, Monture, Kalmiopsis, Starkey

whereas summer months exhibit a relatively small interquartile range, with most MFB values being negative, indicating that model performance is a strong function of the site location.

**Summary of the model performance evaluation results:**

1. Organic carbon and ammonium sulfate dominate $PM_{2.5}$ mass for most part of the year. Ammonium nitrate also becomes important during winter months.
2. The model performance evaluation against MFB and MFE goals and criteria indicates that model demonstrates reasonable performance for $PM_{2.5}$, EC, $SO_4^{2-}$ and $NH_4^+$.
3. The model overpredicts $PM_{2.5}$ during winter and underpredicts during other times of year. This seasonality is observed for all PM species.
4. The negative bias in OC during late summer and early fall may be due to the omission of wildfire emissions from CMAQ during June-September.

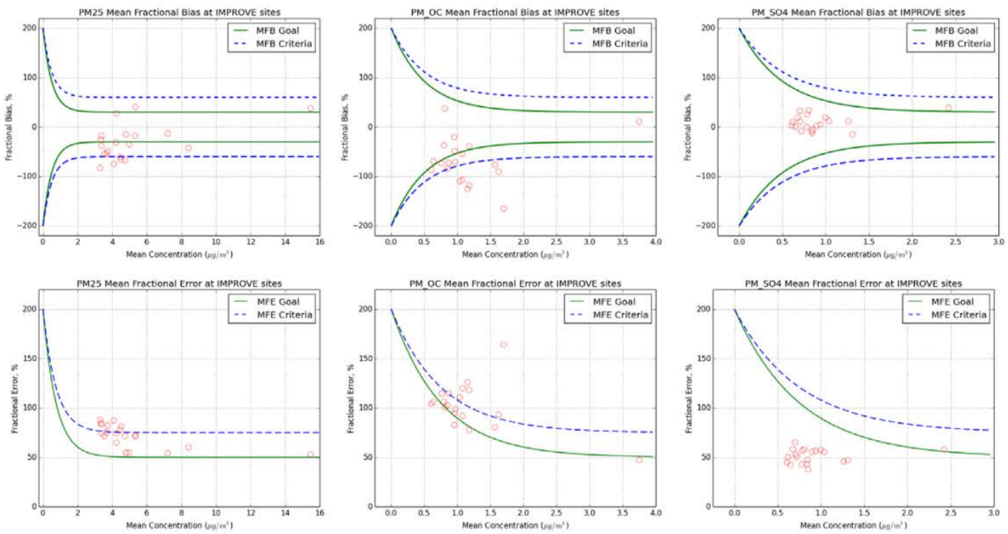


Figure C.13: MFB and MFE in $PM_{2.5}$, OC and sulfate aerosol mass prediction for all IMPROVE sites for the study period.

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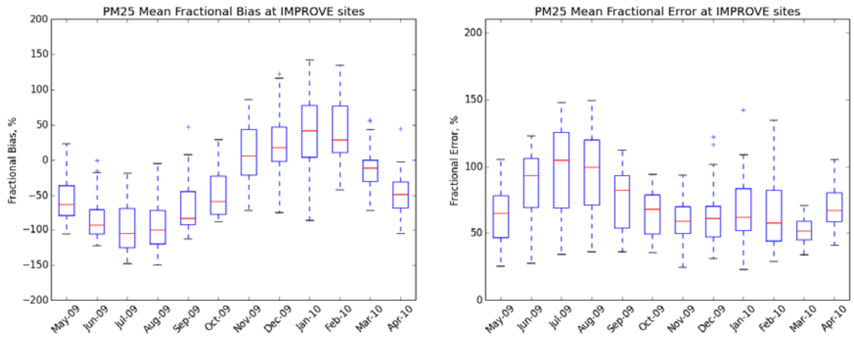


Figure C.14: Box-whisker plots showing monthly variation in MFB and MFE in PM2.5 aerosol mass prediction at all IMPROVE sites

### C.5.2 Visibility Modeling Results

#### C.5.2.1 Visibility Model Evaluation

Modeled visibility data were extracted and the reconstructed deciviews and extinction coefficients were compared to these visibility parameters based on the IMPROVE data. Time series of modeled and observed devicviews, shown in Figure C.15-C.16, exhibit a high degree of variability over time and by site. At some times and sites, the modeled deciview is much higher than observed, while at other times and sites, the reverse is true.

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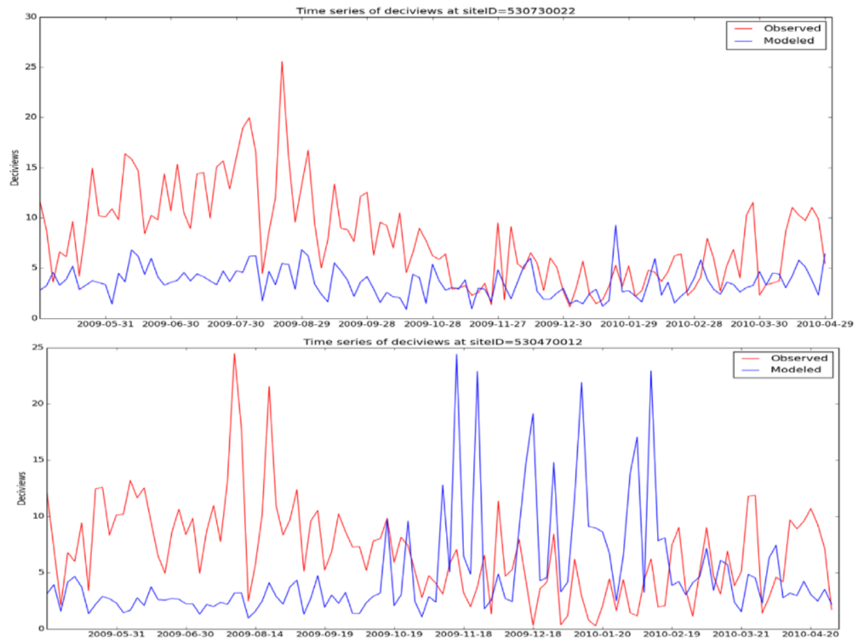


Figure C.15: Time series for comparison of modeled and observed deciviews at North Cascades (top), and Pasayten (bottom)

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Figure C.16: Comparison of modeled and observed deciviews at Wishram (top), and Mt. Rainier (bottom)

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Figure C.17 shows the QQ plot of observed and modeled deciviews for all the IMPROVE sites. The model underpredicts deciviews by 2-5 deciviews when deciviews between 5-20 are observed. The predictions are closer to observations at higher deciviews. The differences between model and observations for visibility are, in part, related to errors in meteorological model results for relative humidity (see discussion in C.5.2.4).

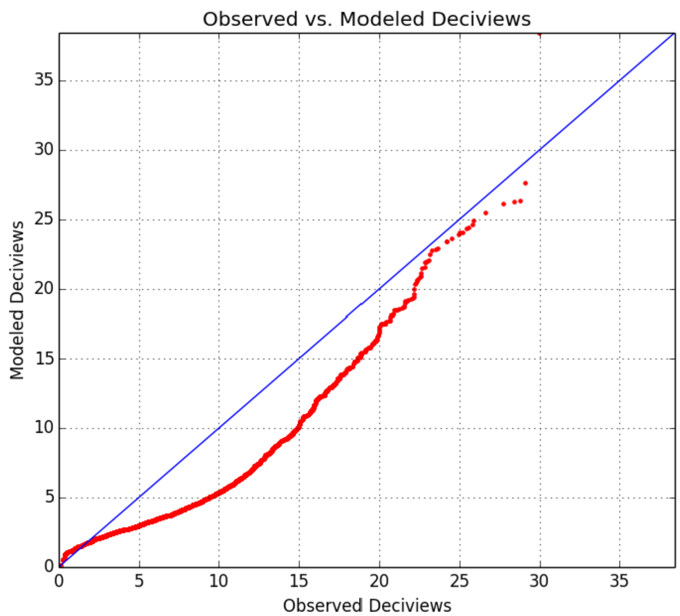


Figure C.17: QQ plot of observed and modeled deciviews at all IMPROVE sites

**C5.2.2 Deciview differences between RACT and BASE case model runs**

Table C.7 shows the deciview differences for the worst and 8$^{th}$ worst visibility days between the RACT and BASE case model runs for IMPROVE sites in Washington. The differences between the RACT and BASE cases are very small relative to BASE case deciviews in the range from 3 to 25. Thus, effectively there is no observable difference between BASE and RACT visibility at IMPROVE sites in Washington.

Table C.7: Deciview difference for 1st highest and 8th highest observed deciview for sites in Washington

| | Site name | Observed dv | Modeled dv | | Δdv |
|---|---|---|---|---|---|
| | | | BASE | RACT | |
| 1st Highest | North Cascades | 25.552 | 5.460 | 5.458 | 0.002 |
| | MtRainier | 18.795 | 6.832 | 6.827 | 0.004 |
| | Pasayten | 24.482 | 3.182 | 3.181 | 0.001 |
| | White Pass | 29.939 | 5.518 | 5.516 | 0.002 |
| | Wishram CORI | 28.791 | 25.488 | 25.486 | 0.002 |
| | Snoqualmie Pass | 20.421 | 5.709 | 5.707 | 0.002 |
| | Seattle Beacon | 25.437 | 18.946 | 18.946 | 0.000 |
| | Olympic | 19.903 | 10.866 | 10.866 | 0.000 |
| 8th Highest | North Cascades | 15.958 | 4.695 | 4.693 | 0.002 |
| | MtRainier | 16.827 | 11.787 | 11.779 | 0.008 |
| | Pasayten | 12.450 | 2.177 | 2.176 | 0.001 |
| | White Pass | 13.417 | 7.311 | 7.308 | 0.003 |
| | Wishram CORI | 22.946 | 6.921 | 6.918 | 0.003 |
| | Snoqualmie Pass | 16.960 | 5.336 | 5.336 | 0.000 |
| | Seattle Beacon | 22.564 | 14.369 | 14.369 | 0.000 |
| | Olympic | 15.038 | 5.770 | 5.769 | 0.000 |

Since no meaningful difference was observed between the RACT and BASE case visibility at the IMPROVE sites during the days of 1st and 8th highest deciviews, we also show the 1st and 8th highest deciview differences between RACT and BASE case (Table C.8). While these results show that the improvement in visibility due to RACT emissions reduction does not necessarily occur during the worst visibility days, even the largest differences are quite small. The highest Δdv was 0.287 at White Pass in Washington, followed by 0.155 at Snoqualmie Pass.

In Table C.9, we also show highest deciview differences between the RACT and BASE cases for Non-IMPROVE sites (AIRNOW sites). Only those sites where the maximum Δdv was greater than 0.10 were tabulated. At these sites, larger visibility improvements are seen compared to IMPROVE sites, with the maximum Δdv equal to 0.61 at Mesa in Washington. However, for these maximum differences, the change between the RACT and BASE cases is still quite small.

Table C.8: 1st Highest and 8th highest deciview differences at IMPROVE sites in WA and OR
(Δdv may not correspond to worst visibility days)

| IMPROVE Sites in WA & OR | | Δdv (BASE case – RACT case) | |
|---|---|---|---|
| **Site ID** | **Site Name** | **1st highest** | **8th highest** |
| 530410007 | White Pass (WA) | 0.2869 | 0.0173 |
| 530370004 | Snoqualmie Pass (WA) | 0.1553 | 0.049 |
| 530470012 | Pasayten (WA) | 0.0803 | 0.0157 |
| 530530014 | Mt Rainier (WA) | 0.062 | 0.0112 |
| 530330080 | Seattle Beacon (WA) | 0.0601 | 0.0167 |
| 530390011 | Wishram CORI (WA) | 0.037 | 0.0129 |
| 410358001 | Crater Lake (OR) | 0.0294 | 0.0038 |
| 530730022 | North Cascades (WA) | 0.0183 | 0.0136 |
| 530090020 | Olympic (WA) | 0.0113 | 0.0023 |
| 410330010 | Kalmiopsis (OR) | 0.0181 | 0.0015 |
| 410390070 | Three Sisters (OR) | 0.0247 | 0.0057 |
| 410610010 | Starkey (OR) | 0.0418 | 0.0168 |
| 410630002 | Hells Canyon (OR) | 0.0123 | 0.0045 |

Table C.9: 1st Highest and 8th highest deciview differences at selected Non IMPROVE sites in WA and OR
(Δdv may not correspond to worst visibility days)

| Non-IMPROVE Sites in WA & OR | | Δdv (BASE case – RACT case) | |
|---|---|---|---|
| **Site ID** | **Site Name** | **1st highest** | **8th highest** |
| 530210002 | Mesa-Pepoit Way | 0.61 | 0.09 |
| 410591003 | Hermiston - Municipal Airport | 0.48 | 0.20 |
| 530272002 | Aberdeen-Division St | 0.42 | 0.26 |
| 410590121 | Pendleton - McKay Creek | 0.39 | 0.15 |
| 530750005 | Lacrosse-Hill St | 0.32 | 0.06 |
| 530710005 | Walla Walla-12th St | 0.31 | 0.07 |
| 530010003 | Ritzville-Alder St | 0.27 | 0.07 |
| 530750006 | Rosalia-Josephine St | 0.27 | 0.04 |
| 530332004 | Kent-James & Central | 0.24 | 0.06 |
| 530330023 | Enumclaw Mud Mt (SO) | 0.19 | 0.02 |
| 530330017 | North Bend Way (SO) | 0.17 | 0.05 |
| 530330039 | Seattle-Queen Anne Hill | 0.17 | 0.04 |
| 530630001 | Cheney-Turnbull | 0.15 | 0.05 |
| 530270008 | Oakville-Chehalis Tribe | 0.15 | 0.10 |
| 530130002 | Dayton-W Main | 0.15 | 0.05 |
| 530330024 | Lake Forest Park-Town Center | 0.14 | 0.04 |
| 530530012 | Mt Rainier- Jackson Visitor Ctr | 0.13 | 0.01 |
| 530330037 | Bellevue-Bellevue Way | 0.13 | 0.05 |

| Non-IMPROVE Sites in WA & OR | | Δdv (BASE case – RACT case) | |
|---|---|---|---|
| **Site ID** | **Site Name** | **1st highest** | **8th highest** |
| 530670013 | Lacey-College St | 0.12 | 0.06 |
| 530490002 | Raymond Commercial St. | 0.12 | 0.05 |
| 530530031 | Tacoma-Alexander Ave | 0.12 | 0.06 |
| 530450007 | Shelton-W Franklin | 0.11 | 0.07 |
| 410170122 | Bend - Road Department | 0.11 | 0.01 |
| 530251002 | Moses Lake-Balsam St | 0.11 | 0.06 |
| 530639999 | Airway Heights-West 12th | 0.10 | 0.04 |

### C.5.2.3 Impact on Visibility in National Parks and Wilderness Areas

The modeled visibility data for the BASE and RACT cases were extracted and the 8th highest deciview difference was calculated for grid cells where at least half of the area of the cell was within any Class I wilderness area or national park. The maximum 8th highest Δdv occurring within each Class I area is shown in Table C.10. Modeled Δdv are small with improvements greater than 0.1 dv occurring at only two locations – Alpine Lake Wilderness, and Glacier Peak Wilderness as shown in the table below. Thus, improvements in these areas due to potential RACT limits on emissions are very small.

Table C.10: 8th highest delta deciview over modeled period (98th percentile delta deciview)

| S. No. | Class I / Wilderness areas in WA/OR/ID | Row # in model domain | Column # in model domain | Δdcv Visibility Impacts due to Potential RACT limit |
|---|---|---|---|---|
| 1. | Alpine Lakes Wilderness | 200 | 83 | 0.127 |
| 2. | Columbia River Gorge NP | 144 | 82 | 0.029 |
| 3. | Crater Lake NP | 76 | 64 | 0.017 |
| 4. | Craters of the Moon NP | 94 | 232 | 0.011 |
| 5. | Diamond Peak Wilderness | 90 | 64 | 0.018 |
| 6. | Eagle Cap Wilderness | 136 | 159 | 0.030 |
| 7. | Gearhart Mountain Wilderness | 61 | 89 | 0.007 |
| 8. | Glacier Peak Wilderness | 208 | 85 | 0.117 |
| 9. | Goat Rocks Wilderness | 168 | 78 | 0.038 |
| 10. | Hells Canyon Wilderness | 150 | 168 | 0.033 |
| 11. | Kalmiopsis Wilderness | 54 | 28 | 0.006 |
| 12. | Mount Adams Wilderness | 161 | 77 | 0.030 |
| 13. | Mount Baker Wilderness | 228 | 69 | 0.057 |
| 14. | Mount Hood Wilderness | 140 | 72 | 0.022 |

| S. No. | Class I / Wilderness areas in WA/OR/ID | Row # in model domain | Column # in model domain | Δdcv Visibility Impacts due to Potential RACT limit |
|---|---|---|---|---|
| 15. | Mount Jefferson Wilderness | 117 | 71 | 0.031 |
| 16. | Mount Rainier NP | 179 | 72 | 0.037 |
| 17. | Mount Washington Wilderness | 111 | 70 | 0.041 |
| 18. | Mountail Lakes Wilderness | 58 | 64 | 0.009 |
| 19. | North Cascades NP | 223 | 83 | 0.080 |
| 20. | Olympic National Park | 198 | 35 | 0.023 |
| 21. | Pasayten Wilderness | 228 | 93 | 0.045 |
| 22. | Sawtooth Wilderness | 109 | 200 | 0.021 |
| 23. | Selway Bitterroot Wilderness | 167 | 194 | 0.053 |
| 24. | Spokane Tribe Class I area | 209 | 138 | 0.053 |
| 25. | Strawberry Mt Wilderness | 110 | 132 | 0.015 |
| 26. | Three Sisters Wilderness | 104 | 72 | 0.044 |
| 27. | Yellowstone National Park | 124 | 277 | 0.016 |

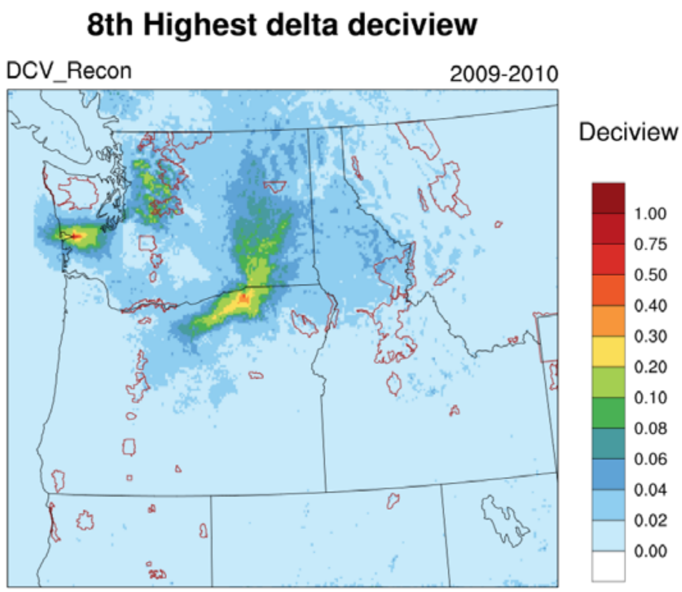

Figure C.18: Map of 8th highest deciview difference due to potential RACT emission limits. Class I boundaries are also shown

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A map of the 8$^{th}$ highest deciview difference is shown in Figure C.18. Most of the change in 8$^{th}$ highest $\Delta$dv occurs in southwestern Washington, potentially due to RACT emissions reduction from the Cosmo facility. Similar to this, Figure C.19- C.20 show the delta deciviews observed at various grid cells lying in National Parks or wilderness areas in PNW and Washington. As seen from Figure C.19 - C.20, a deciview change of more than 0.1 is observed only at a few grid cells all in Alpine Lake Wilderness and Glacier Peak Wilderness.

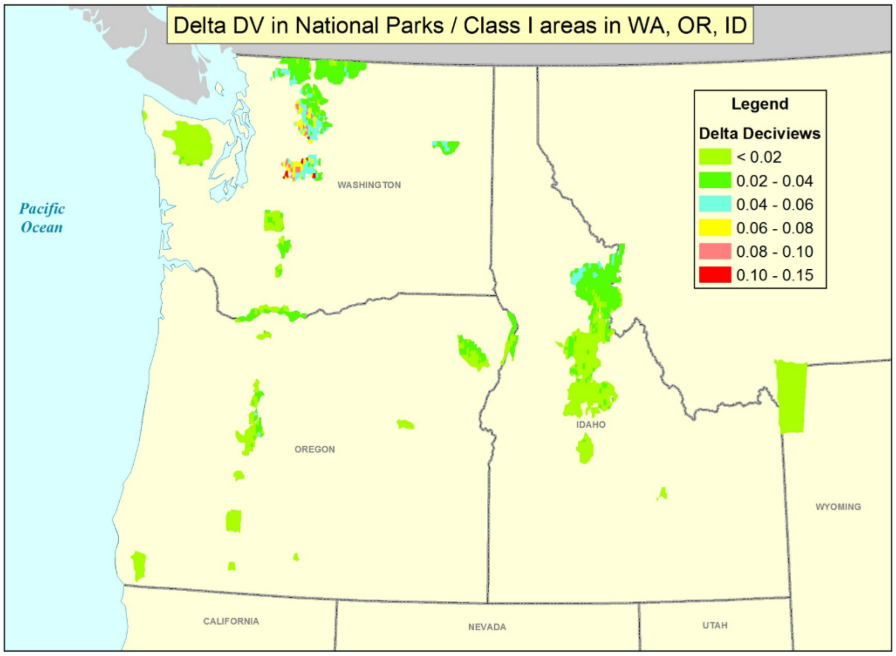


Figure C.19: 8th highest change in deciviews observed at grid cells in National Parks / Class I Wilderness Areas in PNW

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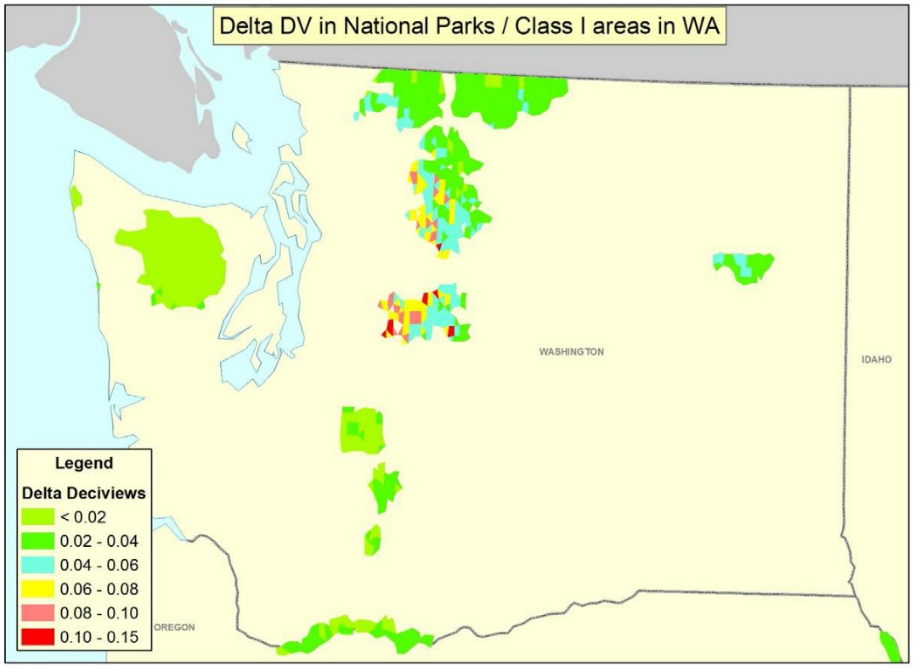


Figure C.20: 8th highest change in deciviews observed at grid cells in National Parks / Class I Wilderness Areas in WA

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### C.5.2.4 Deciview dependence on Relative Humidity Factor [*f*(RH)] during summer and winter

Because the model did a reasonably good job in predicting individual $PM_{2.5}$ species and total $PM_{2.5}$ mass concentration, but had poor performance for visibility, we investigated model performance for humidity in terms of the relative humidity factor (*f*(RH) used to calculate deciviews. We used constant mean concentrations for summer and winter for each species (Table C.11) with a range of *f*(RH) values from 1 to 21. With the fixed concentrations and varying *f*(RH), deciviews were calculated according to equations C1 and C2. As shown in Figure C.21, the deciview depends strongly on *f*(RH); errors in predicting f(RH) will be exhibited as errors in predicting visibility. Since *f*(RH) varied significantly for some days at some locations (Figure C.22) during winter months and was consistently underpredicted at all sites during summer months, these differences dominate errors in predicted concentrations.

Table C.11: Concentrations used for showing *f*(RH) dependence of deciview

| S. No. | Species | Case 1 (Summer) | | Case 2 (Winter) | |
|---|---|---|---|---|---|
| | | Modeled Concentration (μg /m³) | Observed Concentration (μg /m³) | Modeled Concentration (μg /m³) | Observed Concentration (μg/m³) |
| 1. | EC | 0.15 | 0.2 | 0.2 | 0.15 |
| 2. | NH4 | 0.2 | 0.35 | 0.2 | 0.15 |
| 3. | SO4 | 0.6 | 1 | 0.5 | 0.2 |
| 4. | NO3 | 0.05 | 0.15 | 0.4 | 0.2 |
| 5. | OC | 0.3 | 1.5 | 0.5 | 0.5 |
| 6. | Others | 0.6 | 2 | 1 | 0.1 |
| 7. | Total | 1.9 | 5.2 | 2.8 | 1.3 |

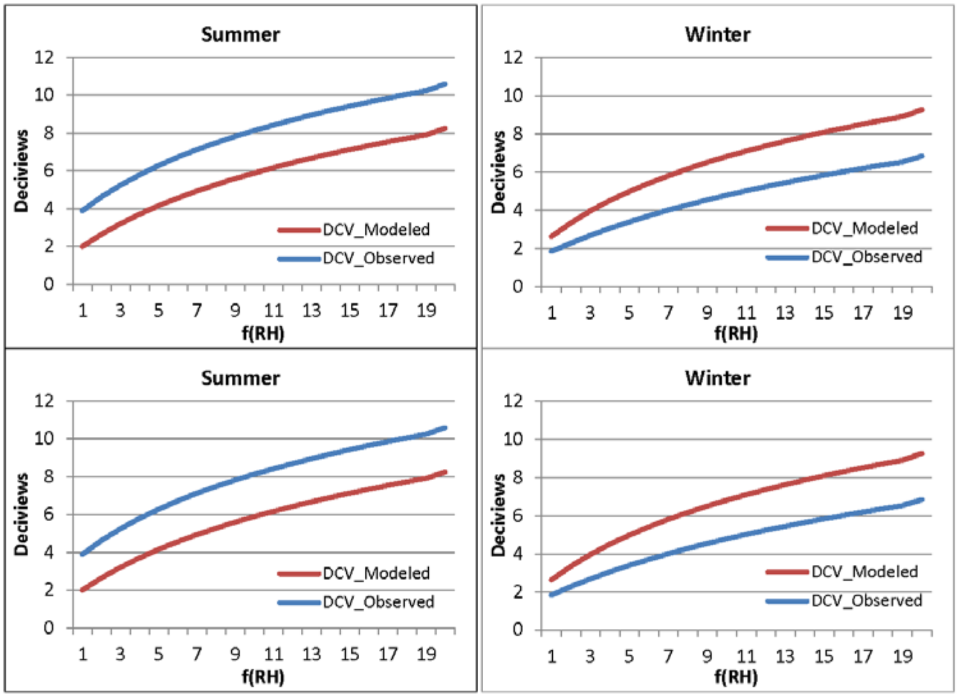


Figure C.21: Illustrating dependence of deciviews on f(RH) with fixed PM concentration

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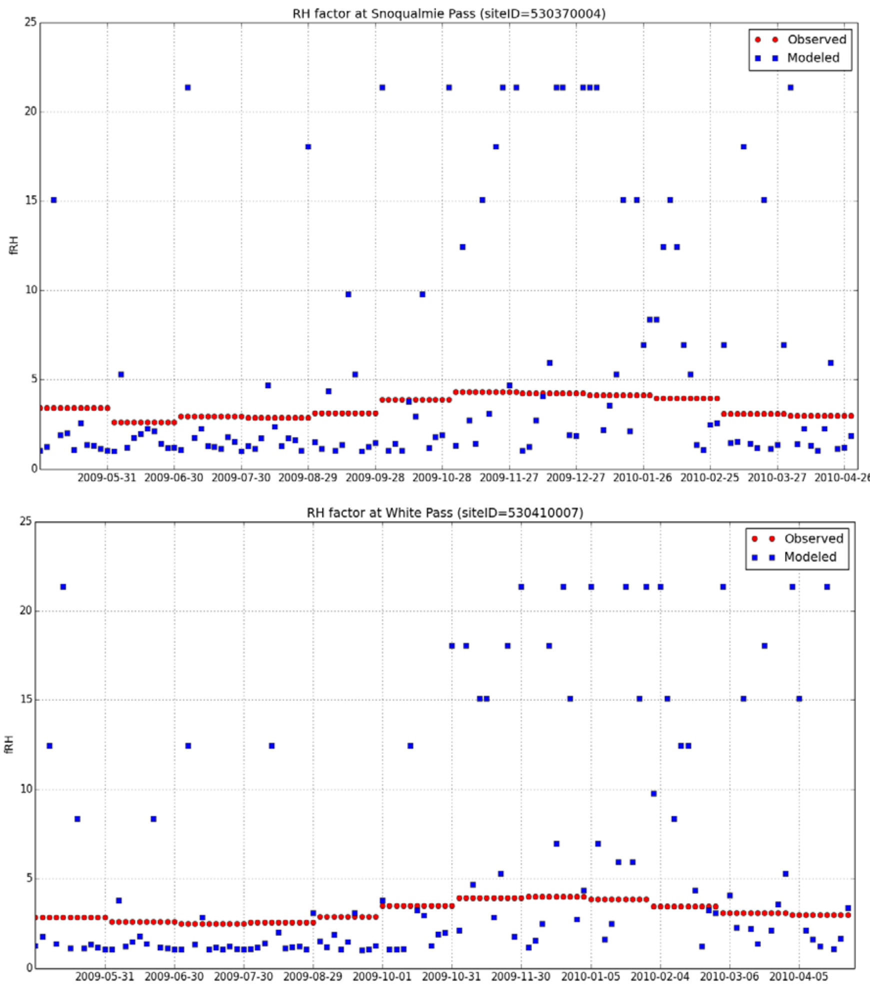


Figure C.22: Observed versus modeled RH factor at two locations in Washington

## Section C.6 Conclusions

AIRPACT-4 model performance was evaluated for total $PM_{2.5}$ and PM species at all IMPROVE sites. Comparison of MFB and MFE against the MFB/MFE goals and criteria show that AIRPACT-4 does a good job, except for PM-OC, which also impacts total $PM_{2.5}$ prediction performance. Based on the CMAQ modeling results presented in the previous sections, we can conclude that predicted improvements in visibility due to potential RACT limits at Washington Pulp and Paper facilities are negligible in national parks and the Class I wilderness areas . Modeled 8th highest Δdv are small with the improvement greater than 0.1dv occurring at only two locations – Alpine Lake Wilderness (0.127 Δdv) and Glacier Peak Wilderness (0.117 Δdv). Maximum modeled improvement doesn't occur on the days of worst visibility for any of the IMPROVE sites in Washington. At some Non-IMPROVE sites, the change in dv is relatively large compared to IMPROVE sites. The relative humidity factor, *f*(RH) plays significant role in the visibility determination and, poor model performance for f(RH) is inhibiting model performance for visibility.

## Section C.7 References

Boylan, James W., and Armistead G. Russell. "PM and light extinction model performance metrics, goals, and criteria for three-dimensional air quality models." *Atmospheric environment* 40.26 (2006): 4946-4959.

Byun D. W. and Ching J.K.S. (editors). "Science Algorithms of the EPA Models-3 Community Multiscale Air Quality Modelling (CMAQ) System". Accessed from USEPA website: http://www.epa.gov/amad/CMAQ/CMAQdocumentation.html

Joseph. K. Vaughan, Serena H. Chung, Farren L. Herron-Thorpe, Emmons Louisa, Lamb Brian K., Zhang Rui, Jaffe Daniel A., Nicole L. Wigder, George H. Mount. "Assessing the Effect of Boundary Ozone Inflow for the Pacific Northwest Region using the AIRPACT-4 Air-Quality Forecast System" Manuscript under preparation (2015).

Simon, Heather, Kirk R. Baker, and Sharon Phillips. "Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012." *Atmospheric Environment* 61 (2012): 124-139.

Emmons, L. K., Walters, S., Hess, P. G., Lamarque, J.-F., Pfister, G. G., Fillmore, D., Granier, C., Guenther, A., Kinnison, D., Laepple, T., Orlando, J., Tie, X., Tyndall, G., Wiedinmyer, C., Baughcum, S. L., and Kloster, S. Description and evaluation of the Model for Ozone and Related chemical Tracers, version 4 (MOZART-4), (2010) *Geosci. Model Dev., 3*, 43-67.

Malm, W. C. "Introduction to Visibility". (1999). Cooperative Institute for Research in the Atmosphere, Colorado State University.

# Appendix D.  Cost Estimates

# Appendix D Cost Estimates

Cost estimates in Chapter 6 were based on references provided in Tables 37 and 38 of Chapter 6.

Wet electrostatic precipitator estimates provided below:

| WESP | Capital Cost | Capital Cost | O&M Costs | O&M Costs | Annualized Costs | Annualized Costs |
|---|---|---|---|---|---|---|
| | Low range $/scfm | High range $/scfm | Low range $/scfm | High range $/scfm | Low range $/scfm | High range $/scfm |
| Recovery Furnaces | $20 | $40 | $5 | $40 | $9 | $47 |
| PTPC | $4,373,153 | $8,746,307 | $1,093,288 | $8,746,307 | $1,967,919 | $10,276,911 |
| WestRock 4 | $4,329,617 | $8,659,235 | $1,082,404 | $8,659,235 | $1,948,328 | $10,174,601 |
| Weyerhaeuser 10 | $6,936,567 | **$13,873,133** | $1,734,142 | **$13,873,133** | $3,121,455 | **$16,300,931** |
| GP Camas 4 | $2,185,649 | $4,371,298 | $546,412 | $4,371,298 | $983,542 | $5,136,275 |
| GP Camas 3 | $1,421,687 | $2,843,375 | $355,422 | $2,843,375 | $639,759 | $3,340,966 |
| KapStone 18 | $4,298,397 | $8,596,794 | $1,074,599 | $8,596,794 | $1,934,279 | $10,101,233 |
| KapStone 19 | $5,216,699 | $10,433,398 | $1,304,175 | $10,433,398 | $2,347,514 | $12,259,242 |
| KapStone 22 | $3,973,999 | $7,947,997 | $993,500 | $7,947,997 | $1,788,299 | $9,338,897 |
| Boise White Wallula 2 | **$1,159,055** | $2,318,109 | **$289,764** | $2,318,109 | **$521,575** | $2,723,779 |
| Boise White Wallula 3 | $3,913,946 | $7,827,893 | $978,487 | $7,827,893 | $1,761,276 | $9,197,774 |
| Cosmo 1,2,3 | $3,109,920 | $6,219,840 | $777,480 | $6,219,840 | $1,399,464 | $7,308,312 |
| Min | **$1,159,055** | $2,318,109 | **$289,764** | $2,318,109 | **$521,575** | $2,723,779 |
| Max | $6,936,567 | **$13,873,133** | $1,734,142 | **$13,873,133** | $3,121,455 | **$16,300,931** |

| Lime Kilns | Capital Cost | Capital Cost | O&M Costs | O&M Costs | Annualized Costs | Annualized Costs |
|---|---|---|---|---|---|---|
| PTPC LK | $471,936 | $943,873 | $117,984 | $943,873 | $212,371 | $1,109,051 |
| WestRock 1 | $656,499 | $1,312,999 | $164,125 | $1,312,999 | $295,425 | $1,542,773 |
| WestRock 2 | $209,332 | $418,664 | $52,333 | $418,664 | $94,199 | $491,930 |
| Weyerhaeuser 4 | $661,034 | $1,322,068 | $165,258 | $1,322,068 | $297,465 | $1,553,429 |
| GP Camas 4 | **$178,848** | $357,697 | **$44,712** | $357,697 | **$80,482** | $420,294 |
| KapStone 3 | $376,020 | $752,040 | $94,005 | $752,040 | $169,209 | $883,646 |
| KapStone 4 | $356,477 | $712,954 | $89,119 | $712,954 | $160,415 | $837,721 |
| KapStone 5 | $271,984 | $543,969 | $67,996 | $543,969 | $122,393 | $639,163 |
| Boise White Wallula | $599,056 | $1,198,113 | $149,764 | $1,198,113 | $269,575 | $1,407,783 |
| Graymont | $1,299,635 | **$2,599,270** | $324,909 | **$2,599,270** | $584,836 | **$3,054,143** |
| Min | **$178,848** | $357,697 | **$44,712** | $357,697 | **$80,482** | $420,294 |
| Max | $1,299,635 | **$2,599,270** | $324,909 | **$2,599,270** | $584,836 | **$3,054,143** |