APPENDIX B

Emission Reduction Analysis for Proposed Amendments to Rule 4352 (Solid Fuel Fired Boilers, Steam Generators, and Process Heaters)

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I. SUMMARY

The District committed to amending Rule 4352 as part of the *2018 PM2.5 Plan*. This appendix details the calculations and assumptions used to estimate the NOx, PM10, PM2.5 and SOx emission reductions associated with the proposed amendments to Rule 4352.

Table B-1 summarizes the estimated emission reductions from each of these pollutants from the baseline emissions inventory in the *2018 PM2.5 Plan*. The calculation methodology is outlined in Section III of this appendix. When fully implemented, the proposed amendments are estimated to achieve 0.71 tons per day (tpd) of NOx emissions reductions (15.8% of baseline emission inventory), SOx emissions reductions of 0.27 tpd (51.4% of baseline emission inventory), PM10 emissions reductions of 0.31 tpd (27.9% of baseline emission inventory), and PM2.5 emissions reductions of 0.28 tpd (28.2% of baseline emission inventory). Since PM2.5 is a subset of PM10, and since the majority of PM10 emissions from solid fuel fired boilers are PM2.5 emissions, the emissions reduction estimates for PM2.5 are nearly the same as PM10. This is further described in Section III of this appendix.

Table B-1 – Estimated NOx, PM10, PM2.5, and SOx Emission Reductions Achieved by 2024

Fuel Type	NOx tpd	PM10 tpd	PM2.5 tpd	SOx tpd
MSW	0.395	0.019	0.018	0.058
Biomass	0.316	0.295	0.264	0.213
Total	**0.711**	**0.313**	**0.282**	**0.271**

Table B-2 shows the percent emission reductions estimated to be achieved from the baseline emissions for units fired on municipal solid waste (MSW), and units fired on biomass.

Table B-2 – Summary of NOx, PM10, PM2.5, and SOx Percent Reductions Achieved by 2024

Fuel Type	# of Units	% NOx	% PM10	% PM2.5	% SOx
MSW	2	45.5%	24.5%	23.2%	64.7%
Biomass	10	8.7%	28.4%	25.4%	48.9%

II. BACKGROUND

The San Joaquin Valley is home to 12 solid fuel fired boilers with active permits that are subject to Rule 4352. These units are located at 10 facilities that fuel their units on either municipal solid waste or biomass. For the purposes of this analysis, the boilers at each facility will be aggregated into a single calculation. This analysis will focus on the current annual permit emission limits as indicated in Table B-3.

Table B-3 – Affected Facility Annual Permitted Potential Emissions

Fuel Type	NOx Permitted Potential (tons/year)	PM10 Permitted Potential (tons/year)	SOx Permitted Potential (tons/year)
Municipal Solid Waste Facility	344.4	70.0	121.9
Biomass Facility	59.9	29.9	29.9
Biomass Facility	107.7	53.7	69.6
Biomass Facility	110.0	101.6	43.8
Biomass Facility	61.3	30.6	15.3
Biomass Facility	231.5	34.7	59.1
Biomass Facility	121.8	62.1	45.1
Biomass Facility	208.8	41.8	27.0
Biomass Facility	313.2	139.4	121.6
Biomass Facility	70.4	22.7	39.1

The District's *2018 PM2.5 Plan* emissions inventory from the 2016 California Emissions Projection Analysis Model (CEPAM) version 1.05 is used throughout this analysis, as this was the foundation for the *2018 PM2.5 Plan*. The 2024 emissions inventories for the two fuel types are shown in Table B-4.

Table B-4 – 2024 Emissions Inventory for Affected Facility Types

Fuel Type	NOx (tons/day)	PM10 (tons/day)	PM2.5 (tons/day)	SOx (tons/day)
MSW	0.868	0.076	0.072	0.089
Biomass	3.628	1.037	0.928	0.436

Source: CEPAM 2016 SIP Baseline Emission Projections, Version 1.05

III. Emissions and Emission Reduction Methodology

This section of the report outlines the procedures used to calculate the current emissions and the estimated emission reductions associated with the proposed amendments to Rule 4352.

The emissions reduction percentages resulting from this rule amendment can be applied directly to the baseline emissions inventory from the *2018 PM2.5 Plan*. These "SIP Currency" reductions (Table B-1) are being credited to the aggregate emissions reduction commitments from the *2018 PM2.5 Plan* (*2018 PM2.5 Plan* Table 4-3, page 4-12).

An emissions factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., pounds of NOx emitted per hour). Such factors facilitate an estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages

of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).

In general, emissions can be calculated from the activity rate and emissions factor as:

$$E = A \times EF \quad (1)$$

Where:

E = emissions;
A = activity rate;
EF = emissions factor; and

For solid fuel-fired boilers, emissions factors will be determined from permit limits for existing permit units and compared to proposed rule limits in the proposed amended rule. This potential to emit was queried from the District's permits database, and will be used in place of A x EF.

For this analysis, Equation 1 shall be applied to each affected facility for the permitted activity rate at the current permit limit and at the proposed amended limit(s) to calculate potential emissions from each facility at each limit. The total potential current emissions and the total of the potential emissions at the proposed limits summed for each category will be used to determine a percent reduction for each pollutant from each affected category, as follows:

$$\%_{Reduced} = \frac{(\sum E_{Current} - \sum E_{Proposed})}{\sum E_{Current}} \quad (2)$$

Where:

$\%_{Reduced}$ = percent reduction;
$E_{Current}$ = current potential emissions; and
$E_{Proposed}$ = the potential emissions at proposed limits.

Finally, the emissions reductions will be calculated by multiplying the emissions inventory defined in Table B-4 by the calculated percent reductions determined as follows:

$$ER = EI \times \%_{Reduced} \quad (3)$$

Where:

ER = emission reduction;
EI = emission inventory; and
$\%_{Reduced}$ = calculated percent reductions.

A. NOx Emission Reduction Calculations

Proposed emission limits for NOx are 90 parts per million volume (ppmv) for units fired on municipal solid waste and 65 ppm for units fired on biomass. Table B-5 shows calculations for potential NOx emissions for each facility in ton/yr.

Table B-5 – NOx Emission Potentials for Affected Facilities

Fuel Type	Permitted NOx Limit (ppmv)	Permitted NOx Potential (tons/year)	Proposed NOx Limit (ppmv)	Proposed Permitted NOx Potential (tons/year)	NOx Percent Reduction
Municipal Solid Waste Facility	165	344.4	90	187.9	45.5%
Biomass Facility	65	59.9	65	59.9	0.0%
Biomass Facility	50	107.7	65	107.7	0.0%
Biomass Facility	65	110	65	110.0	0.0%
Biomass Facility	65	61.3	65	61.3	0.0%
Biomass Facility	65	231.5	65	231.5	0.0%
Biomass Facility	67	121.8	65	118.2	3.0%
Biomass Facility	90	208.8	65	150.8	27.8%
Biomass Facility	76	313.2	65	267.9	14.5%
Biomass Facility	70	70.4	65	65.4	7.1%

Table B-6 shows the total potential NOx emissions, summed by fuel type, and the percent reduced from the proposed NOx limits by applying Equation 2.

Table B-6 – Percent NOx Reductions

Fuel Type	Permitted NOx Potential (ton/yr)	Proposed Permitted NOx Potential (ton/yr)	NOx Percent Reduction
Municipal Solid Waste	344.4	187.9	45.5%
Biomass	1284.6	1172.6	8.7%

Table B-7 shows the results of Equation 3 with percent reductions in Table B-6 applied to the NOx emissions inventory in Table B-4.

Table B-7 – NOx Emission Reductions

Fuel Type	2024 NOx Emissions (tons/day)	% Reduction	2024 NOx Emission Reductions (tons/day)
Municipal Solid Waste	0.868	45.5%	0.395
Biomass	3.628	8.7%	0.316
Total	**4.496**		**0.711**

B. PM Emission Reduction Calculations

Particulate matter permit and rule limits for glass melting furnaces are for the size fraction of PM10. Since PM2.5 is directly proportional to and is a subset of PM10, the

emissions controls to reduce PM10 will likewise reduce PM2.5. Within the emissions inventory established for the *2018 PM2.5 Plan*, a ratio is used to convert PM10 into PM2.5. For this analysis, Equation 1 and Equation 2 will use PM10 limits to determine a percent reduction, and will apply that percent reduction with Equation 3 to both the PM10 and PM2.5 planning inventories to determine emission reductions.

Proposed emission limits for PM10 are 0.04 pounds per metric million British thermal unit (lbs/MMBtu) for units fired on municipal solid waste and 0.03 lbs/MMBtu for units fired on biomass. Table B-8 shows calculations for potential PM10 emissions for each facility in ton/yr.

Table B-8 – PM10 Emission Potentials for Affected Facilities

Fuel Type	Permitted PM10 Limit (lbs/MMBtu)	Permitted PM10 Potential (tons/year)	Proposed PM10 Limit (lbs/MMBtu)	Proposed Permitted PM10 Potential (tons/year)	PM10 Percent Reduction
Municipal Solid Waste Facility	0.053	70	0.04	52.8	24.5%
Biomass Facility	0.04	29.9	0.03	22.4	25.0%
Biomass Facility	0.0214	53.7	0.03	53.7	0.0%
Biomass Facility	0.066	101.6	0.03	46.2	54.5%
Biomass Facility	0.04	30.6	0.03	23.0	25.0%
Biomass Facility	0.012	34.7	0.03	34.7	0.0%
Biomass Facility	0.045	62.1	0.03	41.4	33.3%
Biomass Facility	0.03	41.8	0.03	41.8	0.0%
Biomass Facility	0.045	139.4	0.03	92.9	33.3%
Biomass Facility	0.05	22.7	0.03	13.6	40.0%

Table B-9 shows the total potential PM10 emissions, summed by fuel type, and the percent PM10 reduced for each fuel type by applying Equation 2.

Table B-9 – Percent PM10 Reductions

Fuel Type	Permitted PM10 Potential (ton/yr)	Proposed PM10 Potential (ton/yr)	PM10 Percent Reduction
Municipal Solid Waste	70.0	52.8	24.5%
Biomass	516.5	369.7	28.4%

Table B-10 shows the results of Equation 3 with the percent reductions in Table B-9 applied to the PM10 emissions inventory in Table B-4.

Table B-10 – PM10 Emission Reductions

Fuel Type	2024 PM10 Emissions (tons/day)	% Reduction	2024 PM10 Emission Reductions (tons/day)
Municipal Solid Waste	0.076	24.5%	0.019
Biomass	1.037	28.4%	0.295
Total	**1.113**		**0.313**

Table B-11 shows the results of Equation 3 with the percent reductions in Table B-9 applied to the PM2.5 emissions inventory in Table B-4.

Table B-111 – PM2.5 Emission Reductions

Fuel Type	2024 PM2.5 Emissions (tons/day)	% Reduction	2024 PM2.5 Emission Reductions (tons/day)
Municipal Solid Waste	0.072	24.5%	0.018
Biomass	0.928	28.4%	0.264
Total	**1.00**		**0.282**

C. SOx Emission Reduction Calculations

Proposed emission limits for SOx are 0.03 pounds per metric million British thermal unit (lbs/MMBtu) for units fired on municipal solid waste and 0.02 lbs/MMBtu for units fired on biomass. Table B-12 shows calculations for potential SOx emissions using Equation 1 for each facility in ton/yr.

Table B-122 – SOx Emission Reduction Percentages for Affected Facilities

Fuel Type	Permitted SOx Limit (lbs/MMBtu)	Permitted SOx Potential (tons/year)	Proposed SOx Limit (lbs/MMBtu)	Proposed Permitted SOx Potential (tons/year)	SOx Percent Reduction
Municipal Solid Waste Facility	0.085	121.9	0.03	43.0	64.7%
Biomass Facility	0.04	29.9	0.02	15.0	50.0%
Biomass Facility	0.054	69.6	0.02	25.8	63.0%
Biomass Facility	0.03	43.8	0.02	29.2	33.3%
Biomass Facility	0.035	15.3	0.02	8.7	42.9%
Biomass Facility	0.04	59.1	0.02	29.6	50.0%
Biomass Facility	0.032	45.1	0.02	28.2	37.5%
Biomass Facility	0.063	27	0.02	8.6	68.3%
Biomass Facility Unit 1	0.033	68.6	0.02	41.6	39.4%
Biomass Facility Unit 2	0.038	53	0.02	27.9	47.4%
Biomass Facility	0.05	39.1	0.02	15.6	60.0%

Table B-13 shows the total potential SOx emissions, summed by fuel type, and the percent SOx reduced for each fuel type by applying Equation 2.

Table B-133 – Percent SOx Reductions

Fuel Type	Permit SOx Potential (ton/yr)	Proposed SOx Potential (ton/yr)	SOx Percent Reduction
Municipal Solid Waste	121.9	43.0	64.7%
Biomass	450.5	230.1	48.9%

Table B-14 shows the results of Equation 3 with the percent reductions in Table B-12 applied to the SOx emissions inventory in Table B-4.

Table B-144 – SOx Emission Reductions

Fuel Type	2024 SOx Emissions (tons/day)	% Reduction	2024 SOx Emission Reductions (tons/day)
Municipal Solid Waste	0.089	64.7%	0.058
Biomass	0.436	48.9%	0.213
Total	**0.525**		**0.271**

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